Contract Documents & Specifications

Whitefish Wastewater Treatment Plant Improvements Project 2019

Granular Activated Sludge

Whitefish, Montana
October 2019

Project Owner:
City of Whitefish
P.O. Box 158
Whitefish, MT 59937

Project Design Team:
Anderson Montgomery Consulting Engineers
Robert Peccia & Associates
CTA Architects Engineers
Comma-Q Architecture

Non - Disclosure

Several aspects of this project utilize proprietary equipment supplied by Aqua Aerobics Systems Incorporated. General contractors and other plan holders wishing to bid the project will be required to sign a Non-Disclosure Agreement.

Set Number: _____

CITY OF WHITEFISH

Wastewater Treatment Plant Improvements Project 2019

TECHNICAL SPECIFICATIONS

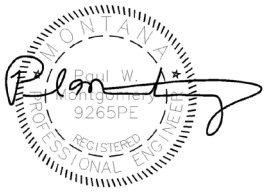
October 2019

Prepared by:

Scott Anderson, P.E.

Reviewed by:

Paul Montgomery, P.E.
Brad Koenig, P.E.



Anderson~Montgomery
CONSULTING ENGINEERS

RPA

TABLE OF CONTENTS

City of Whitefish
Wastewater Treatment
Plant Improvements Project 2019

DIVISION 0 – BIDDING AND CONTRACTING REQUIREMENTS

DIVISION 1 – GENERAL REQUIREMENTS

DIVISION 2 – EXISTING CONDITIONS, SITEWORK

DIVISION 3 – CONCRETE & GROUT

DIVISION 5 – METALS

DIVISION 6 – WOODS, PLASTICS, COMPOSITES

DIVISION 7 – THERMAL & MOISTURE PROTECTION

DIVISION 8 – OPENINGS

DIVISION 9 – FINISHES, PAINT & COATINGS

DIVISION 10 – MISC SPECIALITIES

DIVISION 12 – FURNISHINGS

DIVISION 22 – PLUMBING

DIVISION 23 – HVAC

DIVISION 26 – ELECTRICAL

DIVISION 27 – COMMUNICATIONS

DIVISION 31 – EARTHWORK

DIVISION 32 – EXTERIOR IMPROVEMENTS

DIVISION 33 – UTILITIES

DIVISION 40 – PROCESS INTERCONNECTIONS

DIVISION 41 – MATERIAL PROCESSING & HANDLING EQUIPMENT

DIVISION 43 – PROCESS GAS & LIQUID HANDLING, STORAGE EQUIPMENT

DIVISION 46 – WATER & WASTEWATER EQUIPMENT

APPENDICES

DIVISION 0

BIDDING & CONTRACTING REQUIREMENTS

SECTION 00 11 16
INVITATION TO BID

Separate sealed bids for construction of the Whitefish Wastewater Treatment Plant Improvements Project 2019 will be received by the **City of Whitefish, Attn: Craig Workman, P.E., Director of Public Works, 418 E. 2nd Street, Whitefish, MT 59937-0158 until 2:00 p.m. local time on Tuesday, October 29, 2019**, and then publicly opened and read aloud. The project will include the furnishing of all labor, skill, equipment, and construction materials to construct the proposed improvements to the City of Whitefish wastewater treatment plant in accordance with the plans and specifications. Bids will be for a single prime contract, bid on a Lump Sum basis.

The project will generally consist of the following work:

- Improvements to the Main Wastewater Lift Station
- New Grit Handling Facilities, Enclosed in a Building
- Alum Chemical Feed Equipment
- Three Reactor Basins with Aeration and Influent/Effluent/Waste Sludge Piping Systems
- Main Process Building with Blowers, Biosolids Pumping, Biosolids Mixing, Non-potable Water System and Ultra-violet Disinfection Equipment
- Process Control and Monitoring System
- Sludge Buffer Basins (2) and Water Level Control Basin
- Covered Biosolids Treatment Basin with Mixing and Aeration
- Sidestream Lift Station
- Improvements to Existing Biosolids Drying Beds
- Effluent Outfall and Diffuser
- Renovation of Existing Administration Building
- Ancillary Site Improvements, Utility Piping, Communications Systems and Landscaping

The primary equipment package for the project has been procured and a contract awarded to Aqua Aerobics Systems Inc. for the Granular Activated Sludge treatment process. The Equipment Procurement Agreement and associated documents will be assigned to the General Contractor selected for this project.

Important – The project equipment that has been previously procured utilizes proprietary equipment. All Bidders will be required to sign a Non-Disclosure Agreement prior to bidding and obtaining the Complete Project Bid Package.

The contract documents, consisting of Drawings and Project Specifications, may be obtained at the office of AMCE at 1064 N. Warren St., Helena, MT 59601 (phone: 406-449-3303). The Instructions to Bidders outlines specific requirements for all Bidders to observe. The required payment for a complete set of contract documents is **$250** per set or **$50** for electronic media, which is not refundable. A Partial Set of Drawings (excluding proprietary equipment) and Project Specifications can be examined online at AMCE's website at www.a-mce.com, available after October 2, 2019. Bidders must purchase a numbered set of drawings & specifications in order to be placed on the official Planholders list and to submit a responsive bid.

A Partial Set of Drawings (excluding proprietary equipment) and Project Specifications on the Project will be made available to the local and regional Plans Centers.

There will be a Pre-Bid Conference at the **Whitefish Wastewater Treatment Plant, 350 Monegan Road (Phone 406-863-2465)** at **1:00 p.m. Wednesday, October 9, 2019**. Interested CONTRACTORS are **required** to attend.

CONTRACTORS and any of the CONTRACTOR's subcontractors submitting a bid on this project will be required to obtain registration with the Montana Department of Labor and Industry (DLI) Contractor Registration Unit prior to submitting bids. Forms for registration are available from the Department of Labor and Industry, P.O. Box 8011, 1805 Prospect, Helena, Montana 59604-8011. Information on registration can be obtained by calling 1-406-444-7734. All laborers and mechanics employed by CONTRACTORs or subcontractors in performance of the construction work shall be paid wages at rates as may be required by the laws of and the state of Montana. The CONTRACTOR must ensure that employees and applicants for employment are not discriminated against because of their race, color, religious views, sex or national origin. The **highest** of Montana Prevailing Wage **or** Federal Davis-Bacon Wage Rates apply to this project.

Each bid or proposal must be accompanied by a Certified Check, Cashier's Check, or Bid Bond payable to the City of Whitefish, in an amount not less than ten percent (10%) of the total amount of the bid. Successful BIDDERS shall furnish an approved Performance Bond and a Labor and Materials Payment Bond, each in the amount of one hundred percent (100%) of the contract amount. Insurance as required shall be provided by the successful BIDDER(s) and a certificate(s) of that insurance shall be provided. Bidders must demonstrate their qualifications to do the work.

This project is funded with grant and loan funding from the DNRC Renewable Resources Grant Program, Montana Department of Commerce Treasure State Endowment Program and MDEQ State Revolving Fund Loan. Award of the project will be contingent upon available funding and award concurrence from the MDNRC, MDOC and MDEQ.

No bid may be withdrawn after the scheduled time for the public opening of bids.

The right is reserved to reject any or all proposals received, to waive informalities, to postpone the award of the contract for a period of not to exceed sixty (60) days, and to accept the lowest responsive and responsible bid which is in the best interest of the OWNER.

The City of Whitefish is an Equal Opportunity Employer.

Please publish on:

September, 2019
October, 2019

City of Whitefish
Dana Smith, Acting City Manager
418 2nd Street
Whitefish, MT 59937

SECTION 00 21 13
INSTRUCTIONS TO BIDDERS

ARTICLE 1 - DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office* – The office from which the Bidding Documents are to be issued.

1. For purposes of this document, the Issuing Office shall be as follows:

ANDERSON-MONTGOMERY CONSULTING ENGINEERS

1064 N WARREN ST. HELENA, MT 59601

B. *Bidder* - The Individual or entity who submits a Bid directly to the Owner

C. *Successful Bidder* – The lowest responsible Bidder submitting a responsive Bid to whom Owner (on the basis of Owner's evaluation is hereinafter provided) makes an award.

ARTICLE 2 - COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and formats for the deposit sum stated in the Invitation for Construction Bids. The deposit sum stated is *NON-REFUNDABLE*.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 - QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:

A. Evidence of Bidder's authority to do business in the State of Montana.

B. Bidder's contractor license number

C. Completed Form C-451 – Qualification Statement

D. Subcontractor and Supplier qualification information

1. Coordinate with provisions of Article 12 of these Instructions, "Subcontractors, Suppliers, and Others."

E. DBE Subcontractor Solicitation Information

F. SRF Certifications regarding Debarment, Suspension, and other Responsibility Matters

G. Non-Disclosure Agreement for Use of Aqua Aerobics Drawings and Technical Documentation, Executed with Aqua Aerobics Systems Inc..

H. Purchase of number set of Contract Documents and is actively listed on the Planholders List for the project.

3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 - SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

4.01 Site and Other Areas

A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 Existing Site Conditions

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify:

a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.

b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.

d. Technical Data contained in such reports and drawings.

2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible

for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

4. Geotechnical Report: Appendix C of the Bidding Documents contains a Geotechnical Report and Cone Penetrometer Test (CPT) correlations. The Report and CPT data describe certain select subsurface conditions that are anticipated to be encountered by Contractor during construction in specified locations ("Baseline Conditions"). The Geotechnical Report and CPT data are Contract Documents.

   The Baseline Conditions in the Report are intended to reduce uncertainty and the degree of contingency in submitted Bids. However, Bidders cannot rely solely on the Baseline Conditions. Bids should be based on a comprehensive approach that includes an independent review and analysis of the Report, all other Contract Documents, Technical Data, other available information, and observable surface conditions. Not all potential subsurface conditions are baselined.

   Nothing in the Geotechnical Report is intended to relieve Bidders of the responsibility to make their own determinations regarding construction costs, bidding strategies, and Bid prices, nor of the responsibility to select and be responsible for the means, methods, techniques, sequences, and procedures of construction, and for safety precautions and programs incident thereto.

B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 Site Visit and Testing by Bidders

A. Bidder shall conduct the required Site visit during normal working hours, and shall

not disturb any ongoing operations at the Site.

1. If Bidder wishes to schedule an appointment to conduct Bidders site visit outside of the Pre-Bid Conference, please contact Neil DeZort, 406-253-4849 to schedule an appointment. The Engineer makes no guarantees as to the availability of the Owner to accommodate Bidder's desired appointment times.

B. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.

D. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

E. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 Owner's Safety Program

A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 Other Work at the Site

A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 - BIDDER'S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;

B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent

areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;

D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions or Appendices, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;

E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;

F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;

H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;

I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and

J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 - PRE-BID CONFERENCE

6.01 A pre-bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss

the Project. Bidders are **required** to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 - INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 - BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of ten-percent (10%) of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

8.05 Attorneys-in-fact who sign Bid Bonds must file with the Bid Bond a certified and effective, dated copy of their power of attorney.

ARTICLE 9 - CONTRACT TIMES

9.01 The number of days within which, or the dates by which, Milestones are to be achieved

and the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 - LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 - SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids in the case of a proposed substitute. Each such request shall comply with the requirements of Paragraphs 7.04 and 7.05 of the General Conditions. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner. Substitutes and "or-equal" materials and equipment may be proposed by Contractor in accordance with Paragraphs 7.4 and 7.5 of the General Conditions after the Effective Date of the Contract.

11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

11.03 If an award is made, Contractor shall be allowed to submit proposed substitutes and "or-equals' in accordance with the General Conditions.

11.04 Whether explicitly written or not explicitly written, "OR EQUAL" is implicitly listed as an "Approved Manufacturer" for any and all manufacturers listed in any and all specification sections or included herein or added by addendum or construction drawings, either included or added by addendum.

ARTICLE 12 - SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.01 **If required by the bid documents**, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work:

A. Mechanical Sub-Contractor(s)

B. Electrical Sub-Contractors(s)

C. Environmental/Water Treatment Sub-Contractor(s)

D. Other Major Sub-Contractor(s) requested

If requested by Owner, Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

12.02 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

12.03 The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 7.6.A

ARTICLE 13 - PREPARATION OF BID

13.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form shall be completed in ink or typewriter and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate seal shall be affixed an attested by the corporate secretary or an assistant corporate secretary. The corporate address and state of incorporation shall be shown.

13.03 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.

13.04 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

13.05 A Bid by an individual shall show the Bidder's name and official address.

13.06 A Bid by a joint venture shall be executed by an authorized representative of each joint

venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

13.07 All names shall be printed in ink below the signatures.

13.08 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

13.09 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.

13.10 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

A. Title 39, Chapter 9, Parts 1 and 2 MCA stipulate contractor registration requirements for the State of Montana. Pursuant to 39-9-201 MCA, each construction contractor must be registered with the Montana Department of Labor and Industry. In accordance with 39-9- 201 MCA, "construction contractor" means a person, firm, or corporation that, in the pursuit of an independent business, offers to undertake, undertakes, or submits a bid for construction.

B. No bid shall be considered that does not carry the Bidder's Montana Contractors Registration Number on the bid form.

C. Registration forms and additional information may be obtained by contacting the Montana Department of Labor and Industry, 1805 Prospect Ave., P.O. Box 8011, Helena, MT 59604- 8011, or by calling 406-444-7734.

ARTICLE 14 - BASIS OF BID

14.01 Base Bid

A. Bidders shall submit a Bid on a lump sum basis for the base Bid as provided for in the Bid Form. The cumulative amount on the Bid Form and the Bidders Qualifications will be utilized to determine the lowest responsive and responsible bidder.

B. The Agreement as executed will contain the Substantial Completion time and readiness for final payment time. The Contractor will be assessed liquidated damages at the rate stated in the Agreement for failure to attain Substantial Completion within that time.

14.02 Unit Price

A. NOT USED

14.03 Allowances

A. NOT USED

ARTICLE 15 - SUBMITTAL OF BID

15.01 With each purchased copy of the Bidding Documents, a Bidder is furnished one separate bound copy of the Bid Form, and, if required, the Bid Bond. The actual copy of the Bid Form, or a complete and accurate copy, is to be completed and submitted with the Bid security. The supplemental requirements that must be submitted with Bid Form are described in detail on the Bid Form. As noted in the Bid Advertisement, Bidders must purchase a numbered set of drawings & specifications in order to be placed on the official Planholders list and submit a responsive bid.

15.02 A complete Bid shall be submitted no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid, and shall be enclosed in a plainly marked envelope (or suitable package) and marked with the project title, "**City of Whitefish Wastewater Treatment Plant Improvements Project, 2019**" plus the name and address of Bidder, accompanied by the Bid security and other required documents. To be considered complete, the submitted bid must include the Bid Form, Bid Security and all other required attachments. The bidder's checklist is located in Section 00 43 93 for reference.

15.03 Any irregularities or deviations from the above stated directions, including failure to acknowledge any or all addenda, failure to include any or all of the required Bidder Qualifications, or any and all other irregularities and informalities will be noted at the time of Bid Opening. A judgement on the Bidders Response or Responsibility will be made at the time of Bid Opening, and, contingent upon said judgement, the Bid will either be read aloud or judged unresponsive and not read. Any judgement as to the question of a Bidder's Response or Responsibility will be subject to further interpretation which may result, without undue justification, in a Bidder's Bid being ruled disqualified after the time of Bid Opening. Bids deemed unresponsive at the time of Bid Opening are to be considered disqualified this ruling will be FINAL.

15.04 A Bid shall be received no later than the date and time prescribed and at the place indicated in the invitation for construction bids. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "**BID ENCLOSED, City of Whitefish Wastewater Treatment Plant Improvements Project - 2019**" A mailed Bid shall be addressed to:

City of Whitefish
Craig Workman, P.E., Director of Public Works
Whitefish City Hall
PO Box 158
418 E. 2nd Street
Whitefish, MT 59937-0158

ARTICLE 16 - MODIFICATION AND WITHDRAWAL OF BID

16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

16.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 - OPENING OF BIDS

17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid **Invitation for Construction Bids** and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 - EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.

19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.

19.03 Evaluation of Bids

A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

B. In the comparison of Bids, **after the determination of the lowest base bid**, alternates (**if applicable**) will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner shall announce to all bidders a “Base Bid plus alternates” budget after receiving all Bids, but prior to opening them. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which

Owner determines funds will be available at the time of award.

19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 - BONDS AND INSURANCE

20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 21 - SIGNING OF AGREEMENT

21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten days thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.2 of the General Conditions.

ARTICLE 22 - SALES AND USE TAXES

22.01 Owner is exempt from taxation as legislated by Title 15 of Montana Code Annotated (15-6-201, MCA) & (15-31-102, MCA). Owner is exempt from Montana state sales and use taxes on materials and equipment to be incorporated in the Work.

22.02 All applicable laws, ordinances, and the rules and regulations of authorities having jurisdiction over construction of the project shall apply to the Contract throughout. State laws and ordinances which the Contractor must comply with include, but are not limited to, those involving workmen's compensation insurance, contractor registration, and gross receipts tax.

ARTICLE 23 - CONTRACTS TO BE ASSIGNED

23.01 Owner as "Buyer" has executed a contract with Aqua Aerobics Systems Inc. as "Seller" for the procurement of goods and special services for Whitefish AGS Equipment Contract. The materials and equipment provided for in the procurement contract are to be furnished and delivered to the Point of Destination for installation by the Contractor. Owner will assign said procurement contract to Contractor as set forth in the Agreement.

Contractor will accept the assignment and assume responsibility for the "Seller," which will become a Subcontractor or Supplier to Contractor.

23.02 Bidders may examine the contract documents and associated submittals for the procurement of goods and special services for **City of Whitefish Wastewater Treatment Plant Improvements Project, Sequencing Batch Reactor Equipment Procurement, September 12, 2018** at the office of Anderson-Montgomery Consulting Engineers, Helena, MT. Alternatively, arrangements can be made to view the document electronically. Final copies of Procurement Documents will be supplied to Contractor upon Award of the Whitefish Wastewater System Upgrade Project and any and all required execution of documents in said Procurement Contract will be requested after issuance of the Notice of Award. **Note that use of the Procurement Contract Documents requires execution of a Non-Disclosure Agreement with Aqua Aerobics Systems Inc.**

23.03 The Procurement Document shall be comprised of the following:

A. Whitefish Wastewater Treatment Plant Improvements Project, Sequencing Batch Reactor Equipment Procurement Project Bidding Documents prepared by AMCE, August 2018

B. Aqua Aerobics Bid Proposal dated September 12, 2018

C. Aqua Aerobics Equipment Submittal Package

ARTICLE 24 - NON DISCLOSURE AGREEMENT

24.01 Bidders are advised that a major element of this project involves the acquisition and installation of proprietary wastewater treatment equipment that is legally protected as such. The Aerobic Granular Sludge treatment equipment was developed by Royal HaskoningDHV and is provided through an agreement with Aqua-Aerobic Systems, Inc. Bidders will be required to complete, sign, submit and observe the Non-Disclosure Agreement (NDA). There will be no exceptions. Bidders' failure to completely fulfill the NDA requirements will result in rejection of the bid as non-responsive. **The Non-Disclosure Agreement is available from Anderson-Montgomery Consulting Engineers on request. Contact Kassi Scheeler or Paul Montgomery at 406-449-3303 or Paul@a-mce.com or Kassi@a-mce.com to request the Agreement.**

ARTICLE 25 - WAGE RATE REQUIREMENTS

25.01 If the contract price is in excess of $100,000, provisions of the Contract Work Hours and Safety Standards Act at 29 CFR 5.5(b) apply.

ARTICLE 26 - FUNDING AGENCY SPECIAL PROVISIONS FOR MONTANA PUBLIC FACILITY PROJECTS

26.01 This project is being funded with funds from the following public facility funding programs or agencies:

A. Renewable Resource Grant and Loan Program (RRGL)

B. Treasure State Endowment Program (TSEP)

C. Water Pollution Control State Revolving Fund Loan Program (SRF)

D. City of Whitefish local funds

26.02 Bidder's attention is direction to Section 00 90 00 – Funding Agency Requirements of these contract documents. The successful Bidder shall comply with all applicable articles therein, including but not limited to, the following Instructions to Bidders;

ARTICLE 27 - EQUAL EMPLOYMENT OPPORTUNITY

27.01 BIDDER'S attention is directed to ARTICLE 1.5.1 [Equal Employment Opportunity and Affirmative Action Requirements] of Section 00 90 00, the requirement for ensuring that employees and applicants for employment are not discriminated against because of their race, color, religion, national origin, sex, marital status, age, or political ideas. Bidders on this work will be required to comply with the President's Executive Orders No. 11246 as amended, 11458, 11518, and 11625.

ARTICLE 28 - DISADVANTAGE BUSINESS ENTERPRISES

28.01 DBE solicitation requirements are located in ARTICLE 1.5.2 [Guidance for Participation By Disadvantaged Business (DBE) Enterprises In United States Environmental Protection Agency Programs of 40 CFR 33] of Section 00 90 00. An online DBE quote request form is available to BIDDERS at https://app.mdt.mt.gov/dbeqt/. The BIDDER should fill out and submit the quote request form as early in the bidding period as possible to allow sufficient time for qualified DBE firms to respond. A DBE must be certified as such by a state or federal agency (e.g., the Small Business Administration, the Department of Transportation, or EPA) or by a state, local, or independent private organization, provided their criteria match those under section 8(a) (5) and (6) of the Small Business Act and Small Business Administration's 8(a) Business Development Program Regulations. Self-certification of DBEs is not allowed. Inadequate DBE solicitation efforts by the BIDDER may be grounds for the MDEQ State Revolving Fund program to withhold funds for the project and withhold authorization to award the construction contract. In accordance with Section 00 90 00 Article 1.5.2, failure to submit evidence showing a "good faith effort" may cause the bid to be rejected as non-responsive.

ARTICLE 29 - DEBARMENT CERTIFICATION

29.01 BIDDER'S attention is directed to ARTICLE 1.5.3 [Certification Regarding Debarment, Suspension and Other Responsibility Matters] of Section 00 90 00 with respect to Certification Regarding Debarment. Federal funding is being utilized on this project and the successful bidder must provide the debarment certification statement at the time of bid opening with the bid and other forms required.

ARTICLE 30 - COMPLIANCE WITH WAGE RATE REQUIREMENTS

30.01 BIDDER'S attention is directed to ARTICLE 1.5.7 [Wage Determination] of Section 00

90 00 with respect to wage rates. Under all Schedules of this Contract with the Owner, the Contractor and all subcontractors shall pay for all labor employed at no less than the minimum standard prevailing rate of wages for each classification, which shall be the higher of either the Montana Prevailing Wage Rates or the Federal Davis-Bacon Prevailing Wage Rates, as appended.

ARTICLE 31 - AMERICAN IRON AND STEEL (AIS) REQUIREMENTS

31.01 BIDDER'S attention is directed to ARTICLE 1.5.10 [American Iron and Steel Requirements] of Section 00 90 00. All of the iron and steel products used in the project must be produced in the United States. The term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, rebar, and construction materials. The iron and steel products permanently incorporated in the project must comply with the American Iron and Steel requirements of Section 436 of the Consolidated Appropriations Act of 2014 (P.L. 113-76) and as further interpreted by applicable EPA guidance (see http://water.epa.gov/grants_funding/aisrequirement.cfm).

END OF SECTION 00 21 13

SECTION 00 41 00
BID FORM
WHITEFISH WASTEWATER TREATMENT PLANT
IMPROVEMENTS PROJECT 2019

ARTICLE 1 – BID RECIPIENT

1.1 This Bid is submitted to:

City of Whitefish – Craig Workman, P.E., Director of Public Works
Whitefish City Hall
418 E. 2nd Street
Whitefish, MT 59937-0158

1.2 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.1 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

2.2 Bidder acknowledges the provisions of the Agreement as to the assignment of the procurement contract for procurement of goods and special services for the **City of Whitefish Wastewater Treatment Plant Improvements Project SBR Equipment Procurement**

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.1 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

Addendum No.	Addendum, Date
_____	_____
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.

F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.

I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.

J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.1 Bidder certifies that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the e execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.1 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

City of Whitefish

Wastewater Treatment System Improvements Project 2019

Unit Price Bid Schedule

	BID ITEMS	UNITS	QUANT.	UNIT PRICE	TOTAL
100	***Mobilization, Bonds and Insurance (limited to 10% or less of Bid Item 110)***	**LS**	**1**	$_____	$_____
110	***Improvements to the Whitefish WWTP as described in the Whitefish Wastewater Treatment Improvements Project 2019 Construction Drawings and Specifications, dated September 2019.***	**LS**	**1**	$_____	$_____
120	***Price for Contractor's Payment Obligations to Aqua Aerobics System Inc. for Assigned Equipment Procurement Contract for Sequencing Batch Reactor Equipment Procurement***	**LS**	**1**	$ 2,247,616	$ 2,247,616
Total Estimated Bid Price (Sum of Bid Items 100-120 in figures)					**$**_____ (figures)
Total Estimated Bid Price (in words)					_____ _____ (words)

(The foregoing unit bid prices shall include all labor, materials, equipment, overhead, profit, insurance, and all incidentals required to cover the finished work of the nature called for in the Whitefish Wastewater System Improvement Project 2019 as described in the Project Documents, September 2019

ARTICLE 6 – TIME OF COMPLETION

6.1 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.6 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement**.**

6.2 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.1 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security — See SECTION – 00 43 13;

B. List of Proposed Subcontractors — See Article 12 of SECTION – 00 21 13;

C. Evidence of authority to do business in the state of Montana; or a written covenant to obtain such license within the time for acceptance of Bids;

1. Montana Contractor's Registration Number:

D. Required Bidder Qualification Statement with supporting data

1. FORM C-451 (See SECTION – 00 45 13).

E. USEPA Certification Regarding Debarment, Suspension, and Other Responsibility Matters

F. DBE Subcontractor Solicitation Information

ARTICLE 8 – DEFINED TERMS

8.1 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

This Bid is SUBMITTED on_____, 2019

BY:

If Bidder is:

An Individual

Name (typed or printed):_____

By:_____

(*Individual's Signature*)

Doing business as:_____

A Partnership

Partnership Name:_____

By:_____

(*Signature of general partner – attach evidence of authority to sign)*

Name (typed or printed):_____

A Corporation

Corporation Name:_____

State of Incorporation:_____

Type (General Business, Profession, Service, Limited Liability):_____

By:_____

(*Signature – attach evidence of authority to sign)*

Name (typed or printed):_____

Title:_____

Attest:_____

(*Signature of Corporate Secretary)*

Date of Qualification to do business in Montana is_____/_____/_____.

A Joint Venture

Name of Joint Venture:_____

First Joint Venture Name:_____

By:_____

(*Signature of joint venture partner – attach evidence of authority to sign)*

Name (typed or printed):_____

Title:_____

Second Joint Venture Name:_____

By:_____

(*Signature of joint venture partner – attach evidence of authority to sign)*

Name (typed or printed):_____

Title:_____

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is party to the venture should be in the manner indicated above.)

BIDDER'S BUSINESS ADDRESS & CONTACT INFORMATION:

Bidder's Business address: _____

Business Phone No._____

Business Fax No._____

Business E-Mail Address_____

State Contractor License No._____. (If applicable)

Employer's Tax ID No._____

ADDRESS FOR GIVING NOTICES:

Phone and e-mail address, and Address for receipt of *official communications* if different from Business address and contact information:

_____

_____

SECTION 00 43 13
BID BOND

BIDDER (Name and Address):

_____
_____
_____

SURETY (Name and Address of Principal Place of Business):

_____
_____
_____

OWNER (Name and Address):

City of Whitefish
P.O. Box 158
Whitefish, MT 59645

BID

BID DUE DATE: _____, 2019
PROJECT:

As described in Project Documents, the Bid is for provision of General Construction Services for the City of Whitefish Wastewater Treatment Plant Improvements Project 2019 located at 350 Monegan Road, Whitefish, MT 59937.

BOND

BOND NUMBER: _____
DATE (Not later than Bid due date): _____
PENAL SUM: _____ _____
(Words) (Figures)

IN WITNESS WHEREOF, Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER	SURETY
_____(Seal)	_____(Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature and Title	Signature and Title (Attach Power of Attorney)
Attest: _____	Attest: _____
Signature and Title	Signature and Title

Note: (1) Above addresses are to be used for giving required notice.
(2) Any singular reference to Bidder, Surety, OWNER or other party shall be considered plural where applicable.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to OWNER upon default of Bidder any difference between the total amount of Bidder's Bid and the total amount of the Bid of the next lowest, responsible and responsive Bidder as determined by OWNER for the Work required by the Contract Documents, provided that:

1.1. If there is no such next lowest, responsible and responsive Bidder, and OWNER does not abandon the Project, then Bidder and Surety shall pay to OWNER the penal sum set forth on the face of this Bond, and

1.2. In no event shall Bidder's and Surety's obligation hereunder exceed the penal sum set forth on the face of this Bond.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment Bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1. OWNER accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment Bonds required by the Bidding Documents, or

3.2. All Bids are rejected by OWNER, or

3.3. OWNER fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default by Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from OWNER, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of and any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by OWNER and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power or Attorney evidencing the authority of the officer, agent or representative who executed this Bond on behalf of Surety to execute, seal and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer or proposal as applicable.

END OF SECTION 00 43 13

SECTION 00 43 93
BIDDERS CHECKLIST

Directions: The following items are to be enclosed in an envelope received no later than **October 29, 2019, 2:00 p.m.** at the following address:

City of Whitefish
Craig Workman, P.E., Director of Public Works
Whitefish City Hall
418 E. 2nd Street
Whitefish, MT 59937-0158

_____ Review Instructions to Bidders (Section 00 21 13)

_____ Non-Disclosure Agreement (Section 00 25 00)

_____ Complete Bid Form (Section 00 41 00)

_____ Bid Bond (Section 00 43 13)

_____ Bidder Qualifications Form C-451 (Section 00 45 13)

_____ Funding Agency Forms (Section 00 90 00)

_____ Contractor's Registration

_____ Review Site Conditions

_____ DBE Subcontractor Solicitation Information

_____ SRF Certification Regarding Debarment, Suspension, and Other Responsibility Matters

SECTION 00 45 13
BIDDERS QUALIFICATIONS FORM C-451

QUALIFICATIONS STATEMENT

THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT PERMITTED BY LAWS AND REGULATIONS

1. **SUBMITTED BY:**

   Official Name of Firm: _____

   Address: _____

   _____

   _____

2. **SUBMITTED TO:** _____

3. **SUBMITTED FOR:** _____

   Owner: City of Whitefish

   Project Name: City of Whitefish Wastewater Treatment Plant Improvements Project 2019

   TYPE OF WORK: _____

   _____

   _____

4. **CONTRACTOR'S CONTACT INFORMATION**

   Contact Person: _____

   Title: _____

Phone: _____

Email: _____

5. AFFILIATED COMPANIES:

Name: _____

Address: _____

_____

_____

6. TYPE OF ORGANIZATION:

☐ SOLE PROPRIETORSHIP

Name of Owner: _____

Doing Business As: _____

Date of Organization: _____

☐ PARTNERSHIP

Date of Organization: _____

Type of Partnership: _____

Name of General Partner(s): _____

_____

_____

☐ CORPORATION

State of Organization: _____

Date of Organization: _____

Executive Officers:

- President: _____

- Vice President(s): _____

_____

_____

- Treasurer: _____

- Secretary: _____

☐ LIMITED LIABILITY COMPANY

State of Organization: _____

Date of Organization: _____

Members: _____

_____

_____

_____

☐ JOINT VENTURE

Sate of Organization: _____

Date of Organization: _____

Form of Organization: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

_____

_____

Joint Venture Managing Partner

- Name: _____

- Address: _____

_____

Joint Venture Managing Partner

- Name: _____

- Address: _____

_____

7. LICENSING

Jurisdiction: _____

Type of License: _____

License Number: _____

Jurisdiction: _____

Type of License: _____

License Number: _____

8. CERTIFICATIONS CERTIFIED BY:

Disadvantage Business Enterprise: _____

Minority Business Enterprise: _____

Woman Owned Enterprise: _____

Small Business Enterprise: _____

Other (_____): _____

9. BONDING INFORMATION

Bonding Company: _____

Address: _____

Bonding Agent: _____

Address: _____

_____

_____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

10. FINANCIAL INFORMATION

Financial Institution: _____

Address: _____

_____

Account Manager: _____

Phone: _____

INCLUDE AS AN ATTACHMENT AN AUDITED BALANCE SHEET FOR EACH OF THE LAST 3 YEARS

11. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each

participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Has any Corporate Officer, Partner, Joint Venture participant or Proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

12. SAFETY PROGRAM:

Name of Contractor's Safety Officer:_____

Include the following as attachments:

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) OSHA No. 500- Log & Summary of Occupational Injuries & Illnesses for the past 5 years.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all OSHA Citations & Notifications of Penalty (monetary or other) received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all safety citations or violations under any state all received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide the following for the firm listed in Section V (and for each proposed Subcontractor furnishing or performing Work having a value in excess of 10 percent of the total amount of

the Bid) the following (attach additional sheets as necessary):

Workers' compensation Experience Modification Rate (EMR) for the last 5 years:

YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____

Total Recordable Frequency Rate (TRFR) for the last 5 years:

YEAR	_____	TRFR	____
YEAR	_____	TRFR	____
YEAR	_____	TRFR	____
YEAR	_____	TRFR	____
YEAR	_____	TRFR	____

Total number of man-hours worked for the last 5 Years:

YEAR	_____	TOTAL NUMBER OF	_____
YEAR	_____	TOTAL NUMBER OF	_____
YEAR	_____	TOTAL NUMBER OF	_____
YEAR	_____	TOTAL NUMBER OF	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____

Provide Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) Days Away From Work, Days of Restricted Work Activity or Job Transfer (DART) incidence rate for the particular industry or type of Work to be performed by Contractor and each of Contractor's proposed Subcontractors and Suppliers) for the last 5 years:

YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____

13. EQUIPMENT:

MAJOR EQUIPMENT:

List on **Schedule C** all pieces of major equipment available for use on Owner's Project.

14. SUBCONTRACTORS

MAJOR SUBCONTRACTORS:

List on **Schedule D** all "Major Subcontractors" planned for use on the Project.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HEREWITH, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE
ME THIS _____ DAY OF_____, 20___

NOTARY PUBLIC - STATE OF _____
MY COMMISSION EXPIRES:_____

REQUIRED ATTACHMENTS

1. Schedule A (Current Experience).
2. Schedule B (Previous Experience).
3. Schedule C (Major Equipment).
4. Audited balance sheet for each of the last 3 years for firm named in Section 1.
5. Evidence of authority for individuals listed in Section 7 to bind organization to an agreement.
6. Resumes of officers and key individuals (including Safety Officer) of firm named in Section 1.
7. Required safety program submittals listed in Section 13.
8. Additional items as pertinent.

SCHEDULE A

CURRENT
EXPERIENCE

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE C - LIST OF MAJOR EQUIPMENT AVAILABLE

ITEM	PURCHASE DATE	CONDITION	ACQUIRED VALUE

SCHEDULE D – LIST OF MAJOR SUBCONTRACTORS

(If any of the given "MAJOR SUB-CONTRACTS" will not be used, so indicate by listing "NA" in the respective row under "PROPOSED SUBCONTRACTOR").

MAJOR SUB-CONTRACTS	**PROPOSED SUBCONTRACTOR**	**CITY / STATE**
Mechanical Work (HVAC)		
Mechanical Work (Plumbing)		
Electrical Work		
Roofing Work		
Site / Civil		
Dewatering		
Environmental / Groundwater Remediation		
OTHERS (PLEASE SPECIFY)		

SECTION 00 51 00
NOTICE OF AWARD

To: _____

Address: _____

Contract: **City of Whitefish**

Project: **Whitefish Wastewater Treatment Plant Improvements Project 2019**

You are notified that your Bid dated: _____ for the above Contract has been considered. Your lump sum bid, with documentation, has been found to be in the best interest of the City and you are being provided this Notice of Award for a Contract for the construction of the Whitefish Wastewater Treatment Plant Improvements Project 2019.

The Contract Price of your Contract is _____ _____ **(in words),**

$ _____ (in figures).

You must comply with the following conditions precedent **within 14 days** of the date you receive this Notice of Award.

1. Deliver to the OWNER 2 copies of the fully executed counterparts of the Contract Documents.

2. Deliver required certificates of insurance, as described in the contract documents.

3. Deliver Bond Documents.

Failure to comply with these conditions within the time specified will entitle OWNER to consider your Cost Quotation in default, to annul this Notice of Award.

Within ten days after you comply with the above conditions, OWNER will return to you one fully executed counterpart of the Contract Documents.

DATED this _____ day of _____, 2019.

CITY OF WHITEFISH

BY: _____

TITLE: _____

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged this ____ day of _____, 2019.

_____
Contractor

BY: _____
Name Title

Copy to ENGINEER

END OF SECTION 00 51 00

SECTION 00 52 00
AGREEMENT BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT

THIS AGREEMENT is by and between **The City Of Whitefish, Montana** ("Owner") and _____ ("Contractor").

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

- Improvements to the Main Wastewater Lift Station
- Foundation Stabilization in the form of Rigid Inclusions
- Sludge Handling and Disposal from Existing Lagoon Treatment Cell
- New Grit Handling Facilities, Enclosed in a Building
- Alum Chemical Feed Equipment
- Three Reactor Basins with Aeration and Influent/Effluent/Waste Sludge Piping Systems
- Main Process Building with Blowers, Biosolids Pumping, Biosolids Mixing, Non-potable Water System and Ultra-violet Disinfection Equipment
- Process Control and Monitoring System
- Sludge Buffer Basins (2) and Water Level Control Basin
- Covered Biosolids Treatment Basin with Mixing and Aeration
- Sidestream Lift Station
- Improvements to Existing Biosolids Drying Beds
- Effluent Outfall and Diffuser
- Renovation of Existing Administration Building
- Ancillary Site Improvements, Utility Piping, Communications Systems and Landscaping

ARTICLE 2 – THE PROJECT

2.1 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **Whitefish Wastewater Treatment Plant Improvements Project 2019**

ARTICLE 3 – ENGINEER

3.1 The Project has been designed by:

A. Anderson-Montgomery Consulting Engineers, Inc.

B. With Sub-Consulting provided by:

1. Robert Peccia and Associates
2. CTA Architects Engineers
3. Comma Q Architects

3.2 The Owner has retained Anderson-Montgomery Consulting Engineers, Inc. ("Engineer") to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.1 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract. The Total Contract Time allowed for this Project will be **544 consecutive** calendar days from the date of the Notice to Proceed to the date of Substantial Completion.

4.2 *Contract Times: Dates*

A. The Work will be substantially completed on or before_____, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before_____.

4.3 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay the Owner up to **$1,000.00** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.

2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner up to **$750.00** for each day that expires after such time until the Work is completed and ready for final

payment.

3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

4.4 *Special Damages*

[DELETED]

ARTICLE 5 – CONTRACT PRICE

5.1 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:

1. Mobilization _____

2. Lump Sum for General Construction _____

3. Equipment Procurement Bid Amount _____

4. Total Bid Amount (Sum of 1-3) _____

ARTICLE 6 – PAYMENT PROCEDURES

6.1 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.2 *Progress Payments; Retainage*

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 15th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract

a. **95** percent of Work completed (with the balance being retainage; and

b. **95**percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion **of the entire construction to be provided under the**

Contract Documents, Owner shall pay an amount sufficient to increase total payments to Contractor to **97.5** percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **200** percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.3 *Final Payment*

A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

6.4 *Gross Receipts Withholding Requirements*

A. Pursuant to Section 15-50-206(2)(3), MCA, the Owner is required to withhold one percent (1%) of all payments due the Contractor and is required to transmit such moneys to the Montana Department of Revenue as part of the public contractor's license fee. In like fashion, the Contractor is required to withhold one percent (1%) from payments to subcontracors.

ARTICLE 7 – INTEREST

7.1 All amounts not paid when due shall bear interest at the **maximum rate allowed by law at the place of the Project**.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

8.1 In order to induce Owner to enter into this Contract, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.

B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings**,** and (3) reports and drawings related to other work scheduled in the general vicinity of the project during the planned construction period.

E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site;

information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.

F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.1 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement
2. Performance bond
3. Payment bond
4. General Conditions
5. Supplementary Conditions
6. Specifications:
    a. Work Plan (See Section 01 11 00)
    b. As listed in the table of contents of the Project Manual.
    c. Montana Public Works Standard Specifications (Current Edition)
    d. City of Whitefish Modifications to Montana Public Works Standard Specifications (First Edition)
7. Construction Drawings (not attached but incorporated by reference) consisting of the Drawings listed on the attached sheet index, each bearing the following general title: Whitefish Wastewater Treatment Plant Improvements Project 2019

8. Addenda

9. Exhibits to this Agreement (enumerated as follows):

   a. *Agreement, Exhibit A-1 to Agreement Between Buyer and Seller Dated January 3, 2019– Assignment of Contract, Consent to Assignment, and Acceptance of Assignment and Exhibit A-2 Agreement to Assignment by Sellers Surety* for: **Whitefish Wastewater Treatment Plant Improvements Project – Sequencing Batch Reactor Equipment Procurement Contract as bid September 12, 2018.**

   b. Funding Agency Special Provisions for Montana Public Facility Projects

10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:

   a. Notice to Proceed.

   b. Work Change Directives.

   c. Change Orders.

   d. Field Orders.

B. The documents listed in Paragraph 9.1.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.1 *Terms*

A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.2 *Assignment of Contract*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.3 *Successors and Assigns*

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.4 *Severability*

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.5 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.6 *Other Provisions*

A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

10.7 *Contracts to be Assigned*

A. The contract between Owner as "buyer" and Aqua Aerobics Systems Inc. as "seller" for procurement of goods and special services ("procurement contract") for AGS Treatment Equipment is hereby assigned to Contractor by Owner, and Contractor accepts such assignment. A form documenting the assignment is attached as an exhibit to this Agreement.

B. This assignment will occur on the Effective Date of the Agreement, and will relieve the Owner as "buyer" from all further obligations and liabilities under the procurement contract. Contractor will assume full responsibility for the performance of "seller" as Contractor's Subcontractor or Supplier. Notwithstanding this assignment, all performance guarantees and warranties required by the procurement contract will continue to run for the benefit of the Owner and, in

addition, for the benefit of the Contractor. Except as noted in the agreement between "buyer" and "seller," all rights, duties and obligations of Engineer to "buyer" and "seller" under the "procurement contract" will cease.

C. Owner will provide Contractor with a copy of the assigned procurement contract after the assignment is completed.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

OWNER:

CITY OF WHITEFISH, MONTANA

By:_____

_____

Print Name:

Manager Title:

Attest:_____

Print Name:

Title:

Address for giving notices:

City of Whitefish

418 East 2nd Street

_____

Whitefish, MT 59937

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

CONTRACTOR:

_____

By:

Print Name: Dana Smith

Title: Acting City

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:_____

Print Name:

Title

Address for giving notices:

_____

NOTE TO USER: Use in those states or other jurisdictions where applicable or required.

SECTION 00 55 00
NOTICE TO PROCEED

Owner: **City of Whitefish**

Owner's Contract No.:

Contractor:

Contractor's Project No.:

Engineer: **Anderson Montgomery Consulting Engineers**

Engineer's Project No.:

Project: **Whitefish Wastewater Treatment Plant Improvements Project 2019**

Contract Name:

Effective Date of Contract:

TO CONTRACTOR:

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on _____, 2019. (see Paragraph 4.01 of the General Conditions)

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, [the date of Substantial Completion is _____, and the date of readiness for final payment is_____.

Before starting any Work at the Site, Contractor must comply with the following:
[Note any access limitations, security procedures, or other restrictions]

Recommended:	Accepted:	Accepted:
_____	_____	_____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
_____	_____	_____
(Date)	(Date)	(Date)

SECTION 00 61 10
PERFORMANCE BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *:* **City of Whitefish**
418 E. 2nd Street
Whitefish, MT 59937-0158

CONSTRUCTION CONTRACT
Effective Date of the Agreement: Amount:
Description *(name and location)*:

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: None See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By:_____	**By:**_____
Signature	Signature *(attach power of attorney)*
_____	
_____	
Print Name	Print Name
_____	
_____	
Title	Title
Attest:_____	**Attest:**_____
Signature	Signature

_____

_____

Title Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the

Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

SECTION 00 61 13
PAYMENT BOND

CONTRACTOR *(name and address)*: SURETY *(name and address of principal place of business)*:

OWNER : City of Whitefish, Wastewater Treatment Plant - 350 Monegan Road, Whitefish, MT 59937

CONSTRUCTION CONTRACT
Effective Date of the Agreement: Amount:
Description *(name and location)*:

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bid Form: None See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	
_____	
Print Name	Print Name
_____	
_____	
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature

_____

_____

Title Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond shall arise after the following:

   5.1 Claimants who do not have a direct contract with the Contractor,

      5.1.1 have furnished a written notice of non- payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

      5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).

   5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to

satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2 Pay or arrange for payment of any undisputed amounts.

    7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the

Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of
(1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. **Definitions**

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default**: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

	Contractor's Application for Payment No:	
	Application Period:	Application Date:
To (Owners):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contact No:	Contractor's Project No:	Engineer's Project No:

Application For Payment

Change Order Summary

Approved Change Orders		
Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1. ORIGINAL CONTRACT PRICE..... $ _____

2. Net change by Change Orders..... $ _____

3. Current Contract Price (Line 1 ± 2)..... $ _____

4. TOTAL COMPLETED AND STORED TO DATE

(Column F total on Progress Estimates)..... $ _____

5. RETAINAGE:

a. 95% X _____ **Work Completed**..... $ _____

b. 95% X _____ **Stored Material**..... $ _____

c. Total Retainage (Line 5.a + Line 5.b)..... $ _____

6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c)..... $ _____

7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)..... $ _____

8. AMOUNT DUE THIS APPLICATION..... $ _____

9. BALANCE TO FINISH, PLUS RETAINAGE

(Column G total on Progress Estimates + Line 5.c above)..... $ _____

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:
(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;
(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and
(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor Signature

By:	Date:

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____ _____
(Engineer) (Date)

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____ _____
(Owner) (Date)

Approved by: _____ _____
Funding or Financing Entity (if applicable) (Date)

Progress Estimate - Lump Sum Work

Contractor's Application

For (Contract):	Application Number:
Application Period:	Application Date:

			Work Completed		E	F		G
A		B	C	D				
Specification Section No.	Description	Scheduled Value ($)	From Previous Application (C+D)	This Period	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D	% (F / B)	Balance to Finish (B - F)
	Totals							

Stored Material Summary **Contractor's Application**

For (Contract):								Application Number:			
Application Period:								Application Date:			
A		B	C		D		E	Subtotal Amount Completed and Stored to Date (D + E)	F		G
Bid Item No.	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Storage Location	Description of Materials or Equipment Stored	Stored Previously		Amount Stored this Month ($)		Incorporated in Work		Materials Remaining in Storage ($) (D + E - F)
					Date Placed into Storage (Month/Year)	Amount ($)			Date (Month / Year)	Amount ($)	
				Totals							

SECTION 00 63 49
WORK CHANGE DIRECTIVE

No._____

Date of Issuance:_____ Effective Date:_____

Project: Whitefish Wastewater Treatment Plant Improvements Project 2019	Owner: City of Whitefish, Montana	Owner's Contract No.:
Contract:		Date of Contract:
Equipment Seller:		Engineer's Project No.:

You are directed to proceed promptly with the following change(s):

Item No.	Description

Attachments (list documents supporting change):

Purpose for Work Change Directive:

□ Authorizations fort Work described herein to proceed on the basis of Cost of the Work due to:

□ Non-agreement on pricing of proposed change.

□ Necessity to expedite Work described herein prior to agreeing to changes on Contract Price and Contract Time.

Estimated change in Contract Price and Contract Times:

Contract Price $_____ (increase/decrease) Contract Time_____ (increase/decrease) Days

If the change involves an increase, the estimated amounts are not to be exceeded without further authorization.

Recommended for Approval by Engineer:	Date
Authorized for Owner by:	Date
Accepted for Equipment Seller by:	Date
Approved by Funding Agency (if applicable):	Date

END OF SECTION 00 63 49

SECTION 00 63 63
CHANGE ORDER

Change Order No: _____ Date of Issuance:_____Effective Date: _____

Project: Whitefish Wastewater Treatment Plant Improvements Project 2019	Owner: City of Whitefish	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

The Contract Documents are modified as follows upon execution of this Change Order:

Description:

Attachments: (List documents supporting change):

CHANGE IN CONTRACT PRICE:

Original Contract Price:

$_____

[Increase] [Decrease] from previously approved Change Orders No._____to No._____:

$_____

Contract Price prior to this Change Order:

$_____

[Increase] [Decrease] of this Change Order:

CHANGE IN CONTRACT TIMES:

Original Contract Times: ☐☐Working days

☐☐Calendar days Substantial completion (days or date): _____

Ready for final payment (days or date): _____

[Increase] [Decrease] from previously approved Change Orders No.to No.:

Substantial completion (days): _____

Ready for final payment (days): _____

Contract Times prior to this Change Order:

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

[Increase] [Decrease] of this Change Order:

Substantial completion (days or date): _____

$_____ Ready for final payment (days or date): _____

Contract Price incorporating this Change Order: Contract Times with all approved Change Orders:

Substantial completion (days or date): _____

$_____ Ready for final payment (days or date): _____

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By:_____	By:_____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Date:_____	Date:_____	Date: _____

Approved by Funding Agency (if applicable):_____ Date:

SECTION 00 65 16

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: City of Whitefish	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer: **Anderson Montgomery Consulting Engineers**	Engineer's Project No.:
Project: **Whitefish Wastewater Treatment Plant Improvements Project 2019**	Contract Name:

This [preliminary] [final] Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's responsibilities:

☐ None

☐ As follows

Amendments to Contractor's responsibilities:

☐ None

☐ As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:	RECEIVED:	RECEIVED:
By: _____	By: _____	By: _____
(Authorized signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

SECTION 00 72 00 STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

EJCDC®
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

Issued and Published Jointly by

ACEC
AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

National Society of Professional Engineers®

These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

NOTE: EJCDC publications may be purchased at www.ejcdc.org, or from any of the sponsoring organizations above.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.1 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking

resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Engineer*—The individual or entity named as such in the Agreement.

21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in

the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.

33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.

35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and

used as the basis for reviewing Contractor's Applications for Payment.

36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.

38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.

42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or

attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

46. *Unit Price Work*—Work to be paid for on the basis of unit prices.

47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.2 *Terminology*

A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*:

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*:

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*:

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. *Furnish, Install, Perform, Provide*:

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well- known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.1 *Delivery of Bonds and Evidence of Insurance*

A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Contractor's Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

C. *Evidence of Owner's Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.2 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished

upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.3 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.4 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.5 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere

with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.6 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.1 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.2 *Reference Standards*

A. Standards Specifications, Codes, Laws and Regulations

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.3 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*:

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*:

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.4 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.5 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.1 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.2 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.3 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.4 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph
2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.5 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the

control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
2. abnormal weather conditions;
3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
4. acts of war or terrorism.

D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.1 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary

for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.2 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*:

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise;
(b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the

Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.3 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.4 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or

2. is of such a nature as to require a change in the Drawings or Specifications; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

    a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

    b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

    c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

    a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract

Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or

b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice as required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than
30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.5 *Underground Facilities*

A. *Contractor's Responsibilities*: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;

c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

C. *Engineer's Review*: Engineer will promptly review the Underground Facility and

conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;

   b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

   c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and

   d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than
   30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.6 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph
5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and

remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.

H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences

of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.1 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.

D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.

E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.2 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or

authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.

H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.

I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.

J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.3 *Contractor's Insurance*

A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).
4. Foreign voluntary worker compensation (if applicable).

B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:

1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
2. claims for damages insured by reasonably available personal injury liability coverage.
3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage:
    a. Such insurance shall be maintained for three years after final payment.
    b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
3. Broad form property damage coverage.
4. Severability of interest.
5. Underground, explosion, and collapse coverage.
6. Personal injury coverage.
7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.

8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.

E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.

F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.

H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:

1. include at least the specific coverages provided in this Article.

2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.

3. contain a provision or endorsement that the coverage afforded will not be

canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.

4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.

5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.

J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.4 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.5 *Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."

2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially

generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
6. extend to cover damage or loss to insured property while in transit.
7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
8. allow for the waiver of the insurer's subrogation rights, as set forth below.
9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
10. not include a co-insurance clause.
11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
12. include performance/hot testing and start-up.
13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. *Notice of Cancellation or Change*: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal

refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.

C. *Deductibles*: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.

F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.6 *Waiver of Rights*

A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the

Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.7 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.1 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently,

devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.2 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.3 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.4 *"Or Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items

from other proposed suppliers under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
    a. in the exercise of reasonable judgment Engineer determines that:
        1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
        2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
        3) it has a proven record of performance and availability of responsive service; and
        4) it is not objectionable to Owner.
    b. Contractor certifies that, if approved and incorporated into the Work:
        1) there will be no increase in cost to the Owner or increase in Contract Times; and
        2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.5 *Substitutes*

A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer

authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
    a. shall certify that the proposed substitute item will:
        1) perform adequately the functions and achieve the results called for by the general design,
        2) be similar in substance to that specified, and
        3) be suited to the same use as that specified.
    b. will state:
        1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
        2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
        3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
    c. will identify:
        1) all variations of the proposed substitute item from that specified, and
        2) available engineering, sales, maintenance, repair, and replacement services.
    d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is

complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.6 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.

B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain

Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.

J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see

to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.7 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.8 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.9 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein,

whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data

sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements*:

1. Before submitting a Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings*:

    a. Contractor shall submit the number of copies required in the Specifications.

    b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples*:

    a. Contractor shall submit the number of Samples required in the Specifications.

    b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Other Submittals*: Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review*:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.

5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures*:

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;
2. recommendation by Engineer or payment by Owner of any progress or final payment;
3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
4. use or occupancy of the Work or any part thereof by Owner;
5. any review and approval of a Shop Drawing or Sample submittal;
6. the issuance of a notice of acceptability by Engineer;
7. any inspection, test, or approval by others; or
8. any correction of defective Work by Owner.

D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps,

Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.

B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.1 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance

information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.2 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. an itemization of the specific matters to be covered by such authority and responsibility; and

3. the extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.3 *Legal Relationships*

A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the

Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.1 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.2 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.3 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.4 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.5 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.6 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.7 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.8 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.9 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has

been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.1 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.2 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.3 *Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.4 *Rejecting Defective Work*

A. Engineer has the authority to reject Work in accordance with Article 14.

10.5 *Shop Drawings, Change Orders and Payments*

A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.

C. Engineer's authority as to Change Orders is set forth in Article 11.

D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.6 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.7 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.8 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.9 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.1 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. *Change Orders*:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work,
(2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.

2. *Work Change Directives*: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.2 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.3 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.4 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.5 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.6 *Change Proposals*

A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures*: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto,

or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. *Engineer's Action*: Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. *Binding Decision*: Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

B. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.7 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.8 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.1 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*:

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such

agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.1 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the

performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

    c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental

agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective

Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*: When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.2 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.3 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately

identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.

E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.1 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.2 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
3. by manufacturers of equipment furnished under the Contract Documents;
4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.3 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of

work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.4 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.5 *Uncovering Work*

A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.6 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.7 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.1 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*:

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*:

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to

have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*:

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*:

1. In addition to any reductions in payment (set-offs) recommended by Engineer,

Owner is entitled to impose a set-off against payment based on any of the following:

a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. the Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. the Contract Price has been reduced by Change Orders;

i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

l. there are other items entitling Owner to a set off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.2 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.3 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the

Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.4 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.

2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.5 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to

complete such Work or remedy such deficiencies.

15.6 *Final Payment*

A. *Application for Payment*:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
    a. all documentation called for in the Contract Documents;
    b. consent of the surety, if any, to final payment;
    c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
    d. a list of all disputes that Contractor believes are unsettled; and
    e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance*:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall

account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph
15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due*: Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.7 *Waiver of Claims*

A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.8 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;

2. correct such defective Work;

3. if the defective Work has been rejected by Owner, remove it from the

Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.1 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.2 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the

Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.3 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.4 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or
(2) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.1 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this Article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and

2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this Article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.1 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.2 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.3 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.4 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or

damages sustained by Contractor on or in connection with any other project or anticipated project.

18.5 *No Waiver*

A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.6 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.7 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.8 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00 73 00
SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

SC-6.2 – Insurance—General Provisions

SC-6.2 Add the following paragraph immediately after Paragraph 6.2.B:

1. With limiting any of the other obligations or liabilities of the Contractor, Contractor shall secure and maintain such insurance from an insurance company (or companies) authorized to write insurance in the State of Montana, with a minimum "A.M. Best Rating" of A-, VI, as will protect the Contractor, the vicarious acts of subcontractors, the Owner and the Engineer and their agents and employees from claims for bodily injury, or property damage which may arise from operations and completed operations under this Agreement. Contractor shall commence work under this Agreement until such insurance has been obtained and certificates of insurance, with binders, or certified copies of the insurance policy shall have been filed with the Owner and the Engineer. All insurance coverage shall remain in effect throughout the life of the Agreement, except that the Contractor shall maintain the Commercial General Liability Policy including project and completed operations coverage for a period of at least one year following the substantial completion date for property damage resulting from occurrences during the Agreement period.

SC-6.3 – Contractor's Liability Insurance

SC-6.3 Add the following new paragraph immediately after Paragraph 6.3.J:

K. The limits of liability for the insurance required by Paragraph 6.3 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs 6.3.A.1 and A.2 of the General Conditions:

State:	**Statutory**
Federal, if applicable (e.g., Longshoreman's):	**Statutory**
Employer's Liability:	**$500,000.00**

6.3.C Contractor's Commercial General Liability under Paragraphs 6.03.B and of the General Conditions:

General Aggregate	**$**	**3,000,000.00**
Products - Completed Operations Aggregate	**$**	**3,000,000.00**
Personal and Advertising Injury	**$**	**1,000,000.00**
Each Occurrence (Bodily Injury and Property Damage)	**$**	**1,000,000.00**

Coverage to include:

1) Premises – Operations
2) Operations of Independent Contractor.
3) Contractual Liability.
4) Personal Injury
5) Products and Completed Operations
6) Broad Form Property Damage will include explosion, collapse, blasting, and underground where applicable.
7) Per Project Aggregate Endorsement.

2. Automobile Liability under Paragraph 6.03.D. of the General Conditions:

Bodily Injury:

Each person	**$**	**500,000.00**
Each accident	**$**	**1,000,000.00**
Property Damage: Each	**$**	**1,000,000.00**
[or] Combined Single Limit of	$	1,000,000.00

Coverage to include:

1) All Owned.
2) Hired
3) Non-Owned

3. Excess or Umbrella Liability:

Contractor's Liability Insurance under 6.3.B1 through 6.3.B.4 may be satisfied by primary insurance or a combination of primary and excess or umbrella insurance. Primary occurrence limit cannot be less than $1,000,000.00. Deductible not to exceed $5,000.00 per occurrence on property damage.

4. Contractor's Pollution Liability:

Each Occurrence	**$**	**N.A.**
General Aggregate	**$**	**N.A.**

☒ **If box is checked, Contractor is not required to provide Contractor's Pollution Liability insurance under this Contract**

5. Additional Insureds: In addition to Owner and Engineer, include as additional insureds all Engineering Subconsultants.

6. Contractor's Professional Liability:

Each Claim	**$1,000,000.00**
Annual Aggregate	**$ 3,000,000.00**

7. The Contractual Liability coverage required by paragraph 6.03.B.1 through 6.03.B.4 of the General Conditions shall provide coverage for not less than the following amounts:

Each Occurrence:	**$ 1,000,000.00**
Aggregate	**$ 3,000,000.00**

SC-6.3.I.3 Replace paragraph 6.3.I.3 with the following:

6.3.I.3. Contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 45 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 6.2.C will so provide).

SC-6.5 – Property Insurance

SC-6.5. Delete Paragraph 6.5.A in its entirety and insert the following in its place:

CONTRACTOR shall purchase and maintain property insurance, completed value form, upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. Include the interests of Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of any of them each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;
2. Be written on a Builder's Risk, "all-risk", or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, earth movement, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, flood damage, and such other perils as may be specifically required by the Supplementary Conditions;
3. Include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
4. Cover materials and equipment in transit for incorporation in the Work or stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER;
5. Be endorsed to allow occupancy and partial utilization of the Work by OWNER, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder’s risk insurance.
6. Include performance/hot testing and startup;
7. Be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

8. Hold CONTRACTOR responsible for any deductible or self-insured retention;

9. Be purchased and maintained by CONTRACTOR in accordance with this Paragraph SC- 6.5 and shall comply with the requirements of Paragraph 6.5.B of the General Conditions.

   The qualifications of the insurance company shall comply with the requirements of paragraph 6.2.B.

10. Extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).

11. Allow for the waiver of the insurer's subrogation rights, as set forth below.

12. Provide primary coverage for all losses and damages caused by the perils or causes of loss covered.

13. Not include a co-insurance clause

14. Include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.

15. Cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

16. Include by express endorsement coverage of damage to Contractor's equipment.

SC-6.5.A.1 Add the following new subparagraph after subparagraph 6.5.A.1:

a. In addition to Owner, Contractor, and all Subcontractors, include the Engineer and Engineering Subconsultants as insureds.

SC-6.5.B. Replace Paragraph 6.5.B. with the following language:

All of the policies of insurance (and the certificates or other evidence thereof) required

to be purchased and maintained in accordance with Paragraph 6.5 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 45 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 6.6.

SC-7.6.A Amend Paragraph 7.6.A by adding the following text to the end of the Paragraph:

The Contractor shall not award work valued at more than fifty percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

SC7.7 B Patent Fees and Royalties Modify Paragraph 7.7 B by replacing the text with the following:

7.7 B Exclusive of those conditions set forth in any Non-Disclosure Agreements between Aqua Aerobics Systems, Inc. and the Contractor, and to the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

SC-10.3 – Project Representative

SC-10.3 Add the following new paragraphs immediately after Paragraph 10.03.A:

A. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.

1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.

2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.

3. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
4. Liaison:
    a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
    b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
    c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
6. Shop Drawings and Samples:
    a. Record date of receipt of Samples and Contractor-approved Shop Drawings.
    b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
    c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.
7. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
8. Review of Work and Rejection of Defective Work:
    a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
    b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet

the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

9. Inspections, Tests, and System Start-ups:

    a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.

    b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.

10. Records:

    a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.

    b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.

    c. Maintain records for use in preparing Project documentation.

11. Reports:

    a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.

    b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.

    c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

12. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule

of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

13. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

14. Completion:

    a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.

    b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.

    c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

B. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.

5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off- site by others except as specifically authorized by Engineer.

7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.

8. Authorize Owner to occupy the Project in whole or in part.

SC-15.4 Add the following to the end of Paragraph 15.4.A:

Owner has the right to take possession of or use any completed or substantially completed portions of the Work at any time, but such taking possession or use will not be deemed an acceptance of any Work not completed in accordance with the Contract Documents. Owner's use of any facilities so identified in the Contract Documents will not be grounds for extension of the contract times or change in the contract price. Owner's use of any facilities not specifically identified in the Contract Documents will be in accordance with conditions agreed to prior to such use, and any extra costs or delays in completion incurred and properly claimed by Contractor will be equitably adjusted with a Change Order. Facilities substantially completed in accordance with the Contract Documents which are occupied or used by Owner prior to substantial completion of the entire work will be done in accordance with General Conditions 15.3. Guarantee periods for accepted or substantially completed work including mechanical and electrical equipment will commence upon the start of continuous use by Owner. All tests and instruction of Owner's personnel must be satisfactorily completed, and Owner shall assume responsibility for and operation of all facilities occupied or used except as may arise through portions of Work not yet completed by Contractor. If the Work has been substantially completed and the Engineer certifies that full completion thereof is materially delayed through no fault of the Contractor, the Owner shall, without terminating the Agreement, make payment of the balance due for the portion of the Work fully completed and accepted.

SC-15.6 Final Payment

SC-15.6.A Add the following Paragraph Immediately after Paragraph 15.6.A

Upon correction of deficiencies and completion of the entire Work, Contractor shall notify Engineer in writing requesting a final inspection. If, in the Opinion of the Engineer, the Contractor has satisfactorily completed the Work, Owner, Agency, Engineer, and Contractor shall execute the Final Inspection and Acceptance.

SC-17.1.B Add the following Paragraph Immediately after Paragraph 17.1.B entitled 17.1.C Dispute Resolution Process - Mediation.

C. *Dispute Resolution Process – Mediation:* Owner and Contractor agree that they shall first submit any and all unsettled claims, counterclaims, disputes, and other matters in question between them arising out of or relating to this Agreement or the breach thereof ("Disputes") to mediation by a mediator to be agreed upon by the parties, or each party will choose a mediator and those mediators will together choose a mediator for the mediation. Owner and Contractor agree to participate in the mediation process in good faith. The

process shall be conducted on a confidential basis, and shall be completed within 120 days. If such mediation is unsuccessful in resolving a Dispute, then (1) the parties may mutually agree to a dispute resolution of their choice, or (2) either party may seek to have the Dispute resolved by a court of competent jurisdiction.

"General Decision Number: MT20190070 01/04/2019

Superseded General Decision Number: MT20180071

State: Montana

Construction Type: Heavy

County: Flathead County in Montana.

HEAVY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019

* ELEC0768-010 06/01/2018

	Rates	Fringes
ELECTRICIAN	$ 30.51	13.83

ENGI0400-009 05/01/2013

	Rates	Fringes
POWER EQUIPMENT OPERATOR:		
(Zone 1)		
(1) A-frame truck Crane, oiler (except crane)	$ 23.47	10.40
(2) Crane Oiler,Bulldozer, Roller (Dirt and Grade Compaction)	$ 23.94	10.40
(3) Mechanic, Scraper	$ 24.34	10.40
(4) Cranes, 25 tons - 44 tons	$ 27.00	11.40
(5) Cranes, 45 tons to and incl. 74 tons	$ 28.00	11.40
(6) Cranes, 75 tons to and incl. 149 tons; Cranes, Whirley (All)	$ 29.00	11.40
(7) Cranes, 150 tons to including 250 tons (add $1.00 for every 100 tons over 250 tons); Crane, Stiff-Leg or Derrick; Helicopter		

Hoist; Crane, Tower (all)...$ 30.00 11.40

ZONE DEFINITIONS FOR POWER EQUPMENT OPERATORS:

The zone hourly rates applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the nearest County Court House of the following listed towns to the center of the job:

BILLINGS, BOZEMAN, BUTTE, GREAT FALLS, HELENA, KALISPELL, MISSOULA

Zone 1: 0 to 30 miles - Base Pay
Zone 2: 30 to 60 miles - Base Pay + $3.50
Zone 3: Over 60 miles - Base Pay + $5.50

IRON0014-016 07/01/2018

	Rates	Fringes
IRONWORKER: Reinforcing and Structural	$ 27.25	24.37

SUMT2011-046 02/08/2011

	Rates	Fringes
CARPENTER (Form Work Only)	$ 24.30	7.80
CARPENTER, Excludes Form Work	$ 21.13	7.00
LABORER: Common or General	$ 17.99	5.90
LABORER: Pipelayer	$ 21.81	4.83
LABORER: Landscape and Irrigation	$ 15.14	1.30
OPERATOR: Backhoe	$ 21.44	8.05

OPERATOR: Bobcat/Skid
Steer/Skid Loader.....$ 21.99 8.55

OPERATOR: Excavator.....$ 22.94 9.05

OPERATOR: Grader/Blade.....$ 24.69 8.40

OPERATOR: Loader (Front End)....$ 24.20 7.84

TRUCK DRIVER: Dump Truck.....$ 18.84 5.92

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

==========

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that

classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an

interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==========

END OF GENERAL DECISION
"

"General Decision Number: MT20190079 01/04/2019

Superseded General Decision Number: MT20180080

State: Montana

Construction Type: Highway

Counties: Montana Statewide.

HIGHWAY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019

* SUMT2014-001 02/19/2014

	Rates	Fringes
CARPENTER		
Carpenter/Piledriverman	$ 29.00	11.82
Millwright	$ 32.00	11.82

Zone 1: 0 to 25 miles - Free

Zone 2: 25 to 50 miles - Base Pay +$2.50

Zone 3: Over 50 miles - Base Pay +$3.00

The Carpenter zone hourly rate applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Courthouse of the following cities to the center of the job:

Billings, Bozeman, Butte, Great Falls, Helena, Missoula, Kalispell

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

CEMENT MASON/CONCRETE FINISHER	$ 24.87	10.80

Zone 1: 0 to 25 miles - Free

Zone 2: 25 to 50 miles - Base + $2.50

Zone 3: Over 50 miles -Base + $3.00

The Cement Mason/Concrete Finisher zone hourly rate applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Courthouse of the following cities to the center of the job:

Billings, Bozeman, Butte, Great Falls, Helena, Missoula, Kalispell

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

DIVER

Diver Tender	$ 37.16	14.52
Diving	$ 76.32	14.52
Stand-By	$ 38.16	14.52

The tender shall receive 2 hours at the straight time pay rate per shift for dressing and/or undressing a Diver when work is done under hyperbaric conditions.

Depth Pay (Surface Diving):

0-20 ft.: Free zone

>20-100 ft.: $2.00 per ft.

>100-150 ft.: $3.00 per ft.

>150-220 ft.: $4 00 per ft.

>220 ft.: $5.00 per ft.

Diving in Enclosures (Diver Only):

0-25 ft.: Free zone

>25-300 ft.: $1.00 per ft.

DIVER ZONE PAY:

The hourly wage rates applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Court House of the following cities only to the center of the job:

BILLINGS, BOZEMAN, BUTTE, GREAT FALLS, HELENA, KALISPELL, MISSOULA

ZONE 1: 0 to 25 miles - Free

ZONE 2: 25 to 50 miles - Base Pay +$2.50

ZONE 3: Over 50 miles - Base Pay +$3.00

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

ELECTRICIAN (LINE
CONSTRUCTION)

Equipment Operator.....	$ 33.27	14.16
Groundman.....	$ 25.98	13.25
Lineman.....	$ 43.43	15.38

TRAVEL PAY:

$50.00 per day - 0-25 Miles From the County Courthouse of the following cities: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell and Missoula

$60.00 per day - Over 25 Miles

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

ELECTRICIAN

All Areas.....	$ 32.74	13.42

TRAVEL PAY:

Zone 1: 0 to 10 miles - Free

Zone 2: 10 to 60 miles - Federal mileage both ways/day

Zone 3: Over 60 miles - $75.00 per day

The Electrician zone hourly rate applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Courthouse of the following cities to the center of the job:

Billings, Bozeman, Butte, Great Falls, Helena, Kalispell,

Missoula

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

IRONWORKER.....$ 27.25 20.98

TRAVEL PAY:

0 to 45 miles - Free

45-85 miles - $55.00 per day

Over 85 miles - $85.00 per day

The Ironworker zone hourly rate applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Courthouse of the following cities to the center of the job:

Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, Missoula

Zone 1: 0 to 25 miles - Free

Zone 2: 25 to 50 miles - Base + $2.50

Zone 3: Over 50 miles - Base + $3.00

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

LABORER

Group 1.....	$ 20.90	9.60
Group 2.....	$ 23.97	9.60
Group 3.....	$ 24.19	9.60
Group 4.....	$ 25.18	9.60

GROUP 1: Flag Person

GROUP 2: All General Labor work; Burning Bar; Bucket Man; Carpenter Tender; Caisson Worker; Cement Mason Tender; Cement Handler (dry); Chuck Tender; Choker Setter; Concrete Worker; Curb Machine-Lay Down; Crusher and Batch Plant Worker; Fence Erector; Form Setter; Form Stripper; Heater Tender; Landscaper; Pipe Wrapper; Pot Tender; Powderman Tender; Rail and Truck Loaders and Unloaders; Riprapper; Sealants for Concrete and other materials; Sign Erection, Guard Rail and Jersey Rail;

Stake Jumper; Spike Driver; Signalman; Tail Hoseman; Tool Checker and Houseman; Traffic Control Worker

GROUP 3: Concrete Vibrator; Dumpman (Grademan); Equipment Handler; Geotextile and Liners; High-Pressure Nozzleman; Jackhammer (Pavement Breaker); Laser

Equipment; Non-riding Rollers; Pipelayer; Posthole Digger (power); Power Driven Wheelbarrow; Rigger; Sandblaster; Sod-Cutter-power; Tampers

GROUP 4: Asphalt Raker; Cutting Torch; Grade Setter; High-Scaler; Power Saws (Faller & Concrete); Powderman ($1.00 per hour above Group 4 rate); Rock & Core Drill; Track or Truck

Mounted Wagon Drill; Welder including Air Arc

LABORERS ZONE PAY:

The hourly wage rates applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Court House of the following cities only to the center of the job:

BILLINGS, BOZEMAN, BUTTE, GREAT FALLS, HELENA, KALISPELL, MISSOULA

ZONE 1: 0 to 25 miles - Free

ZONE 2: 25 to 50 miles - Base Pay +$2.50

ZONE 3: Over 50 miles - Base Pay +$3.00

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

PAINTER (Pavement Marking/Milling and related work. Includes operating marking and all other equipment and all work involved in application of pavement markings including epoxies, paints, tape, buttons, thermo-plastics and

any other products applied
for traffic marking purposes
and for directing and
regulating traffic and
cutting rumble strips).....$ 28.00 10.30

PAINTER ZONE PAY:

The hourly wage rates applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Court House of the following cities only to the center of the job:

BILLINGS, BOZEMAN, BUTTE, GREAT FALLS, HELENA, KALISPELL, MISSOULA

ZONE 1: 0 to 25 miles - Free

ZONE 2: 25 to 50 miles - Base Pay +$2.50

ZONE 3: Over 50 miles - Base Pay +$3.00

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

POWER EQUIPMENT OPERATOR:

Group 1	$ 26.52	10.40
Group 2	$ 28.55	10.40
Group 3	$ 29.41	10.40
Group 4	$ 30.10	10.40
Group 5	$ 31.44	10.40
Group 6	$ 32.13	10.40
Group 7	$ 34.23	10.40

GROUP 1: Air Compressor; Auto Fine Graders; Belt Finishing Machine; Boring Machine (small); Cement Silo; Crane, A-Frame Truck Crane; Crusher Conveyor; DW-10, 15, and 20 Tractor Roller; Farm Tractor; Forklift; Form Grader; Front End Loader Under 1 CU Yard; Heavy Duty Drills; Herman Nelson Heater; Mulching Machine; Oiler, All Except Cranes & Shovels; Pumpman

GROUP 2: Air Doctor; Backhoe/Excavator/Shovel to and including 3 CU Yard; Bit Grinder; Bituminous Paving Travel Plant; Boring Machine Large; Broom, Self-Propelled; Concrete Travel Batcher; Concrete Float & Spreader; Concrete Bucket Dispatcher;

Concrete Finish Machine; Concrete Conveyor; Distributor; Dozer; Rubber-Tired, Push & Side Boom; Elevating Grader/Gradall; Field Equipment Serviceman; Front End Loader 1 CU Yard to including 5 CU Yard; Grade Setter; Heavy Duty Drills, All Types;

Hoist/Tugger, All; Hydralift & Similar; Industrial Locomotive; Motor Patrol, Except Finish; Mountain Skidder; Oiler - Cranes & Shovels; Pavement Breaker, EMSCO; Power Saw, Self-Propelled; Pugmill; Pumpcrete/Grout Machine; Punch Truck; Roller, Other Than Asphalt; Roller, Sheepsfoot, Self-Propelled; Roller, 25 Tons and Over; Ross Carrier; Rotomill Under 6 Ft; Trenching Machine; Washing/Screening Plant

GROUP 3: Asphalt Paving Machine; Asphalt Screed; Backhoe/Excavator/Shovel Over 3 CU Yard; Cableway Highline; Concrete Batch Plant; Concrete Curing Machine; Concrete Pump; Cranes; Creter; Cranes, Electric Overhead; Cranes 24 Tons and Under; Curb Machine/Slip Form Paver; Finish Dozer; Front End

Loader Over 5 CU Yard; Mechanic/Welder; Pioneer Dozer; Roller Asphalt (Breakdown & Finish); Rotomill, Over 6 FT; Scraper, Single, Twin or Pulling Belly Dump; Yo-Yo Cat

GROUP 4: Asphalt/Hot Plant Operator, Cranes, 25 Tons to 44 Tons; Crusher Operator; Finish Motor Patrol; Finish Scraper

GROUP 5: Cranes, 45 Tons To Including 74 Tons

GROUP 6: Cranes, 75 Tons To Including 149 Tons; Crane, Whirley (All)

GROUP 7: Cranes, 150 Tons To Including 250 Tons (Add $ 1.00 For Every 100 Tons Over 250 Tons; Crane, Tower (All)

POWER EQUIPMENT OPERATOR ZONE PAY:

The hourly wage rates applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Court House of the following cities only to the center of the job:

BILLINGS, BOZEMAN, BUTTE, GREAT FALLS, HELENA, KALISPELL, MISSOULA

ZONE 1: 0 to 25 miles - Free

ZONE 2: 25 to 50 miles - Base Pay +$2.50

ZONE 3: Over 50 miles - Base Pay +$3.00

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

TRUCK DRIVER		
Group 1.....	$ 22.39	10.16
Group 2.....	$ 28.06	10.16

GROUP 1: Pilot Car

GROUP 2: Combination Truck and Concrete Mixer and Transit Mixer; Dry Batch Trucks; Distributor Driver; Dumpman; Dump Trucks and Similar Equipment; Dumpster; Flat Trucks; Lumber Carriers; Lowboys; Pickup; Powder Truck Driver; Power Boom; Serviceman; Service Truck/Fuel Truck/ Tireperson; Truck Mechanic; Trucks With Power Equipment; Warehouseman, Partsman, Cardex and Warehouse Expeditor; Water Trucks

TRUCK DRIVER ZONE PAY:

The hourly wage rates applicable to each project shall be determined by measuring the road miles over the shortest practical maintained route from the County Court House of the following cities only to the center of the job:

BILLINGS, BOZEMAN, BUTTE, GREAT FALLS, HELENA, KALISPELL, MISSOULA

ZONE 1: 0 to 25 miles - Free

ZONE 2: 25 to 50 miles - Base Pay +$2.50

ZONE 3: Over 50 miles - Base Pay +$3.00

The agency shall calculate the mileage and include it in the special provisions of the bid documents and awarded contract

---

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

==========

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after

award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and

the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can

be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==========

END OF GENERAL DECISION
"

MONTANA
PREVAILING WAGE RATES FOR HEAVY CONSTRUCTION SERVICES 2019

Effective: January 26, 2019

Steve Bullock, Governor
State of Montana

Galen Hollenbaugh, Commissioner
Department of Labor and Industry

To obtain copies of prevailing wage rate schedules, or for information relating to public works projects and payment of prevailing wage rates, visit ERD at www.mtwagehourbopa.com or contact:

Employment Relations Division
Montana Department of Labor and Industry
P. O. Box 201503
Helena, MT 59620-1503
Phone 406-444-5600
TDD 406-444-5549

The department welcomes questions, comments, and suggestions from the public. In addition, we'll do our best to provide information in an accessible format, upon request, in compliance with the Americans with Disabilities Act.

MONTANA PREVAILING WAGE REQUIREMENTS

The Commissioner of the Department of Labor and Industry, in accordance with Sections 18-2-401 and 18-2-402 of the Montana Code Annotated (MCA), has determined the standard prevailing rate of wages for the occupations listed in this publication.

The wages specified herein control the prevailing rate of wages for the purposes of Section 18-2-401, et seq., MCA. It is required each employer pay (as a minimum) the rate of wages, including fringe benefits, travel allowance, zone pay and per diem applicable to the district in which the work is being performed as provided in the attached wage determinations.

All Montana Prevailing Wage Rates are available on the internet at www.mtwagehourbopa.com or by contacting the department at (406) 444-6543.

In addition, this publication provides general information concerning compliance with Montana's Prevailing Wage Law and the payment of prevailing wages. For detailed compliance information relating to public works contracts and payment of prevailing wage rates, please consult the regulations on the internet at www.mtwagehourbopa.com or contact the department at (406) 444-6543.

GALEN HOLLENBAUGH
Commissioner
Department of Labor and Industry
State of Montana

TABLE OF CONTENTS

MONTANA PREVAILING WAGE REQUIREMENTS:

WAGE RATES:

A. Date of Publication January 26 2019

B. Definition of Heavy Construction
The Administrative Rules of Montana (ARM), 24.17.501(4) – (4)(a), states *"Heavy construction projects include, but are not limited to, those projects that are not properly classified as either 'building construction', or 'highway construction.'*

Heavy construction projects include, but are not limited to, antenna towers, bridges (major bridges designed for commercial navigation), breakwaters, caissons (other than building or highway), canals, channels, channel cut-offs, chemical complexes or facilities (other than buildings), cofferdams, coke ovens, dams, demolition (not incidental to construction), dikes, docks, drainage projects, dredging projects, electrification projects (outdoor), fish hatcheries, flood control projects, industrial incinerators (other than building), irrigation projects, jetties, kilns, land drainage (not incidental to other construction), land leveling (not incidental to other construction), land reclamation, levees, locks and waterways, oil refineries (other than buildings), pipe lines, ponds, pumping stations (prefabricated drop-in units – not buildings), railroad construction, reservoirs, revetments, sewage collection and disposal lines, sewers (sanitary, storm, etc.), shoreline maintenance, ski tows, storage tanks, swimming pools (outdoor), subways (other than buildings), tipples, tunnels, unsheltered piers and wharves, viaducts (other than highway), water mains, waterway construction, water supply lines (not incidental to building), water and sewage treatment plants (other than buildings) and wells."

C. Definition of Public Works Contract
Section 18-2-401(11)(a), MCA defines "public works contract" as *"…a contract for construction services let by the state, county, municipality, school district, or political subdivision or for nonconstruction services let by the state, county, municipality, or political subdivision in which the total cost of the contract is in excess of $25,000..."*.

D. Prevailing Wage Schedule
This publication covers only Heavy Construction occupations and rates in the specific localities mentioned herein. These rates will remain in effect until superseded by a more current publication. Current prevailing wage rate schedules for Building Construction, Highway Construction and Nonconstruction Services occupations can be found on the internet at www.mtwagehourbopa.com or by contacting the department at (406) 444-6543.

E. Rates to Use for Projects
ARM, 24.17.127(1)(c), states *"The wage rates applicable to a particular public works project are those in effect at the time the bid specifications are advertised."*

F. Wage Rate Adjustments for Multiyear Contracts
Section 18-2-417, MCA states:

"(1) Any public works contract that by the terms of the original contract calls for more than 30 months to fully perform must include a provision to adjust, as provided in subsection (2), the standard prevailing rate of wages to be paid to the workers performing the contract.

(2) The standard prevailing rate of wages paid to workers under a contract subject to this section must be adjusted 12 months after the date of the award of the public works contract. The amount of the adjustment must be a 3% increase. The adjustment must be made and applied every 12 months for the term of the contract.

(3) Any increase in the standard rate of prevailing wages for workers under this section is the sole responsibility of the contractor and any subcontractors and not the contracting agency."

G. Fringe Benefits
Section 18-2-412, MCA states:

"(1) To fulfill the obligation...a contractor or subcontractor may:

(a) pay the amount of fringe benefits and the basic hourly rate of pay that is part of the standard prevailing rate of wages directly to the worker or employee in cash;

(b) make an irrevocable contribution to a trustee or a third person pursuant to a fringe benefit fund, plan, or program that meets the requirements of the Employee Retirement Income Security Act of 1974 or that is a bona fide program approved by the U. S. department of labor; or

(c) make payments using any combination of methods set forth in subsections (1)(a) and (1)(b) so that the aggregate of payments and contributions is not less than the standard prevailing rate of wages, including fringe benefits and travel allowances, applicable to the district for the particular type of work being performed.

(2) The fringe benefit fund, plan, or program described in subsection (1)(b) must provide benefits to workers or employees for health care, pensions on retirement or death, life insurance, disability and sickness insurance, or bona fide programs that meet the requirements of the Employee Retirement Income Security Act of 1974 or that are approved by the U. S. department of labor."

Fringe benefits are paid for all hours worked (straight time and overtime hours). However, fringe benefits are not to be considered a part of the hourly rate of pay for calculating overtime, unless there is a collectively bargained agreement in effect that specifies otherwise.

H. Dispatch City
ARM, 24.17.103(11), defines dispatch city as *"...the courthouse in the city from the following list which is closest to the center of the job: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, and Missoula."*

I. Zone Pay
Zone pay is not travel pay. ARM, 24.17.103(24), defines zone pay as *"...an amount added to the base pay; the combined sum then becomes the new base wage rate to be paid for all hours worked on the project. Zone pay must be determined by measuring the road miles one way over the shortest practical maintained route from the dispatch city to the center of the job."* See section H above for a list of dispatch cities.

J. Computing Travel Benefits
ARM, 24.17.103(22), states *" 'Travel pay,' also referred to as 'travel allowance,' is and must be paid for travel both to and from the job site, except those with special provisions listed under the classification. The rate is determined by measuring the road miles one direction over the shortest practical maintained route from the dispatch city or the employee's home, whichever is closer, to the center of the job."* See section H above for a list of dispatch cities.

K. Per Diem
ARM, 24.17.103(18), states *" 'Per diem' typically covers costs associated with board and lodging expenses. Per diem is paid when an employee is required to work at a location outside the daily commuting distance and is required to stay at that location overnight or longer."*

L. Apprentices
Wage rates for apprentices registered in approved federal or state apprenticeship programs are contained in those programs. Additionally, Section 18-2-416(2), MCA states, *"...The full amount of any applicable fringe benefits must be paid to the apprentice while the apprentice is working on the public works contract."* Apprentices not registered in approved federal or state apprenticeship programs will be paid the appropriate journey level prevailing wage rate when working on a public works contract.

M. Posting Notice of Prevailing Wages
Section 18-2-406, MCA, provides that contractors, subcontractors, and employers who are *"...performing work or providing construction services under public works contracts, as provided in this part, shall post in a prominent and accessible site on the project or staging area, not later than the first day of work and continuing for the entire duration of the project, a legible statement of all wages and fringe benefits to be paid to the employees."*

N. Employment Preference
Sections 18-2-403 and 18-2-409, MCA require contractors to give preference to the employment of bona fide Montana residents in the performance of work on public works contracts.

O. Projects of a Mixed Nature
Section 18-2-408, MCA states:

"(1) The contracting agency shall determine, based on the preponderance of labor hours to be worked, whether the public works construction services project is classified as a highway construction project, a heavy construction project, or a building construction project.

(2) Once the project has been classified, employees in each trade classification who are working on that project must be paid at the rate for that project classification"

P. Occupations Definitions
You can find definitions for these occupations on the following Bureau of Labor Statistics website:
http://www.bls.gov/oes/current/oes_stru.htm

Q. Welder Rates
Welders receive the rate prescribed for the craft performing an operation to which welding is incidental.

R. Foreman Rates
Rates are no longer set for foremen. However, if a foreman performs journey level work, the foreman must be paid at least the journey level rate.

S. Proper Classification for Pipefitter and Laborer/Pipelayer Work on Water and Waste Water Treatment Plants
The proper classification for the following work is Pipefitter, when it is performed inside a building structure or performed at a location which will later be inside of a building: Joining steel pipe larger than 12 inches in diameter with bolted flange connections that has been pre-fabricated off site and does not require any modification such as cutting, grinding, welding, or other fabrication in order to be installed. All other work previously classified as pipefitter remains in that classification. The proper classification for that work when it is at a location that will always be outside a building is Pipelayer, which is under the Laborer Group 3 classification.

WAGE RATES

BOILERMAKERS

Wage	Benefit
$32.19	$30.61

Duties Include:
Construct, assemble, maintain, and repair stationary steam boilers, boiler house auxiliaries, process vessels, pressure vessels and penstocks. Bulk storage tanks and bolted steel tanks.

Travel:
0-120 mi. free zone
>120 mi. federal mileage rate/mi.

Special Provision:
Travel is paid only at the beginning and end of the job.

Per Diem:
0-70 mi. free zone
>70-120 mi. $65.00/day
>120 mi. $80.00/day

↑ Back to Table of Contents

BRICK, BLOCK, AND STONE MASONS

Wage	Benefit
$33.68	$14.89

Travel:
0-20 mi. free zone
>20-35 mi. $30.00/day
>35-55 mi. $35.00/day
>55 mi. $65.00/day

↑ Back to Table of Contents

CARPENTERS

Wage	Benefit
$30.00	$13.07

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

CEMENT MASONS AND CONCRETE FINISHERS

Wage	Benefit
$22.21	$12.18

Duties Include:
Smooth and finish surfaces of poured concrete, such as floors, walks, sidewalks, or curbs. Align forms for sidewalks, curbs, or gutters.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $2.95/hr.
>60 mi. base pay + $4.75/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 1

Wage	Benefit
$27.41	$13.25

This group includes but is not limited to:
Air Compressor; Auto Fine Grader; Belt Finishing; Boring Machine (Small); Cement Silo; Crane, A-Frame Truck Crane; Crusher Conveyor; DW-10, 15, and 20 Tractor Roller; Farm Tractor; Forklift; Form Grader; Front-End Loader, under 1 cu. yd; Oiler, Heavy Duty Drills; Herman Nelson Heater; Mucking Machine; Oiler, All Except Cranes/Shovels; Pumpman.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 2

Wage	Benefit
$28.20	$13.25

This group includes but is not limited to:
Air Doctor; Backhoe\Excavator\Shovel, up to and incl. 3 cu. yds; Bit Grinder; Bitunimous Paving Travel Plant; Boring Machine, Large; Broom, Self-Propelled; Concrete Travel Batcher; Concrete Float & Spreader; Concrete Bucket Dispatcher; Concrete Finish Machine; Concrete Conveyor; Distributor; Dozer, Rubber-Tired, Push, & Side Boom; Elevating Grader\Gradall; Field Equipment Serviceman; Front-End Loader, 1 cu. yd up to and incl. 5 cu. yds; Grade Setter; Gravel Conveyor; Heavy Duty Drills, All Types; Hoist\Tugger, All; Hydralift Forklifts & Similar; Industrial Locomotive; Motor Patrol (except finish); Mountain Skidder; Oiler, Cranes\Shovels; Pavement Breaker, EMSCO; Power Saw, Self-Propelled; Pugmill; Pumpcrete\Grout Machine; Punch Truck; Roller, other than Asphalt; Roller, Sheepsfoot (Self-Propelled); Roller, 25 tons and over; Ross Carrier; Rotomill, under 6 ft; Trenching Machine; Washing /Screening Plant

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 3

Wage	Benefit
$28.95	$13.25

This group includes but is not limited to:
Asphalt Paving Machine; Asphalt Screed; Backhoe\Excavator\Shovel, over 3 cu. yds; Cableway Highline; Concrete Batch Plant; Concrete Curing Machine; Concrete Pump; Cranes, Creter; Cranes, Electric Overhead; Cranes, 24 tons and under; Curb Machine\Slip Form Paver; Finish Dozer; Front-End Loader, over 5 cu. yds; Mechanic\Welder; Pioneer Dozer; Roller Asphalt (Breakdown & Finish); Rotomill, over 6 ft; Scraper, Single, Twin, or Pulling Belly-Dump; YO-YO Cat.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 4

Wage	Benefit
$29.95	$13.25

This group includes but is not limited to:
Asphalt\Hot Plant Operator; Cranes, 25 tons up to and incl. 44 tons; Crusher Operator; Finish Motor Patrol; Finish Scraper.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 5

Wage	Benefit
$30.95	$13.25

This group includes but is not limited to:
Cranes, 45 tons up to and incl. 74 tons.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 6

Wage	Benefit
$31.95	$13.25

This group includes but is not limited to:
Cranes, 75 tons up to and incl. 149 tons; Cranes, Whirley (All).

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 7

Wage	Benefit
$32.95	$13.25

This group includes but is not limited to:
Cranes, 150 tons up to and incl. 250 tons; Cranes, over 250 tons—add $1.00 for every 100 tons over 250 tons; Crane, Tower (All); Crane Stiff-Leg or Derrick; Helicopter Hoist.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

↑ Back to Table of Contents

CONSTRUCTION LABORERS GROUP 1/FLAG PERSON FOR TRAFFIC CONTROL

Wage	Benefit
$21.58	$9.22

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.05/hr.
>60 mi. base pay + $4.85/hr.

↑ Back to Table of Contents

CONSTRUCTION LABORERS GROUP 2

Wage	Benefit
$24.40	$9.22

This group includes but is not limited to:
General Labor; Asbestos Removal; Burning Bar; Bucket Man; Carpenter Tender; Caisson Worker; Cement Mason Tender; Cement Handler (dry); Chuck Tender; Choker Setter; Concrete Worker; Curb Machine-lay Down; Crusher and Batch Worker; Heater Tender; Fence Erector; Landscape Laborer; Landscaper; Lawn Sprinkler Installer; Pipe Wrapper; Pot Tender; Powderman Tender; Rail and Truck Loaders and Unloaders; Riprapper; Sign Erection; Guardrail and Jersey Rail; Spike Driver; Stake Jumper; Signalman; Tail Hoseman; Tool Checker and Houseman and Traffic Control Worker. See, Section S.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.05/hr.
>60 mi. base pay + $4.85/hr.

↑ Back to Table of Contents

CONSTRUCTION LABORERS GROUP 3

Wage	Benefit
$24.54	$9.22

This group includes but is not limited to:
Concrete Vibrator; Dumpman (Grademan); Equipment Handler; Geotextile and Liners; High-Pressure Nozzleman; Jackhammer (Pavement Breaker) Non-Riding Rollers; Pipelayer; Posthole Digger (Power); Power Driven Wheelbarrow; Rigger; Sandblaster; Sod Cutter-Power and Tamper.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.05/hr.
>60 mi. base pay + $4.85/hr.

↑ Back to Table of Contents

CONSTRUCTION LABORERS GROUP 4

Wage	Benefit
$25.26	$9.22

This group includes but is not limited to:
Hod Carrier*******; Water Well Laborer; Blaster; Wagon Driller; Asphalt Raker; Cutting Torch; Grade Setter; High-Scaler; Power Saws (Faller & Concrete); Powderman; Rock & Core Drill; Track or Truck Mounted Wagon Drill and Welder incl. Air Arc

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $3.05/hr.
>60 mi. base pay + $4.85/hr.

↑ Back to Table of Contents

DIVERS

	Wage	Benefit
Stand-By	$38.76	$16.40
Diving	$77.52	$16.40

Depth Pay (Surface Diving)

0-20 ft.	free zone
>20-100 ft.	$2.00 per ft.
>100-150 ft.	$3.00 per ft.
>150-220 ft.	$4.00 per ft.
>220 ft.	$5.00 per ft.

Diving In Enclosures

0-25 ft.	free zone
>25-300 ft.	$1.00 per ft.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

DIVER TENDERS

Wage	Benefit
$37.76	$16.40

The tender shall receive 2 hours at the straight time pay rate per shift for dressing and/or undressing a Diver when work is done under hyperbaric conditions.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

ELECTRICIANS

Wage	Benefit
$34.08	$14.59

Travel:
No mileage due when traveling in employer's vehicle.

The following travel allowance is applicable when traveling in employee's vehicle:

0-18 mi. free zone
>18-60 mi. federal mileage rate/mi.
>60 mi. $75.00/day

↑ Back to Table of Contents

HEATING AND AIR CONDITIONING

Wage	Benefit
$29.62	$18.00

Duties Include:
Testing and balancing, commissioning and retro-commissioning of all air-handling equipment and duct work.

Travel:
0-50 mi. free zone
>50 mi.
- $0.25/mi. in employer vehicle.
- $0.65/mi. in employee vehilcle.

Per Diem:
$70/day

↑ Back to Table of Contents

INSULATION WORKERS - MECHANICAL (HEAT AND FROST)

Wage	Benefit
$36.67	$19.47

Duties Include:
Insulate pipes, ductwork or other mechanical systems.

Travel:
0-30 mi. free zone
>30-40 mi. $20.00/day
>40-50 mi. $30.00/day
>50-60 mi. $40.00/day
>60 mi. $45.00/day plus
- $0.56/mi. if transportation is not provided.
- $0.20/mi. if in company vehicle.

>60 mi. $86.00/day on jobs requiring an overnight stay plus
- $0.56/mi. if transportation is not provided.
- $0.20/mi. if in company vehicle.

↑ Back to Table of Contents

IRONWORKERS - STRUCTURAL STEEL AND REBAR PLACERS

Wage	Benefit
$27.75	$25.45

Duties Include:
Structural steel erection; assemble prefabricated metal buildings; cut, bend, tie, and place rebar; energy producing windmill type towers; metal bleacher seating; handrail fabrication and ornamental steel.

Travel:
0-45 mi. free zone
>45-60 mi. $40.00/day
>60-100 mi. $65.00/day
>100 mi. $85.00/day

Special Provision:
When the employer provides transportation, travel will not be paid. However, when an employee is required to travel over 70 miles one way, the employee may elect to receive the travel pay in lieu of the transportation.

↑ Back to Table of Contents

LINE CONSTRUCTION – EQUIPMENT OPERATORS

Wage	Benefit
$35.04	$14.58

Duties Include:
All work on substations

Travel:
No Free Zone
$60.00/day

↑ Back to Table of Contents

LINE CONSTRUCTION – GROUNDMAN

Wage	Benefit
$27.35	$13.70

Duties Include:
All work on substations

Travel:
No Free Zone
$60.00/day

↑ Back to Table of Contents

LINE CONSTRUCTION – LINEMAN

Wage	Benefit
$45.74	$15.89

Duties Include:
All work on substations

Travel:
No Free Zone
$60.00/day

↑ Back to Table of Contents

MILLWRIGHTS

Wage	Benefit
$33.00	$13.07

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

PAINTERS

Wage	Benefit
$26.08	$16.17

Travel:
No mileage due when traveling in employer's vehicle.

The following travel allowance is applicable when traveling in employee's vehicle:

No free zone.
$0.60/mi.

Per Diem:
$80.00/day

↑ Back to Table of Contents

PILE BUCKS

Wage	Benefit
$30.00	$13.07

Duties Include:
Set up crane; set up hammer; weld tips on piles; set leads; insure piles are driven straight with the use of level or plum bob. Give direction to crane operator as to speed, and direction of swing. Cut piles to grade.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

PLUMBERS, PIPEFITTERS, AND STEAMFITTERS

Wage	Benefit
$35.66	$18.36

Duties Include:
Assemble, install, alter, and repair pipe-lines or pipe systems that carry water, steam, air, other liquids or gases. Testing of piping systems, commissioning and retro-commissioning. Workers in this occupation may also install heating and cooling equipment and mechanical control systems. See, Section S.

Travel:
0-70 free zone
>70 mi.

- On jobs when employees do not work consecutive days: $0.55/mi. if employer doesn't provide transportation. Not to exceed two trips.
- On jobs when employees work any number of consecutive days: $100.00/day.

↑ Back to Table of Contents

SHEET METAL WORKERS

Wage	Benefit
$29.62	$18.00

Duties Include:
Testing and balancing, commissioning and retro-commissioning of all air-handling equipment and duct work. Manufacture, fabrication, assembling, installation, dismantling, and alteration of all HVAC systems, air conveyer systems, and exhaust systems. All lagging over insulation and all duct lining.

Travel:
0-50 mi. free zone
>50 mi.

- $0.25/mi. in employer vehicle
- $0.65/mi. in employee vehicle

Per Diem:
$70.00/day

↑ Back to Table of Contents

SOLAR PHOTOVOLTAIC INSTALLERS

Wage	Benefit
$33.58	$14.56

Travel:
No mileage due when traveling in employer's vehicle.

The following travel allowance is applicable when traveling in employee's vehicle:

0-08 mi. free zone
>08-50 mi. federal mileage rate/mi. in excess of the free zone.
>50 mi. $66.00/day

↑ Back to Table of Contents

TRUCK DRIVERS

Pilot Car Driver
No Rate Established

	Wage	Benefit
Truck Driver	$28.88	$9.37

Group 2:
Combination Truck and Concrete Mixer and Transit Mixer; Dry Batch Trucks; Distributor Driver; Dumpman; Dump Trucks and similar equipment; Dumpster; Flat Trucks; Lumber Carriers; Lowboys; Pickup; Powder Truck Driver; Power Boom; Serviceman; Service Truck/Fuel Truck/Tireperson; Truck Mechanic; Trucks with Power Equipment; Warehouseman, Partsman, Cardex and Warehouse Expeditor; Water Trucks.

Zone Pay:
All Districts
0-30 mi. free zone
>30-60 mi. base pay + $3.05/hr.
>60 mi. base pay + .$4.85/hr.

↑ Back to Table of Contents

MONTANA
PREVAILING WAGE RATES FOR HIGHWAY CONSTRUCTION SERVICES 2019

Effective: January 26, 2019

Steve Bullock, Governor
State of Montana

Galen Hollenbaugh, Commissioner
Department of Labor and Industry

To obtain copies of prevailing wage rate schedules, or for information relating to public works projects and payment of prevailing wage rates, visit ERD at www.mtwagehourbopa.com or contact:

Employment Relations Division
Montana Department of Labor and Industry
P. O. Box 201503
Helena, MT 59620-1503
Phone 406-444-6543

The department welcomes questions, comments, and suggestions from the public. In addition, we'll do our best to provide information in an accessible format, upon request, in compliance with the Americans with Disabilities Act.

MONTANA PREVAILING WAGE REQUIREMENTS

The Commissioner of the Department of Labor and Industry, in accordance with Sections 18-2-401 and 18-2-402 of the Montana Code Annotated (MCA), has determined the standard prevailing rate of wages for the occupations listed in this publication.

The wages specified herein control the prevailing rate of wages for the purposes of Section 18-2-401, et seq., MCA. It is required each employer pay (as a minimum) the rate of wages, including fringe benefits, travel allowance, zone pay and per diem applicable to the district in which the work is being performed as provided in the attached wage determinations.

All Montana Prevailing Wage Rates are available on the internet at www.mtwagehourbopa.com or by contacting the department at (406) 444-6543.

In addition, this publication provides general information concerning compliance with Montana's Prevailing Wage Law and the payment of prevailing wages. For detailed compliance information relating to public works contracts and payment of prevailing wage rates, please consult the regulations on the internet at www.mtwagehourbopa.com or contact the department at (406) 444-6543.

GALEN HOLLENBAUHG
Commissioner
Department of Labor and Industry
State of Montana

TABLE OF CONTENTS

MONTANA PREVAILING WAGE REQUIREMENTS:

WAGE RATES:

A. Date of Publication January 26 2019

B. Definition of Highway Construction
The Administrative Rules of Montana (ARM), 24.17.501(3) – (3)(a), states *"Highway construction projects include, but are not limited to, the construction, alteration, or repair of roads, streets, highways, runways, taxiways, alleys, trails, paths, and parking areas, bridges constructed or repaired in conjunction with highway work, and other similar projects not incidental to building construction or heavy construction.*

Highway construction projects include, but are not limited to, alleys, base courses, bituminous treatments, bridle paths, concrete pavement, curbs, excavation and embankment (for road construction), fencing (highway), grade crossing elimination (overpasses or underpasses), guard rails on highways, highway signs, highway bridges (overpasses, underpasses, grade separation), medians, parking lots, parkways, resurfacing streets and highways, roadbeds, roadways, runways, shoulders, stabilizing courses, storm sewers incidental to road construction, street paving, surface courses, taxiways, and trails."

C. Definition of Public Works Contract
Section 18-2-401(11)(a), MCA defines "public works contract" as *"…a contract for construction services let by the state, county, municipality, school district, or political subdivision or for nonconstruction services let by the state, county, municipality, or political subdivision in which the total cost of the contract is in excess of $25,000..."*.

D. Prevailing Wage Schedule
This publication covers only Highway Construction occupations and rates in the specific localities mentioned herein. These rates will remain in effect until superseded by a more current publication. Current prevailing wage rate schedules for Building Construction, Heavy Construction and Nonconstruction Services occupations can be found on the internet at www.mtwagehourbopa.com or by contacting the department at (406) 444-6543.

E. Rates to Use for Projects
ARM, 24.17.127(1)(c), states *"The wage rates applicable to a particular public works project are those in effect at the time the bid specifications are advertised."*

F. Wage Rate Adjustments for Multiyear Contracts
Section 18-2-417, MCA states:

"(1) Any public works contract that by the terms of the original contract calls for more than 30 months to fully perform must include a provision to adjust, as provided in subsection (2), the standard prevailing rate of wages to be paid to the workers performing the contract.

(2) The standard prevailing rate of wages paid to workers under a contract subject to this section must be adjusted 12 months after the date of the award of the public works contract. The amount of the adjustment must be a 3% increase. The adjustment must be made and applied every 12 months for the term of the contract.

(3) Any increase in the standard rate of prevailing wages for workers under this section is the sole responsibility of the contractor and any subcontractors and not the contracting agency."

G. Fringe Benefits
Section 18-2-412, MCA states:

"(1) To fulfill the obligation...a contractor or subcontractor may:

(a) pay the amount of fringe benefits and the basic hourly rate of pay that is part of the standard prevailing rate of wages directly to the worker or employee in cash;

(b) make an irrevocable contribution to a trustee or a third person pursuant to a fringe benefit fund, plan, or program that meets the requirements of the Employee Retirement Income Security Act of 1974 or that is a bona fide program approved by the U. S. department of labor; or

(c) make payments using any combination of methods set forth in subsections (1)(a) and (1)(b) so that the aggregate of payments and contributions is not less than the standard prevailing rate of wages, including fringe benefits and travel allowances, applicable to the district for the particular type of work being performed.

(2) The fringe benefit fund, plan, or program described in subsection (1)(b) must provide benefits to workers or employees for health care, pensions on retirement or death, life insurance, disability and sickness insurance, or bona fide programs that meet the requirements of the Employee Retirement Income Security Act of 1974 or that are approved by the U. S. department of labor."

Fringe benefits are paid for all hours worked (straight time and overtime hours). However, fringe benefits are not to be considered a part of the hourly rate of pay for calculating overtime, unless there is a collectively bargained agreement in effect that specifies otherwise.

H. Dispatch City
ARM, 24.17.103(11), defines dispatch city as *"...the courthouse in the city from the following list which is closest to the center of the job: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, and Missoula."*

I. Zone Pay
Zone pay is not travel pay. ARM, 24.17.103(24), defines zone pay as "...an amount added to the base pay; the combined sum then becomes the new base wage rate to be paid for all hours worked on the project. Zone pay must be determined by measuring the road miles one way over the shortest practical maintained route from the dispatch city to the center of the job." See section H above for a list of dispatch cities.

J. Computing Travel Benefits
ARM, 24.17.103(22), states *" 'Travel pay,' also referred to as 'travel allowance,' is and must be paid for travel both to and from the job site, except those with special provisions listed under the classification. The rate is determined by measuring the road miles one direction over the shortest practical maintained route from the dispatch city or the employee's home, whichever is closer, to the center of the job."* See section H above for a list of dispatch cities.

K. Per Diem
ARM, 24.17.103(18), states *" 'Per diem' typically covers costs associated with board and lodging expenses. Per diem is paid when an employee is required to work at a location outside the daily commuting distance and is required to stay at that location overnight or longer."*

L. Apprentices
Wage rates for apprentices registered in approved federal or state apprenticeship programs are contained in those programs. Additionally, Section 18-2-416(2), MCA states *"...The full amount of any applicable fringe benefits must be paid to the apprentice while the apprentice is working on the public works contract."* Apprentices not registered in approved federal or state apprenticeship programs will be paid the appropriate journey level prevailing wage rate when working on a public works contract.

M. Posting Notice of Prevailing Wages
Section 18-2-406, MCA, provides that contractors, subcontractors, and employers who are *"...performing work or providing construction services under public works contracts, as provided in this part, shall post in a prominent and accessible site on the project or staging area, not later than the first day of work and continuing for the entire duration of the project, a legible statement of all wages and fringe benefits to be paid to the employees."*

N. Employment Preference
Sections 18-2-403 and 18-2-409, MCA require contractors to give preference to the employment of bona fide Montana residents in the performance of work on public works contracts.

O. Projects of a Mixed Nature
Section 18-2-408, MCA states:

"(1) The contracting agency shall determine, based on the preponderance of labor hours to be worked, whether the public works construction services project is classified as a highway construction project, a heavy construction project, or a building construction project.

(2) Once the project has been classified, employees in each trade classification who are working on that project must be paid at the rate for that project classification"

P. Occupations Definitions
You can find definitions for these occupations on the following Bureau of Labor Statistics website:
http://www.bls.gov/oes/current/oes_stru.htm

Q. Welder Rates
Welders receive the rate prescribed for the craft performing an operation to which welding is incidental.

R. Foreman Rates
Rates are no longer set for foremen. However, if a foreman performs journey level work, the foreman must be paid at least the journey level rate.

WAGE RATES

BRICK, BLOCK, AND STONE MASONS

Wage	Benefit
$28.71	$14.79

Travel:
0-45 mi. free zone
>45-60 mi. $32.50/day
>60-90 mi. $62.00/day
>90 mi. $75.00/day

↑ Back to Table of Contents

CARPENTERS

Wage	Benefit
$33.00	$13.07

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

CEMENT MASONS AND CONCRETE FINISHERS

Wage	Benefit
$24.87	$12.18

Duties Include:
Smooth and finish surfaces of poured concrete, such as floors, walks, sidewalks, or curbs. Align forms for sidewalks, curbs, or gutters.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 1

Wage	Benefit
$26.52	$11.15

This group includes but is not limited to:
Air Compressor; Auto Fine Grader; Belt Finishing; Boring Machine (Small); Cement Silo; Crane, A-Frame Truck Crane; Crusher Conveyor; DW-10, 15, and 20 Tractor Roller; Farm Tractor; Forklift; Form Grader; Front-End Loader, under 1 cu. yd; Oiler, Heavy Duty Drills; Herman Nelson Heater; Mucking Machine; Oiler, All Except Cranes/Shovels; Pumpman.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 2

Wage	Benefit
$28.55	$11.15

This group includes but is not limited to:
Air Doctor; Backhoe\Excavator\Shovel, up to and incl. 3 cu. yds; Bit Grinder; Bitunimous Paving Travel Plant; Boring Machine, Large; Broom, Self-Propelled; Concrete Travel Batcher; Concrete Float & Spreader; Concrete Bucket Dispatcher; Concrete Finish Machine; Concrete Conveyor; Distributor; Dozer, Rubber-Tired, Push, & Side Boom; Elevating Grader\Gradall; Gravel Conveyor; Field Equipment Serviceman; Front-End Loader, 1 cu. yd up to and incl. 5 cu. yds; Grade Setter; Gravel Conveyor; Heavy Duty Drills, All Types; Hoist\Tugger, All; Hydralift Forklifts & Similar; Industrial Locomotive; Motor Patrol (except finish); Mountain Skidder; Oiler, Cranes\Shovels; Pavement Breaker, EMSCO; Power Saw, Self-Propelled; Pugmill; Pumpcrete\Grout Machine; Punch Truck; Roller, other than Asphalt; Roller, Sheepsfoot (Self-Propelled); Roller, 25 tons and over; Ross Carrier; Rotomill, under 6 ft; Trenching Machine; Washing /Screening Plant

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 3

Wage	Benefit
$29.41	$11.15

This group includes but is not limited to:
Asphalt Paving Machine; Asphalt Screed; Backhoe\Excavator\Shovel, over 3 cu. yds; Cableway Highline; Concrete Batch Plant; Concrete Curing Machine; Concrete Pump; Cranes, Creter; Cranes, Electric Overhead; Cranes, 24 tons and under; Curb Machine\Slip Form Paver; Finish Dozer; Front-End Loader, over 5 cu. yds; Mechanic\Welder; Pioneer Dozer; Roller Asphalt (Breakdown & Finish); Rotomill, over 6 ft; Scraper, Single, Twin, or Pulling Belly-Dump; YO-YO Cat.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 4

Wage	Benefit
$30.10	$11.15

This group includes but is not limited to:
Asphalt\Hot Plant Operator; Cranes, 25 tons up to and incl. 44 tons; Crusher Operator; Finish Motor Patrol; Finish Scraper.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 5

Wage	Benefit
$31.44	$11.15

This group includes but is not limited to:
Cranes, 45 tons up to and incl. 74 tons.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 6

Wage	Benefit
$32.13	$11.15

This group includes but is not limited to:
Cranes, 75 tons up to and incl. 149 tons; Cranes, Whirley (All).

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION EQUIPMENT OPERATORS GROUP 7

Wage	Benefit
$34.23	$11.15

This group includes but is not limited to:
Cranes, 150 tons up to and incl. 250 tons; Cranes, over 250 tons—add $1.00 for every 100 tons over 250 tons; Crane, Tower (All); Crane Stiff-Leg or Derrick; Helicopter Hoist.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION LABORERS GROUP 1/FLAG PERSON FOR TRAFFIC CONTROL

Wage	Benefit
$20.90	$9.65

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION LABORERS GROUP 2

Wage	Benefit
$23.97	$9.60

This group includes but is not limited to:
General Labor; Asbestos Removal; Burning Bar; Bucket Man; Carpenter Tender; Caisson Worker; Cement Mason Tender; Cement Handler (dry); Chuck Tender; Choker Setter; Concrete Worker; Curb Machine-lay Down; Crusher and Batch Worker; Heater Tender; Fence Erector; Landscape Laborer; Landscaper; Lawn Sprinkler Installer; Pipe Wrapper; Pot Tender; Powderman Tender; Rail and Truck Loaders and Unloaders; Riprapper; Sign Erection; Guardrail and Jersey Rail; Spike Driver; Stake Jumper; Signalman; Tail Hoseman; Tool Checker and Houseman and Traffic Control Worker.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION LABORERS GROUP 3

Wage	Benefit
$24.19	$9.60

This group includes but is not limited to:
Concrete Vibrator; Dumpman (Grademan); Equipment Handler; Geotextile and Liners; High-Pressure Nozzleman; Jackhammer (Pavement Breaker) Non-Riding Rollers; Pipelayer; Posthole Digger (Power); Power Driven Wheelbarrow; Rigger; Sandblaster; Sod Cutter-Power and Tamper.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

CONSTRUCTION LABORERS GROUP 4

	Wage	Benefit
	$25.18	$9.60

This group includes but is not limited to:
Hod Carrier***; Water Well Laborer; Blaster; Wagon Driller; Asphalt Raker; Cutting Torch; Grade Setter; High-Scaler; Power Saws (Faller & Concrete); Powderman; Rock & Core Drill; Track or Truck Mounted Wagon Drill and Welder incl. Air Arc.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

DIVERS

	Wage	Benefit
Stand-By	$38.76	$16.40
Diving	$77.52	$16.40

Depth Pay (Surface Diving)

0-20 ft.	free zone
>20-100 ft.	$2.00 per ft.
>100-150 ft.	$3.00 per ft.
>150-220 ft.	$4.00 per ft.
>220 ft.	$5.00 per ft.

Diving In Enclosures

0-25 ft.	free zone
>25-300 ft.	$1.00 per ft.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

DIVER TENDERS

	Wage	Benefit
	$37.76	$16.40

The tender shall receive 2 hours at the straight time pay rate per shift for dressing and/or undressing a Diver when work is done under hyperbaric conditions.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

ELECTRICIANS

Wage	Benefit
$33.58	$13.93

Travel:
No mileage due when traveling in employer's vehicle.

The following travel allowance is applicable when traveling in employee's vehicle:

0-18 mi. free zone
>18-60 mi. federal mileage rate/mi.
>60 mi. $75.00/day

↑ Back to Table of Contents

IRONWORKERS - STRUCTURAL STEEL AND REBAR PLACERS

Wage	Benefit
$27.75	$25.45

Duties Include:
Structural steel erection; assemble prefabricated metal buildings; cut, bend, tie, and place rebar; energy producing windmill type towers; metal bleacher seating; handrail fabrication and ornamental steel.

Travel:
0-45 mi. free zone
>45-60 mi. $40.00/day
>60-100 mi. $65.00/day
>100 mi. $85.00/day

Special Provision:
When the employer provides transportation, travel will not be paid. However, when an employee is required to travel over 70 miles one way, the employee may elect to receive the travel pay in lieu of the transportation.

↑ Back to Table of Contents

LINE CONSTRUCTION – EQUIPMENT OPERATORS

Wage	Benefit
$35.04	$14.58

Travel:
No Free Zone
$60.00/day

↑ Back to Table of Contents

LINE CONSTRUCTION – GROUNDMAN

Wage	Benefit
$27.35	$13.70

Travel:
No Free Zone
$60.00/day

↑ Back to Table of Contents

LINE CONSTRUCTION – LINEMAN

Wage	Benefit
$45.74	$15.76

Travel:
No Free Zone
$60.00/day

↑ Back to Table of Contents

MILLWRIGHTS

Wage	Benefit
$33.00	$13.07

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

PAINTERS

Wage	Benefit
$28.00	$10.30

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

↑ Back to Table of Contents

PILE BUCKS

Wage	Benefit
$30.00	$13.07

Duties Include:
Set up crane; set up hammer; weld tips on piles; set leads; insure piles are driven straight with the use of level or plum bob. Give direction to crane operator as to speed, and direction of swing. Cut piles to grade.

Zone Pay:
0-30 mi. free zone
>30-60 mi. base pay + $4.00/hr.
>60 mi. base pay + $6.00/hr.

↑ Back to Table of Contents

TRUCK DRIVERS

	Wage	Benefit
Pilot Car Driver	$22.39	$10.16
Truck Driver	$28.06	$10.16

Truck drivers include but are not limited to:
Combination Truck and Concrete Mixer and Transit Mixer; Dry Batch Trucks; Distributor Driver; Dumpman; Dump Trucks and similar equipment; Dumpster; Flat Trucks; Lumber Carriers; Lowboys; Pickup; Powder Truck Driver; Power Boom; Serviceman; Service Truck/Fuel Truck/Tireperson; Truck Mechanic; Trucks with Power Equipment; Warehouseman, Partsman, Cardex and Warehouse Expeditor; Water Trucks.

↑ Back to Table of Contents

Zone Pay:
All Districts
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + .$3.00/hr.

SECTION 00 90 00
FUNDING AGENCY SPECIAL PROVISIONS
MONTANA PUBLIC FACILITY PROJECTS

This section supplements Division 0 of the Montana Public Works Standard Specifications, Sixth Edition, dated April, 2010.

Included herein are supplemental general conditions that are required by Montana public facility funding programs or agencies listed in 1.1 below but are not included in the Montana Public Works Standard Specifications, Division 0.

ARTICLE 1. SPECIAL PROVISIONS

1.1 FUNDING AGENCIES

This project is being funded with funds from one or more of the following public facility funding programs or agencies:

Renewable Resource Grant and Loan Program
(RRGL) Treasure State Endowment Program
(TSEP)
~~United States Department of Agriculture Rural Development (USDA/RD) Community Development Block Grant Program (CDBG)~~
Drinking Water or Water Pollution Control State Revolving Fund Loan Program (SRF)

1.1.1 Applicable Funding Agency Special Provisions

In addition to Section 1.2 below, the following sections also apply as indicated:

_____ Section 1.3 (Additional USDA/RD Requirements)
_____ Section 1.4 (Additional CDBG Requirements)
__X__ Section 1.5 (Additional SRF Requirements)
__X__ Exhibit A (Project Sign Detail)
_____ Exhibit B (HUD Form 4010)
__X__ Exhibit C (Federal Labor Standards Provisions)
_____ Exhibit D (Reserved)
__X__ Exhibit E (American Iron and Steel Forms)

1.2 SPECIAL PROVISIONS FOR ALL FUNDING AGENCIES

The following requirements pertain to all of the funding programs or agencies listed in 1.01 above. If project funding sources include any of the programs or agencies listed, the following general requirements must be met in addition to those required in the Montana Public Works Standard Specifications, Division 0:

1.2.1 Reports, Information, and Access to Records

The contractor, at such times and in such form as required by the owner (defined herein as the entity for which the project is being constructed) shall furnish reports pertaining to the work or services undertaken pursuant to this contract, the costs and obligations incurred or to be incurred in connection therewith, and any other matters covered by this contract.

The owner and any federal, state or local governmental agency having a valid interest in this project shall be permitted by the contractor to have full access to and the right to examine pertinent documents of the contractor involving transactions related to this contract during the period of the project and for three (3) years from the date of final payment or until all findings have been resolved to the satisfaction of the funding agencies.

1.2.2 Contractor Eligibility and Certification Regarding Debarment

The contractor certifies that the contractor's firm and the firm's principals are not debarred, suspended, or otherwise ineligible to receive any Montana public works contracts or subcontracts pursuant to 18-2-432 (2), MCA.

For federally funded projects, the contractor certifies that the contractor's firm and the firm's principals are not debarred, suspended, voluntarily excluded, or otherwise ineligible for participation in federally assisted contracts under Executive Order 12549, "Debarment and Suspension" (24 CFR 24.505).

1.2.3 Contractor Registration and Worker's Compensation Requirements

Title 39, Chapter 9, Parts 1 and 2 MCA stipulate contractor registration requirements for the State of Montana. Pursuant to 39-9-201 MCA, each construction contractor must be registered with the Montana Department of Labor and Industry. In accordance with 39-9-102 MCA, "construction contractor" means a person, firm, or corporation that, in the pursuit of an independent business, offers to undertake, undertakes, or submits a bid for construction.

No bid shall be considered that does not carry the bidder's Montana Contractor's Registration Number on the bid form.

Registration forms and additional information may be obtained by contacting the Montana Department of Labor and Industry, 1805 Prospect Ave., P.O. Box 8011, Helena, MT 59604-8011, or by calling 406-444- 7734.

The contractor must provide certification that workers' compensation insurance will be maintained as required by the Montana Workers' Compensation Act (39-71-101 MCA).

1.2.4 Minimum Wage Requirements

Unless superseded by federal law, 18-2-401 MCA and 18-2-402 MCA require that each employer pay, as a minimum, the rate of wages, including fringe benefits and zone pay applicable for the work being performed, as provided in the current Montana Prevailing Wage Requirements as determined by the Montana Department of Labor and Industry.

The current wage determination(s) must be included in the contract documents.

If the SRF Loan Program is funding the project in whole or in part, federal and state laws require that each employer pay, as a minimum, prevailing wages for each classification in accordance with the Federal Labor Standards Provisions (Davis-Bacon) **(Exhibit C)** or Montana Prevailing Wage Requirements, whichever is greater**.**

If the CDBG Program is funding the project in whole or in part, HUD Form 4010-Federal Labor

Standards Provisions **(Exhibit B)** must be included in the contract documents.

1.2.5 Compliance With State and Federal Laws and Regulations

All applicable laws, ordinances, rules and regulations of authorities having jurisdiction over construction of the project shall apply to the contract throughout.

The contractor must comply with all applicable state and federal occupational disease and health and safety laws and regulations.

1.2.6 Project Sign

All projects will have a sign erected at a prominent location near the major portion of the work in plain view of the general public prior to submittal of the first pay estimate. The sign will generally conform to the following:

"The CONTRACTOR, or such contractor as the ENGINEER may designate, when construction begins, shall erect a sign constructed of 4'X8'X¾" exterior plywood (A-B) and shall be supported by and bolted to two (2) 4"X4" posts with the bottom of the sign at a point at least two (2) feet above the ground line. The project sign shall be maintained in a good condition until project completion.

The sign will be edged, painted and lettered as shown on **Exhibit A**. The letters shall be approximately three
(3) inches in height.

The cost of the sign is incidental to the contract price. The sign shall remain the property of the owner.

A statement indicating all agencies participating in the financing of the project shall be included on the sign. The sign shall be subject to agency approval prior to being erected.

1.2.7 Gross Receipts Withholding Requirements

Pursuant to Section 15-50-206(2)(3), MCA, the owner is required to withhold one percent (1%) of all payments due the contractor and is required to transmit such moneys to the Montana Department of Revenue as part of the public contractor's license fee. In like fashion, the contractor is required to withhold one percent (1%) from payments to subcontractors.

1.2.8 Clean Air and Clean Water Acts, Executive Order 11738 and EPA Regulations:

If this Contract exceeds $100,000, Contractor shall comply with all applicable standards, orders or requirements issued under Section 306 of the Clean Air Act (42 USC 1857(h)); Section 508 of the Clean Water Act (33 USC 1368); Executive Order 11738; and Environmental Protection Agency Regulations (40 CFR Part 15).

1.3 ADDITIONAL SPECIAL PROVISIONS FOR USDA/RD (NA to this Project)

1.3.1 The following documents shall be attached to and made a condition of the contract documents for any project funded, in whole or in part, by Rural Development:

If the bid amount exceeds $10,000, signed Compliance Statement (RD 400-6). Refer to specific equal opportunity requirements set forth in paragraph 18.10 of the General Conditions;

If the bid amount exceeds $25,000, signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions (AD-1048); and

If the bid amount exceeds $100,000, signed RD Instruction 1940-Q, Exhibit A-1, Certification for Contracts, Grants, and Loans. Refer to paragraph 18.11 of the General Conditions.

1.3.2 Free and Open Competition

All procurement transactions will be conducted in a manner that provides maximum free and open competition. Examples of what are considered to be restrictive of competition include but are not limited to: employment preferences to Montana Bidders or Montana Contractors and Montana residents.

1.3.3 Contractor's Retainage

No payments will be made that would deplete the retainage nor place in escrow any funds that are required for retainage or invest the retainage for the benefit of the contractor.

1.4 ADDITIONAL SPECIAL PROVISIONS FOR CDBG (NA to this project)

1.4.1 Equal Employment Opportunity Provisions

a. Equal Employment Opportunity (Executive Order 11246). During the performance of this contract, the Contractor agrees as follows:

(i) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection of training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(ii) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

(iii) The contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the Department's contracting officer advising the labor union or workers' representative of the contractor's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(iv) The contractor will comply with all of the provision of Executive Order 11246 of September 24, 1965, and of the rules, regulations and relevant orders of the Secretary of Labor.

(v) The contractor will furnish all information and reports required by Executive Order 11246 of

September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records and accounts by the Department and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

(vi) In the event of the contractor's noncompliance with the non- discrimination clauses of this contract or with any of such rules, regulations or orders, this contract may be canceled, terminated or suspended in whole or in part and the contractor may be declared ineligible for further government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rules, regulations, or order of the Secretary of Labor, or as otherwise provided by law.

(vii) The contractor will include the provisions of paragraphs 1 through 7 in every subcontract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that each provision will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the Department may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, however, that in the event the contractor becomes involved in or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Department, the contractor may request the United States to enter into such litigation to protect the interest of the United States.

b. Title VII of the Civil Rights Act of 1964. Provides that no person shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.

c. Section 109 of the Housing and Community Development Act of 1974. "No person in the United States shall on the ground of race, color, national origin or sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity funded in whole or in part with funds available under this title. Any prohibition against discrimination on the basis of age under the Age Discrimination Act of 1975 or with respect to an otherwise qualified handicapped individual as provided in Section 504 of the Rehabilitation Act of 1973 shall also apply to any such program or activity."

d. Section 3 of the Housing and Community Development Act of 1968. The contractor will ensure that to the greatest extent feasible opportunities for training and employment arising in connection with this CDBG- assisted project will be extended to project area residents. Further, the contractor will, to the greatest extent feasible, utilize business concerns located in or substantially owned by residents of the project area, in the award of contracts and purchase of services and supplies.

e. Minority Business Enterprise. Under the provisions of Executive Order 11246 contractors on federally- funded projects are required to take affirmative steps to assure that minority businesses are used when possible as sources of supplies, equipment, construction and services. Additionally, the contractor must document all affirmative steps taken to solicit minority businesses and forward this documentation along with the names of the minority subcontractors and suppliers to the owner upon request.

f. Nondiscrimination Provision in all Public Contracts Pursuant to Section 49-3-207, MCA, the Contractor certifies that all hiring will be on the basis of merit and qualifications and there will be no

discrimination on the basis of race, color, religion, creed, political ideas, sex, age, marital status, physical or mental handicap, or national origin.

1.4.2 Uniform Federal Accessibility Standards (UFAS)

All design specifications for the construction of any building shall provide access to the physically handicapped in accordance with the Uniform Federal Accessibility Standards and HUD regulations 24 CFR Part 8, "Nondiscrimination Based on Handicap in Federally Assisted Programs and Activities of HUD".

1.4.3 Certification of Compliance with Federal Clean Air and Water Acts (Applicable to Federally Assisted Construction Contracts and Related Sub-Contracts Exceeding $100,000.)

During the performance of this contract, the contractor and all subcontractors shall comply with the requirements of the Clean Air Act, as amended, 42 USC 1857 et seq., the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq., and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR 15, as amended.

1.4.4 Preconstruction Conference

After the contract(s) have been awarded, but before the start of construction, a conference will be held for the purpose of discussion requirements on such matters as project supervision, coordination with city or county officials, on-site inspections, progress schedules and reports, payrolls, payments to contractors, contract change orders, insurance, safety and other items pertinent to the project. The contractor shall arrange to have all supervisory personnel connected with the project on hand to meet with representatives of the engineer and owner to discuss any problems anticipated.

1.4.5 Contract Pricing

The cost plus a percentage of cost method of contracting shall not be used.

1.5 ADDITIONAL SPECIAL PROVISIONS FOR SRF

1.5.1 Equal Employment Opportunity and Affirmative Action Requirements on Federally Assisted Construction Contracts

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation in each trade 2.7%

__ Goals for female participation in each trade 6.9%

These goals are applicable to all the contractor's construction work (whether or not it is Federal or

Federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from contractor to contractor or from project to project for the sole purpose of meeting the contractor's goals shall be a violation of the contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number for the subcontractor; employer identification number of the subcontractor, estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the contract is to be performed (see form on page 11).

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is the Missoula Economic Area.

This notice shall be included in, and shall be a part of, all solicitations for offers and bids on all federal and federally assisted construction contracts or subcontracts.

EQUAL OPPORTUNITY CLAUSE

The Equal Opportunity Clause published at 41 CFR Part 60-1.4(b) is required to be included in, and is part of, all nonexempt federally assisted construction contracts and subcontracts. The Equal Opportunity Clause shall be considered to be a part of every contract and subcontract required by the regulations in this part to include such a clause, whether or not it is physically incorporated in such contracts.

In addition to the clause described above, all federal contracting officers, all applicants, and all non-construction contractors, as applicable, shall include the specifications set forth in this section in all federal and federally assisted construction contracts in excess of $10,000 to be performed in geographical areas designated by the Director pursuant to §60-4.6 of this part and in construction subcontracts in excess of $10,000 necessary in whole or in part to the performance of non-construction Federal contracts and subcontracts covered under the Executive Order.

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS (EXECUTIVE ORDER 11246)

1. As used in these specifications:
a. "Covered Area" means the geographical area described in the solicitation from which this

contract resulted;
b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
c. "Employer identification number" means the Federal Social Security number used on the employer's quarterly Federal Tax Return, U.S. Treasury Department Form 941.
d. "Minority" includes:
(i)Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
(ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
(iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);
(iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area, (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The contractor shall implement the specific affirmative action standards provided in paragraphs (7)(a) through (p) of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the contractor should reasonably by able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the federal register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the contractor's employees are assigned to work. The contractor, where possible, will assign two or more women to each construction project. The contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off- the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the contractor by the union or, if referred, not employed by the contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

e. Develop on-the-job training opportunities and/or participate in training programs for the areas which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the contractor's employment needs, especially those programs funded or approved by the Department of Labor. The contractor shall provide notice of these programs to the sources compiled under (7)(b) above.

f. Disseminate the contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with

all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the contractor's EEO policy with other contractors and subcontractors with whom the contractor does or anticipates doing business.

i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a contractor's workforce.

k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisor's adherence to and performance

under the contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7)(a) through (p). The efforts of a contractor association, joint contractor- union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under (7)(a) through (p) of these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the contractor. The obligation to comply, however, is the contractor's and failure of such a group to fulfill an obligation shall not be a defense for the contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the contractor has achieved its goals for women generally, the contractor may be in violation of the Executive order if a specific minority group of women is under-utilized).

10. The contractor shall not use the goals and timetables of affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The contractor shall not enter into any subcontract with any person or firm debarred from government contracts pursuant to Executive Order 11246.

12. The contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph (7) of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was

performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program)

CONTRACTOR'S NAME, ADDRESS & TELEPHONE NUMBER

_____

_____

_____

_____

Return to:
USDOL/ESA/OFC
CP
Denver District Office
1999 Broadway-Suite
1177
P.O. BOX 46550
Denver, CO 80201-6550

CONTRACTOR' EMPLOYER ID NUMBER:_ _____

CONTRACT INFORMATION

PROJECT AND LOCATION:				
Dollar Amount of	Estimated Start Date	Estimated Completion Date	Contract No.	Geographical Area

NOTIFICATION OF SUBCONTRACTS AWARDED (>$10,000)

Subcontractors Name, Address, & Phone	Employer ID Number of	Estimated $ Amount of Subcontract	Estimated Start	Estimated Completion

1.5.2 Guidance for Participation By Disadvantaged Business (DBE) Enterprises In United States Environmental Protection Agency Programs of 40 CFR 33.

The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

A. REQUIREMENTS

1. The recipient and prime contractor will exercise good faith efforts to attract and utilize small, minority, and women's business (DBEs) enterprises primarily through outreach, recruitment, and race/gender neutral activities. At a minimum, the recipient and project bidders will follow the six affirmative steps below:

a. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities including placing DBEs on solicitation lists and soliciting them whenever they are potential sources;

b. Make information on forthcoming opportunities available to DBEs and arrange time frames and establish delivery schedules, when the requirements of the work permit, which will encourage participation by DBEs;

c. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs; including dividing total requirements, when economically feasible, into small tasks or quantities to permit maximum participation by DBEs;

d. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually;

e. Using the services of the Small Business Administration and the Office of Minority Business Enterprise of the U.S. Department of Commerce, as appropriate; and

f. Require a. through e. to be taken if subcontracts are awarded.

B. FAIR SHARE OBJECTIVE

1. The fair share objective for this project is 2 %MBE's and 3 % WBE's.

C. DEFINITIONS

1. Minority Business Enterprise (MBE) is a business concern which is:

a. Certified as socially and economically disadvantaged by the Small Business Administration;

(1) Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities.

(2) Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system is impaired due to diminished capital and credit opportunities, as compared to others in the same business area who are not socially disadvantaged. In determining the degree of diminished credit and capital opportunities, the Small Business Administration shall consider, but not be limited to, the assets and net worth of such socially disadvantaged individuals. Individuals who certify that they are members of named groups (Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Asian-Indian Americans), are to be considered socially and economically disadvantaged. Economically and

socially disadvantaged individuals are deemed to include women.

b. Certified as a minority business enterprise by a State or Federal agency; or

c. An independent business concern which is at least 51 percent owned and controlled by minority group member(s).

(1) A minority group member is an individual who is a citizen of the United States and one of the following:

(a) Black American:

(b) Hispanic American (with origins from Puerto Rico, Mexico, Cuba, South or Central America)

(c) Native American (American Indian, Eskimo, Aleut, native Hawaiian); or

(d) Asian-Pacific American (with origins from Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territories of the Pacific, Northern Marianas, Laos, Cambodia, Taiwan or the Indian subcontinent).

(2) In order to satisfy the third criteria of the MBE definition, the minority ownership's interest must be real, substantial and continuing. Such interest is characterized by:

(a) Risk of loss/share of profit commensurate with the proportional ownership; and

(b) Receipt of the customary incidents of ownership, such as compensation (i.e. salary and other personnel compensation).

(3) A minority owner must have and exercise control of the business decisions. Characteristics of control include, but are not limited to:

(a) Authority to sign bids and contracts;

(b) Decisions in price negotiations;

(c) Incurring liabilities for the firm;

(d) Final staffing decisions;

(e) Policy-making; and

(f) General company management decisions.

(4) Only those firms performing a useful business function according to custom and practice in the industry are qualified as MBEs. Acting merely as a passive conduit of funds to some other firm where such activity is unnecessary to accomplish the project does not constitute a "useful business function according to custom and practice in the industry." The purpose of this approach is to discourage the use of MBE "fronts" and limit the creation of an artificial supplier and broker marketplace.

2. Women's Business Enterprise (WBE) is a business which is certified as such by a State or Federal agency, or which meets the following definition:

"A women's business enterprise is an independent business concern which is at least 51 percent owned by a woman or women, who also control and operate it. Determination of whether a business is at least 51 percent owned by a woman or otherwise qualified WBE which is 51 percent owned by a married woman in a community property State will not be disqualified because her husband has a 50 percent interest in her share. Similarly, a business which is 51 percent owned by a married man and 49 percent owned by an unmarried woman will not become a qualified WBE by virtue of his wife's 50 percent interest in his share of the business."

As in the case of a MBE, only United States citizens will be deemed to be WBEs. Similar to the MBE criteria, WBE should meet the criteria cited in subparagraphs C.1.c.(2), (3), and (4).

3. Fair Share or Fair Share Objective A fair share or a fair share objective is an amount of funds

reasonably commensurate with the total project funding and the availability of qualified MBEs and WBEs, taking into account experience on EPA-funded projects and other comparable projects in the area. A fair share objective does not constitute an absolute requirement, but a commitment on the part of the bidder to exercise good faith *efforts* as defined in this section to use MBEs and WBEs to achieve the fair share objective.

4. Small Business (SBE). Any business entity, including its affiliates, that is independently owned and operated, and not dominant in its field of operations in which it is bidding on Government contracts, and qualified as a small business under the criteria and size standards set forth in 13 CFR Part 121.

5. Small Business in a Rural Area. A small business in a rural area (SBRA) is a business entity meeting the definition of a small business, and is located and conducts its principal operations in a geographical area (county) listed in the Small Business Administration's Listing of Non-Metropolitan Counties by State.

6. Recipient. A party receiving SRF financial assistance.

7. Project. The work financed through an SRF loan.

8. Bidder. A party seeking to obtain a contract with a recipient through a competitive, advertised, sealed bid process.

9. Offeror. A party seeking to obtain a contract with a recipient through a negotiative procurement process.

10. Prime Contractor. A party that has obtained a contract with a recipient through a competitive, advertised, sealed bid process.

11. Good Faith Efforts. Good faith efforts by a recipient, prime contractor, and/or bidder/offeror means efforts to attract and utilize SBEs, MBEs, and WBEs (DBEs) primarily through outreach, recruitment, and race/gender neutral activities. The following are examples of activities to assist recipients, prime contractors and/or bidders/offerors to comply with good faith efforts.

a. Include qualified SBEs, MBEs, and WBEs on solicitation lists.

(1) Maintain and update a listing of qualified SBEs, MBEs, and WBEs and SBRAs that can be solicited for supplies, construction and/or services.

(2) Provide listings to all interested parties who requested copies of the bidding or proposing documents.

(3) Contact appropriate sources within your geographic area and State to identify qualified MBEs and WBEs for placement on your minority and women's business listings.

(4) Utilize other MBE/WBE listings such as those of the State's Minority Business Office, the Small Business Administration, Minority Business Development Agency, US EPA- Office of Small and Disadvantaged Business Utilization (OSDBU) and the Department of Transportation.

(5) Have the State environmental agency personnel review this solicitation list.

b. Ensure that SBEs, MBEs, and WBEs are solicited.

(1) Conduct meetings, conferences, and follow-ups with SBEs, MBEs, WBEs, and SBRAs, small, minority and/or women's business associations, minority media, etc., to inform these groups of opportunities to provide supplies, services, and construction.

(2) MBE utilization is facilitated if the recipient or prime contractor advertises through the minority media. Such advertisements may include, but are not limited to, contracting and subcontracting opportunities, hiring and employment, or any other matter related to the project.

(3) Conduct pre bid, pre-solicitation, and post-award conferences to ensure that consultants, suppliers, and builders solicit SBEs, MBEs, WBEs, and SBRAs.

(4) Provide bidders and offerors with listings of qualified SBEs, MBEs, WBEs, and SBRAs and establish that a fair share of contracts/procurements should be awarded to these groups.

(5) Advertise in general circulation, trade publications, State agency publications of identified source, minority or women's business focused media, etc., concerning contracting opportunities on your projects. Maintain a list of minority or women's business-focused publications that may be utilized to solicit MBEs or WBEs.

(6) Provide interested SBEs, MBEs, WBEs, or SBRAs with adequate information about plans, specifications, timing and other requirements of the proposed projects.

(7) Provide SBE, SBRA, MBE or WBE trade organizations with succinct summaries of solicitations.

(8) Notify SBEs, MBEs, WBEs, or SBRAs of future procurement opportunities so that they may establish bidding solicitations and procurement plans.

c. Make information on forthcoming opportunities available to DBEs and arrange time frames and establish delivery schedules, where requirements of the work permit, which will encourage participation by SBEs, MBEs, WBEs and SBRAs.

(1) Consider lead times and scheduling requirements often needed by SBE, MBE, WBE or SBRA participation.

(2) Develop realistic delivery schedules which may provide for greater SBE, MBE, WBE or SBRA participation.

(3) Whenever possible, post solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date

d. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs; including dividing total requirements when economically feasible, into small tasks or quantities to permit maximum participation of SBEs, MBEs, WBEs and SBRAs.

(1) Perform an analysis to identify portions of work that can be divided and performed by qualified SBEs, MBEs, WBEs and SBRAs.

(2) Scrutinize the elements of the total project to develop economically feasible units of work that are within the bonding range of SBEs, MBEs, WBEs and SBRAs.

(3) Analyze bid packages for compliance with the good faith efforts to afford SBEs, MBEs, WBEs and SBRAs maximum participation.

(4) Encourage contracting with a consortium of SBEs, MBEs, WBEs, and SBRAs when a contract is too large for one of these firms to handle individually

e. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the US Department of Commerce, as appropriate.

(1) Use the services of outreach programs sponsored by the Minority Business Development Agency and/or the Small Business Administration to recruit bona fide firms for placement on SBEs', MBEs', WBEs', or SBRAs' bidders lists to assist these firms in the development of bid packaging.

(2) Seek out Minority Business Development Centers (MBDCs) to assist recipients and prime contractors in identifying MBEs for potential work opportunities on this project.

f. If the prime contractor awards subcontracts, require the prime contractor to take the steps in paragraphs a. through e. of this section.

D. ADDITIONAL CONTRACT PROVISIONS

1. The prime contractor must pay its subcontractors for satisfactory performance no more than 30 days from the prime contractor's receipt of payment from the owner.

2. The prime contractor must notify the owner in writing prior to any termination of a DBE subcontractor for convenience.

3. If a DBE subcontractor fails to complete work under the subcontract for any reason, the prime contractor must employ the six good faith efforts if soliciting a replacement subcontractor, even if the fair share objectives have already been achieved.

E. REPORTING

1. Bidders/offerors shall demonstrate compliance with "good faith" efforts in order to be deemed responsible.
   Efforts could include maintaining phone/mail logs (see attached MBE/WBE Subcontractor Solicitation Sheet), submitting proof of DBE solicitation advertisements, completion of the on-line DBE quote request form located at https://app.mdt.mt.gov/dbeqt/, etc.. The owner may specify other methods of demonstrating compliance.

2. Documentation of a "good faith" effort should be submitted with the bid, or within seven (7) calendar days of the bid opening.

MBE/WBE SUBCONTRACTOR SOLICITATION INFORMATION						
Name, Address & Phone No. of Subcontractor Contacted	Date Request for Quote Sent	Description of Work Offered	Date of Phone Follow-up & Person Contacted	Amount of Quote or Reason for Not Quoting*	Quote Accepted? If not, list reason for rejection	Indicate MBE, WBE, or other Subcontract

* - Use additional sheets if necessary.

The undersigned hereby certifies that the above information is true and correct:

Contractor:_____

By:_____ _____
Signature Title

Date:_____

1.5.3 Certification Regarding Debarment, Suspension and Other Responsibility Matters

A. INSTRUCTIONS

Under Executive Order 12549, an individual or organization debarred or excluded from participation in Federal assistance or benefit programs may not receive any assistance award under a Federal program, or a subagreement thereunder for $25,000 or more. The status of prospective individuals or organizations can be checked at:

https://www.sam.gov

A prospective prime contractor must submit a completed certification (see form on the following page) or explanation to the project owner for the project. Each prospective subcontractor must submit a completed certification or explanation to the prime contractor for the project.

B. HOW TO OBTAIN FORMS

Additional forms may be obtained from the State or may be reproduced.

SRF Project Number

United States Environmental Protection
Agency Washington, DC 20460

Certification Regarding Debarment, Suspension, and Other Responsibility Matters

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to $10,000 or imprisonment for up to 5 years, or both.

Typed Name & Title of Authorized Representative

Signature of Authorized Representative Date

_____I am unable to certify to the above statements. My explanation is attached.

1.5.4 Prohibition against Listed Violated Facilities

A. REQUIREMENTS

(1) To comply with all the requirements of section 114 of the Clean Air Act, as amended (42 U.S.C. 1857, et seq., as amended by Pub. L. 92-604) and section 308 of the Clean Water Act (33 U.S.C. 1251, as amended), respectively, which relate to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, respectively, and all regulations and guidelines issued thereunder before the award of this contract.

(2) That no portion of the work required by this prime contract will be performed in a facility listed on the Environmental Protection Agency list of violating facilities on the date when this contract was awarded unless and until the EPA eliminates the name of such facility or facilities from the listing.

(3) To use his best efforts to comply with clean air and clean water standards at the facilities in which the contract is being performed.

(4) To insert the substance of the provisions of this clause, including this paragraph (4), in any nonexempt subcontract.

B. DEFINITIONS

(1) Air Act means the Clean Air Act, as amended (42 U.S.C. 1857 et seq.).

(2) Water Act means the Clean Water Act, as amended (33 U.S.C. 1251 et seq.).

(3) Clean Air Standards means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted under the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 (d) of the Air Act (42 U.S.C. 1857c-5(d)), an approved implementation procedure or plan under section 111 (c) or section 111(d), or an approved implementation procedure under section 112(d) of the Air Act (42 U.S.C. 1857c-7(d)).

(4) Clean Water Standards means any enforceable limitation, control, condition, prohibition, standard, or other requirement which is promulgated under the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. 1342), or by a local government to ensure compliance with pretreatment regulations as required by section 307 of Water Act (33 U.S.C. 1317).

(5) Compliance means compliance with clean air or water standards. Compliance shall also mean compliance with a schedule or plan ordered or approved by a court of competent jurisdiction, the Environmental Protection Agency in accordance with the requirements of the Air Act or Water Act and regulations.

(6) Facility means any building, plant, installation, structure, mine, vessel, or other floating craft, location, or site of operations, owned, leased, or supervised by a contractor or subcontractor, to be used in the performance of a contract or subcontract. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location or site shall be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are located in one

geographical area.

1.5.5 Discovery of Archaeological and other Historical Items

In the event of an archaeological find during any phase of construction, the following procedure will be followed:

(1) Construction shall be halted, with as little disruption to the archaeological site as possible.

(2) The Contractor shall notify the Owner who shall contact the State Historical Preservation Officer.

(3) The State Historical Preservation Officer may decide to have an archaeologist inspect the site and make recommendations about the steps needed to protect the site, before construction is resumed.

(4) The entire event should be handled as expediently as possible in order to hold the loss in construction time to a minimum while still protecting archaeological finds.

A similar procedure should be followed with regard to more recent historical resources. Should any artifacts, housing sites, etc., be uncovered, the same procedure should be followed as for an archaeological find.

In the event archaeological/historical data are evaluated to meet National Register criteria, the Advisory Council on Historic Preservation may be notified and asked to comment.

1.5.6 Williams-Steiger Occupational Safety and Health Act of 1970

A. AUTHORITY

(1) The contractor is subject to the provisions of the Williams-Steiger Occupational Safety and Health Act of 1970.

(2) These construction documents and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of the Federal law(s) , including but not limited to the latest amendment of the following:

a. Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 94-596;

b. Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations;

c. Part 1926 - Safety and Health Regulations for Construction, Chapter XVII of Title 29, Code of Federal Regulations.

B. SAFETY AND HEALTH PROGRAM REQUIREMENTS

(1) This project, its prime contractor and its subcontractors, shall at all times be governed by Chapter XVII of Title 29, Code of Federal Regulations, Part 1926 - Safety and Health Regulations for Construction (29 CFR 22801), as amended to date.

(2) To implement the program and to provide safe and healthful working conditions for all persons, general project safety meetings will be conducted at the site at least once each month during the course of construction, by the construction superintendent or his/her designated safety officer. Notice of such meeting shall be issued not less than three (3) days prior, stating the exact time,

location, and agenda to be included. Attendance by the owner, architect, general foreman, shop steward(s), and trades, or their designated representatives, witnessed in writing as such, shall be mandatory.

(3) To further implement the program, each trade shall conduct a short gang meeting, not less than once a week, to review project safety requirements mandatory for all persons during the coming week. The gang foreman shall report the agenda and specific items covered to the project superintendent, who shall incorporate these items in his/her daily log or report.

(4) The prime contractor and all subcontractors shall immediately report all accidents, injuries, or health hazards to the owner and architect, or their designated representatives, in writing. This shall not obviate any mandatory reporting under the provisions of the Occupational Safety and Health Act of 1970.

(5) This program shall become a part of the contract documents and the contract between the owner and prime contractor, prime contractor and all subcontractors, as though fully written therein.

1.5.7 Wage Determination

The Contractor and all subcontractors shall pay for all labor employed at no less than the minimum standard prevailing rate of wages for each classification, which shall be the higher of either the Montana Prevailing Wage Rates or the Federal Davis-Bacon Prevailing Wage Rates.

Please refer to EXHIBIT C for Federal Labor Standards Provisions for Federally Assisted Construction Contracts.

If you have a question about complying with the prevailing wage regulations (occupations, payroll forms, payment of fringe benefits, travel or per diem, etc.), you should contact the Labor Standards Bureau Wage and Hour Unit of the Montana Department of Labor and Industry or visit their website: http://dli.mt.gov/

1.5.8 Access

1. The recipient must insure that representatives of the Environmental Protection Agency and the State will have access to project records and the project work whenever it is in preparation or progress and must provide proper facilities for such access and inspection. The recipient must allow the Regional Administrator, the Comptroller General of the United States, the State agency, or any authorized representative, to have access to any books, documents, plans, reports, papers, including records of contractors which are pertinent to the project for the purpose of making audit, examination, excerpts, copies, and transcriptions thereof. The recipient must insure that a party to a subagreement will afford access to such project work, sites, documents, and records.

1.5.9 Construction Site Erosion and Sediment Control Measures

Every effort shall be made by the contractors and subcontractors to prevent and correct problems associated with erosion and runoff processes which could occur during and after project construction. The efforts should be consistent with applicable local ordinances, the EPA Nonpoint Source Pollution Control Guidance and Department of Environmental Quality Stormwater Management Plan.

Wherever appropriate, the contractor's efforts shall reflect the following engineering principles:

1. When appropriate, land grading and excavating should be kept at a minimum to reduce the possibility of creating runoff and erosion problems which require extensive control measures.

2. Whenever possible, topsoil should be removed and stockpiled before grading begins.

3. Land exposure should be minimized in terms of area and time.

4. Exposed areas subject to erosion should be covered as quickly as possible by means of mulching or vegetation.

5. Natural vegetation should be retained whenever feasible.

6. Appropriate structural or agronomic practices to control runoff and sedimentation should be provided during and after construction.

7. Early completion of stabilized drainage systems (temporary and permanent systems) will substantially reduce erosion potential.

8. Roadways and parking lots should be paved or otherwise stabilized as soon as feasible.

9. Clearing and grading should not be started until a firm construction schedule is known and can be effectively coordinated with the grading and clearing activity.

1.5.10 American Iron and Steel (AIS) Requirements

On January 17, 2014, H.R. 3547, "Consolidated Appropriations Act, 2014," (Public Law 113-76, Section 436) was enacted. This law provides appropriations for both the Clean Water State Revolving Fund and the Drinking Water State Revolving Fund for federal fiscal year 2014, while adding an American iron and steel requirement to these already existing programs.

The Act includes a provision for "Use of American Iron and Steel," in Section 436(a)(1). None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products permanently incorporated in the project are produced in the United States.

The term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, rebar, and construction materials. The iron and steel products used in the project must comply with the American Iron and Steel requirements of Section 436 of the Consolidated Appropriations Act of 2014 (P.L. 113-76) and as further interpreted by applicable EPA guidance
(see http://water.epa.gov/grants_funding/aisrequirement.cfm).

AIS CERTIFICATION FORMS – The Contractor must ensure that all qualifying iron and steel components used in the project have met the AIS requirements. To verify AIS compliance, the Contractor must obtain a "Manufacturer Certification" form (or equivalent statement) from the product manufacturer. Upon completion of the project, the Contractor shall provide the Owner with the "Contractor Certification" form and copies of all "Manufacturer Certification" forms and/or

statements. The referenced certification forms are located in Exhibit E of Section 00900.

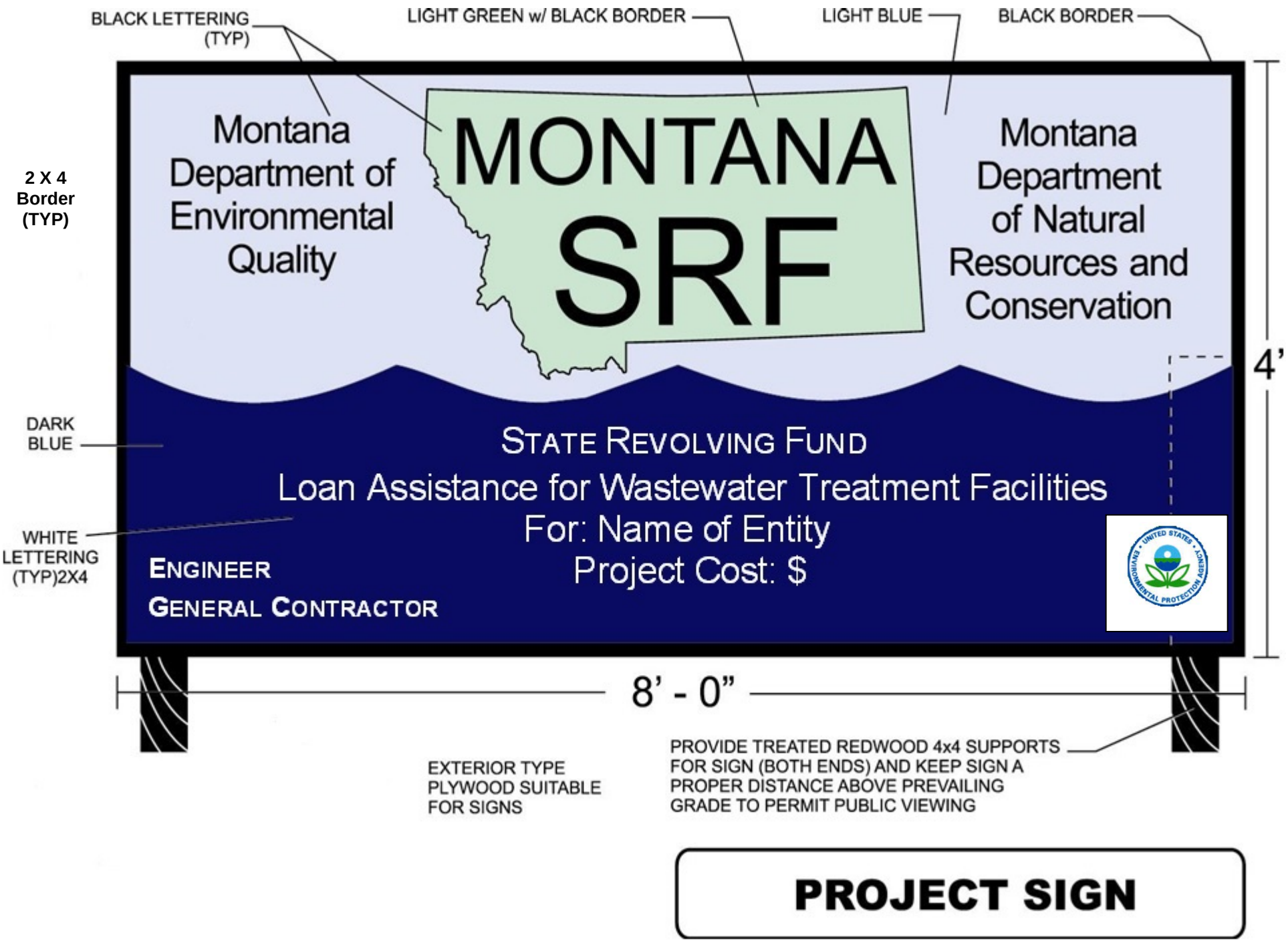
AIS WAIVERS - A waiver from the American Iron and Steel requirements may be issued by the Administrator of the Environmental Protection Agency if it is found that: 1) applying the American Iron and Steel provisions would be inconsistent with the public interest; 2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or 3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent. Waiver requests must be submitted to the state for review and submittal to the EPA.

NATIONAL AIS WAIVERS - The EPA has issued the following national waivers; 1) De Minimis (April 15, 2014); 2) Product Waiver for Pig Iron and Direct Reduced Iron (February 18, 2015); 3) Minor Components in Iron and Steel Products (October 27, 2015); and 4) Final Extension of the Short-Term National Product Waiver for Stainless Steel Nuts and Bolts used in Pipe Couplings, Restraints, Joints, Flanges and Saddles (August 24, 2018).

1.6 Exhibits

EXHIBIT A (Required for All Projects)

Project Sign Detail



PROJECT SIGN

EXHIBIT B (Required for CDBG Projects)

HUD Form 4010-Federal Labor Standards Provisions

EXHIBIT C (Required for SRF Projects)

Federal Labor Standards Provisions For
Federally Assisted Construction Contracts United
States Department of Labor
CFR Code of Federal Regulations Pertaining to ESA (Federal
Davis-Bacon Wages)

Federal Labor Standards
Provisions For
Federally Assisted Construction
Contracts United States Department of
Labor
CFR Code of Federal Regulations Pertaining to
ESA (Federal Davis-Bacon Wages)

Title 29, Chapter I, Part 5, Subpart A (29 CFR 5.5)

Section Name: Contract provisions and related

matters.

(a) The Recipient shall assure that the subrecipient(s) shall insert in full in any contract in excess of
$2,000 which is entered into for the actual construction, alteration or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the applicable FY appropriation requirements, the following clauses:

(1) Minimum wages. (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in Sec. 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
(2) The classification is utilized in the area by the construction industry; and
(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The loan or grant recipient shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally- assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the

project), all or part of the wages required by the contract, the (Agency or SRF program) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records. (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the SRF program if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the SRF program. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the SRF program if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the SRF program, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

(B) Each payroll submitted shall be accompanied by a ``Statement of Compliance,'' signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under Sec.
5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained

under Sec.
5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the ``Statement of Compliance'' required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the loan or grant recipient or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship

program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the SRF program may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination: Debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are

herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility. (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(b) Contract Work Hours and Safety Standards Act. The Agency Head shall cause or require the contracting officer to insert the following clauses set forth in paragraphs (b)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Sec. 5.5(a) or 4.6 of part 4 of this title. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The loan or grant recipient shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause

set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

(c) In addition to the clauses contained in paragraph (b), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in Sec. 5.1, the Agency Head shall cause or require the contracting officer to insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Agency Head shall cause or require the contracting officer to insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the loan or grant recipient and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=99c9a20e960f56be66f17ae91b52c888&rgn=div5&view=text&node=29:1.1.1.1.6&idno=29

EXHIBIT D (Required for SRF Projects)

Reserved

EXHIBIT E

American Iron and Steel (AIS) Forms

CONTRACTOR CERTIFICATION

Consolidated Appropriations Act, 2014

USE OF AMERICAN IRON AND STEEL

On January 17, 2014, H.R. 3547, "Consolidated Appropriations Act, 2014," (Public Law 113-76, Section 436) was enacted. This law provides appropriations for both the Clean Water State Revolving Fund and the Drinking Water State Revolving Fund for federal fiscal year 2014, while adding an American iron and steel requirement to these already existing programs.

The Act includes a provision for "Use of American Iron and Steel," in Sec. 436(a)(1). None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products permanently incorporated in the project are produced in the United States.

As the general contractor for the project(s) using revolving loan funds, the undersigned attests that they have performed the necessary oversight to ensure this provision was met on the project(s) being funded.

I, the undersigned authorized representative of _____ do hereby certify that all materials and supplies used on the project(s) have complied with the above provision of the Consolidated Appropriations Act.

Project Name _____

DEQ Loan Project Number _____

Authorized Signature _____, Date _____

Title _____

Print Name _____

MANUFACTURER CERTIFICATION

Consolidated Appropriations Act, 2014

USE OF AMERICAN IRON AND STEEL

On January 17, 2014, H.R. 3547, "Consolidated Appropriations Act, 2014," (Public Law 113-76, Section 436) was enacted. This law provides appropriations for both the Clean Water State Revolving Fund and the Drinking Water State Revolving Fund for federal fiscal year 2014, while adding an American iron and steel requirement to these already existing programs.

The Act includes a provision to for "Use of American Iron and Steel," in Section 436(a)(1). None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products permanently incorporated in the project are produced in the United States.

This certification applies to the following specific iron and steel products to be incorporated into this project:

Manufacturer Name:_____

Material/Product Description:_____

Location of factory where these products will be manufactured: _____

As a manufacturer for the project(s) using revolving loan funds, the undersigned attests that they have performed the necessary oversight to ensure this provision was met on the project(s) being funded.

I, the undersigned authorized representative of _____
do hereby certify that all qualifying iron and steel products purchased for or used on the project(s) have complied with the above provision of the Consolidated Appropriations Act.

Project Name _____

DEQ Loan Project Number _____

Authorized Signature _____ Date _____

Title _____,

Print Name _____.

SECTION 00 95 10
SPECIAL PROVISIONS

Contents:

1. PROJECT DESCRIPTION

The project will be constructed as one Schedule. Work shall generally include specified equipment; structures; electrical; HVAC; excavation; dewatering; bedding; pipe; fittings; valves; thrust blocking; connection to existing mains; testing; backfill; utility conflicts; painting, carpentry, surface restoration; pavement; fertilizing and seeding.

2. SITE INSPECTION AND PRE-BID CONFERENCE

All Bidders should satisfy themselves as to the construction conditions by personal examination of the site described in this document. Bidders are encouraged to make any investigation necessary to assess the nature of the construction and the difficulties to be encountered. A pre-bid conference will be held, commencing at 1:00 P.M. at the Whitefish Wastewater Treatment Plant in Whitefish on October 9, 2019. All bidders are required to attend the pre-bid in order to be considered responsible for bidding purposes.

3. CONTRACT TIME, CONSTRUCTION PHASING & LIQUIDATED DAMAGES

Time is of the essence on this project and schedules must be adhered to. The following tentative schedule of events will be followed, to the extent possible:

a.	Initial Advertisement for Bids	September 29, 2019
b.	Pre-Bid Conference 1:00 P.M.	October 9, 2019
c.	Bid Opening 2:00 P.M.	October 29, 2019
d.	Notice of Tentative Award	November 19, 2019
e.	Pre-Construction Conference	December 16, 2019
f.	Notice to Proceed	December 16, 2019
g.	Substantial Completion	544 calendar days after NTP (June 14, 2021)
h.	Plant Startup	90 days after Substantial Completion

The Total Contract Time for this Project will be **544 consecutive** calendar days, as stated in the Agreement. Subject to the provisions of the Contract Documents, the Owner shall be entitled to reimbursement for Contractor caused expenses incurred by the Owner for unscheduled employment of the Engineer. Liquidated damages for the unscheduled employment of the Engineer and/or Inspector will be assessed against the Contractor necessitated by the following:

- The Contractor working beyond the specified contract time.
- The Contractor working more than 8 hours per day, (or 40 hours per week if four ten hour shifts are worked) or on Saturdays, Sundays and Federal Holidays.
- The Contractor utilizing material, supplies, or equipment that requires the redesign of the project.
- The Contractor destroying or disturbing baselines, benchmarks or reference stakes.
- The failure of the Contractor to maintain acceptable as-built records.
- Retests by the Engineer of tests that have failed.

- Retests by others for tests that require Engineer's presence.
- Repeated review of submittals and shop drawings that have not been approved.
- Additional inspection as a result of unacceptable work.
- Failing to follow design or construction documents.
- Submitting excessive or unreasonable claims requiring Engineer's review.
- Failing to properly document pay requests.

Liquidated damages for the unscheduled employment of the Engineer and/or Inspector shall be determined based on the following hourly rates up to the daily limits identified in the Agreement:

Project Manager	$150.00/Hour
Project Engineer	$130.00/Hour
Inspector	$95.00/Hour
Mileage	$ 0.60/Mile

Out of pocket expenses for materials, equipment, supplies, transportation, and subsistence shall be billed at cost plus ten percent. Liquidated damages for unscheduled employment of the Engineer and/or Inspector shall be deducted from monthly progress payments and the final payment as the damages are incurred.

The Contractor shall reimburse the Owner for all costs incurred as a result of the Contractor's failure to complete the work within the time period specified in the Contract unless modified by a Change in Contract Time. The Owner shall have one or more representatives observing the work at all times work is taking place. The Contractor shall reimburse the Owner for the cost of engineers, architects, attorneys, construction field representatives, and other professionals that are incurred due to the Contractor's failure to complete the work within the Contract time period.

4. PROJECT RELATED CONTACTS

Owner: City of Whitefish
Public Works Department
418 East Second Street
Craig Workman, P.E., Public Works Director
Neil DeZort, Water & Wastewater Superintendent
Telephone: 406-863-2460

Engineer: Anderson-Montgomery Cons. Eng., Inc.
1064 N. Warren Street
Helena, Montana 59601
Contact: Paul Montgomery, P.E.
Telephone: 406-449-3303
Cell: 406-459-8463
FAX: 406-449-3304

Field Representative: Matt Patterson

(406) 752-5025
Robert Peccia & Associates
102 Cooperative Way, Suite 300
Kalispell, MT 59901

Utilities:
NorthWestern Energy – Distribution Gas Mains
Eric J Smith, District Engineer
Telephone: 406-751-2219, 406-871-2570 (cell)

Spectrum Communications

1-800-892-4357

Flathead Electric
Stan Pluid
Telephone: 406-751-4461

One Call Locators
Telephone: 811 or (406)424-5555

5. GENERAL CONSTRUCTION REQUIREMENTS

Construction Limits. Work will occur within the confines of the Whitefish wastewater treatment plant site and will not affect private land. Where construction limits, or property lines, are not specifically called out on the Drawings, the limit shall be the closest adjacent property line or easement line, whichever is less.

Areas of Disturbances. Approved areas of disturbance are those areas disturbed by construction activities within the construction limits and along designated or approved access routes. Such areas shall require reclamation and revegetation operations, including grading to the original contours, top soiling with salvaged or imported topsoil, seeding, fertilizing, and mulching as specified herein. Other areas that are disturbed by the Contractor's activities outside of the limits noted above will be considered as site damage or unapproved areas of disturbance subject to Repair and Replacement Quality as specified in the Supplementary Conditions. This includes areas selected by the Contractor outside the defined construction limits for mobilization, offices, equipment, or material storage.

6. SOILS INFORMATION

Geotechnical investigation work has been done for this Project. **Appendix C** of the contract documents contains the February 2018 *City of Whitefish Wastewater Treatment Plant Geotechnical Report* by Pioneer Technical Services, as well as the raw results from two Cone Penetrometer Test (CPT) tests conducted by Big Sky Subsurface in April 2019. The soil investigations represent only the site conditions at each borehole and CPT site at the time the investigations were conducted and should not be considered as a warranty that the conditions

exist throughout the site. This data is provided strictly for informational purposes in an effort to provide the contractor with all available information. There is no guarantee that the soil and groundwater conditions portrayed in the study are descriptive of conditions within the general construction area or for any particular time of the year. The Bidder/Contractor is encouraged to conduct its own geotechnical studies in order to derive the necessary information upon which to base its bid and determine means and methods for construction.

7. ENGINEERING, INSPECTIONS, AND TESTING

The Contractor's work will be periodically tested and observed to insure compliance with the Contract Documents. Complete payment will not be made until the Contractor has demonstrated that the work is complete and has been performed as required. If the Engineer detects a discrepancy between the work and the requirements of the Contract Documents at any time, up to and including final inspection, such work will not be completely paid for until the Contractor has corrected the deficiency.

The Engineer will periodically monitor the construction of work to determine if the work is being performed in accordance with the contract requirements. The Engineer does not have the authority or means to control the Contractor's methods of construction. It is, therefore, the Contractor's responsibility to utilize all methods, equipment, manpower, and other means necessary to assure that the work is installed in compliance with the Drawings and Specifications, and laws and regulations applicable to the work. Any discrepancies noted shall be brought to the Contractor's attention, who shall immediately correct the discrepancy. Failure of the Engineer to detect a discrepancy will not relieve the Contractor of his ultimate responsibility to perform the work as required.

The Contractor shall inspect the work as it is being performed. Any deviation from the Contract requirements shall be immediately corrected. Prior to any scheduled observation by the Engineer, the Contractor shall again inspect the work and certify to the Engineer that he has inspected the work and it meets the requirements of the Contract Documents. **All buried work items shall be inspected by the Engineer prior to backfilling, or may not be considered for payment**.

The work will be subject to review by the Owner, whose findings shall be as valid as those of the Engineer. The results of all such observations shall be directed to the Contractor through the Engineer.

Services Provided by the Contractor. The Contractor shall provide the following services:

- Any field surveys to establish locations, elevations, grades and alignments as stipulated on the Plans.
- Preparation and certification of all required shop drawings and submittals as described in the Supplementary Conditions.
- Tests as required by the Contract Documents which include, but are not limited to, proctors and concrete strength laboratory tests. All tests requiring the services of a laboratory to determine compliance with the Contract Documents shall be

performed by an independent commercial testing laboratory acceptable to the Engineer. The laboratory shall be staffed with experienced technicians properly equipped, and fully qualified to perform the tests in accordance with the specified standards.

- The Contractor shall provide an independent laboratory for any tests necessary to determine the compliance of the materials used in the asphalt mix with the Contract Documents.
- Maintenance of project record drawings.
- The Contractor shall arrange for and pay for all tests required by the Contract Documents.
- The Contractor shall provide an independent laboratory to check compaction of subgrade, backfill and base/subbase course using Proctor information supplied by the Contractor. These tests are only to determine if the material is complying with the Contract Documents. It is the responsibility of the Contractor to insure that this level of compaction is constant in all locations. Compaction testing shall test moisture content and compaction as specified in the Contract Documents. Tests shall be taken upon every specified lift for both trenches and roadways/sidewalks at a maximum spacing of 100 feet along the trench or roadway/sidewalk alignment, or as directed by the Engineer.
- The Contractor shall provide an independent laboratory to determine cast-in-place concrete characteristics including: slump; air content and to cast and test cylinders for strength analysis as specified in the Contract Documents. The Contractor is responsible for proper onsite storage, transportation and laboratory strength testing of the cylinders. All on-site concrete testing shall be performed by a certified ACI technician.
- The Contractor shall provide an independent laboratory to perform, at minimum but not limited to, one (1) set of three (3) Marshall “pucks” to establish a job specific target density for the bituminous mix. For each days production, or for each 1,000 tons produced per day, the engineer will mark three random locations upon the mat for the removal of a 4” diameter core to be cut for density determination. A “percent compaction” value will be determined by comparing the average core density values for that day with the job specific target density previously determined by the Marshall “pucks”. The independent laboratory will be required to document the thickness of asphalt material pulled from each core and to further trim each core prior to density testing. Documentation of test results shall be submitted to the engineer as they become available throughout construction activity.
- Contractor shall provide for disinfection and bacteriological testing of all newly installed water mains. Testing shall include chlorine residual testing as well as coliform testing for completed water mains utilized as a source of potable water.
- The contractor shall perform performance tests for any newly installed equipment as specified within these contract documents.

Testing Services Provided by the Owner. The Owner is not required to perform any testing services during the construction of this project. All required testing shall be the responsibility of the Contractor. The Contractor shall provide an approved independent testing laboratory

to perform all necessary testing during construction activities.

The Engineer will observe and record the results of Contractor field tests for unit process performance and pressure and leakage of water, sanitary sewers, manholes, tanks, calibration of equipment and related materials tests. Contractor shall coordinate tests with Engineer and provide all necessary equipment and labor to perform the required tests.

The Engineer will observe and review the results of Contractor's disinfection efforts, as well as bacteriological testing of the water mains. Contractor shall coordinate tests with its contract laboratory as well as the Engineer and provide all necessary equipment and labor to perform the required tests. Contractor shall pay for all initial and repeat (if necessary) bacteriological samples.

8. PAYMENTS TO CONTRACTOR

8.1 Scope. This section supersedes the sections of the General Conditions pertaining to payments to the Contractor, to be in compliance with MCA 28-2-2103 as amended on October 1, 2003. If an alternate billing, approval, and/or payment cycle is required for this project those provisions are discussed in the "Instructions to Bidders" section of these Contract Documents, and shall supersede this section on Payments to the Contractor.

8.2 Application for Partial and Final Payment. The Contractor shall prepare and submit two (2) copies of the Application for Payment on a monthly billing cycle, including Schedule of Value to support the request for payment. At the Preconstruction Conference it will be agreed upon which day of the month this application should be submitted so that it coincides with the Owner's billing approval and payment schedule. After the first partial payment request is submitted the Contractor shall submit their subsequent applications on the same date each month for the duration of the project.

a. After the Contractor submits their Application for Payment the Owner will have twenty one (21) days to review and approve payment for the entire amount of the request, or the undisputed portion of the request. During this same time period the Engineer will review the payment request and make recommendations to the Owner on the items which the Engineer feels are approved for payment, and which items are in dispute. Items which are in dispute will be documented in writing and provided to the Contractor for correction and resubmission on subsequent payment requests. The undisputed portion will be approved for payment, and will be paid within seven (7) calendar days after approval. Five percent (5%) of all partial payments will be withheld from payment until the completion of the project as discussed below.
b. The Final Application for Payment, including release of the five percent (5%) retainage, may only be submitted after the Engineer has signed the Certificate of Substantial Completion and all punch list items have been addressed.
c. The Contractor will complete the City of Whitefish Payment Request with each Application for Payment.

9. UTILITIES

The exact locations of existing underground utilities that may conflict with the work are not precisely known. It shall be the Contractor's responsibility to contact the owners of the respective utilities and arrange for field location services.

9.1 Notification. The Contractor shall contact, in writing, all public and private utility companies that may have utilities that may be encountered during excavation. The notification shall include the following information:

- The nature of the work that the Contractor will be performing.
- The time, date and location that the Contractor will be performing work that may conflict with the utility.
- The nature of work that the utility will be required to perform such as moving a power pole, supporting a pole or underground cable, etc.
- Requests for field location and identification of utilities.
- A copy of the letter of notification shall be provided to the Engineer. During the course of construction, the Contractor shall keep the utility companies notified of any change in schedule or nature of work that differs from the original notification.

9.2 Identification. All utilities that may conflict with the work shall be the Contractor's responsibility to locate before any excavation is performed. Field markings provided by the utilities shall be preserved by the Contractor until actual excavation commences. All utility locations on the Drawings should be considered approximate and should be verified in the field by the Contractor. The Contractor shall also be responsible for locating all utilities that are not located on the Drawings.

9.3 Public Utilities. Water, sewer, storm drainage, electric, gas and other utilities owned and operated by the public entities shall, unless otherwise specifically requested by the utility owner, be removed, relocated, supported or adjusted as required by the Contractor at the Contractor's expense. All such work shall be in accordance with these Specifications, or the Owner's Standard Specifications or written instructions when the work involved is not covered by these Specifications.

9.4 Other Utilities. Utilities owned and operated by private individuals, railroads, school districts, associations, or other entities not covered in these Special Provisions shall, unless otherwise specifically requested by the utility owner, be removed, relocated, supported or adjusted as required by the Contractor at the Contractor's expense. All work shall be in accordance with the utility owner's directions, or by methods recognized as being the standard of the industry when directions are not given by the owner of the utility.

9.5 Damage to Utilities and Private Property. The Contractor shall protect all utilities and private property and shall be solely responsible for any damage resulting from his construction activities. The Contractor shall hold the Owner and Engineer harmless from all actions resulting from his failure to properly protect utilities and private property. All damage to utilities shall be repaired at the Contractor's expense to the full satisfaction of the owner of the damaged utility or property. The Contractor shall provide the Owner with a letter from the owner of the damaged utility or property stating that it has been repaired to the utility owner's full satisfaction.

9.6 Water Mains and Services. All water mains and services exposed during construction shall be adequately supported and protected from freezing at all times. Sections of water mains shall not be valved off without first giving the Owner sufficient notification and receiving authorization from the Engineer. Unless otherwise permitted in writing by the Owner, water mains and services shall not be shut off for more than 4 hours. All recipients of water service shall be notified in advance of any interruption of service.

Whenever a water main or service is damaged as a result of the Contractor's operations, the Contractor shall take immediate steps to repair the damage and disinfect all water mains and services contaminated as a result of the damage.

Existing water services from the mains to private property which interferes with trenching operations may be cut and replaced at the Contractor's option and expense provided the requirements for notification, length of interruption, and disinfection specified above are adhered to.

9.7 Maintenance of Flows. Adequate provisions shall be made for maintaining the flow of sewers, drains, and watercourses encountered during construction. Culverts, ditches, fences, crosswalks, and structures which are disturbed by this construction shall be satisfactorily restored to their original condition upon completion of the work. No additional payment shall be made for this work. All costs shall be merged with related bid items.

9.8 Structures. The Contractor shall exercise every precaution to prevent damage to existing buildings or structures in the vicinity of his work. In the event of such damages, he shall repair them to the satisfaction of the owner of the damaged structure at no cost to the Owner.

9.9 Overhead Utilities. The Contractor shall use extreme caution to avoid a conflict, contact, or damage to overhead utilities, such as power lines, streetlights, telephone lines, television lines, poles, or other appurtenances during the course of construction of this project.

9.10 Buried Gas Lines. The Contractor shall provide some means of overhead support for buried gas lines exposed during trenching to prevent rupture in case of trench caving.

9.11 Pavement Removal. Where trench excavation or structure excavation requires the removal of curb and gutter, concrete sidewalks, or asphaltic or concrete pavement, the pavement or concrete shall be cut in a straight line parallel to the edge of the excavation by use of a spade-bitted air hammer, concrete saw, colter wheel, or similar approved equipment to obtain a straight, square clean break. Pavement cuts shall be 2 feet wider than the actual trench opening.

9.12 Survey Markers and Monuments. The Contractor shall use every care and precaution to protect and not disturb any survey marker or monuments, such as those that might be located at lot or block corners, property pins, intersection of street monuments or addition line demarcation. Such protection shall include markings with flagged high lath and close supervision. No monuments shall be disturbed without prior approval of the Engineer. Any survey marker or monument disturbed by the Contractor during the construction of the project

shall be replaced at no cost to the Owner by a licensed land surveyor.

9.13 Temporary Utilities. The Contractor shall provide all temporary electrical, lighting, telephone, heating, cooling, ventilating, water, sanitary, fire protection, and other utilities and services necessary for the performance of the work. All fees, charges, and other costs associated therewith shall be paid for by the Contractor. Limited electrical service may be available from the wastewater plant for the Contractor's utilization.

10. STORED MATERIALS

Contractor shall use an approved storage area for materials and offices which should be available on site. Materials and/or equipment purchased by the Contractor may be paid for on a monthly basis providing invoices for said materials and equipment are presented to the Engineer, such materials have been approved through the submittal process and are adequately stored, protected and insured.

11. NOTICES

It will be the responsibility of the Contractor to notify the following individuals for the following items:

- Owner and emergency services of service outages in writing a minimum of 24 hours in advance.
- Contractor to place "NO PARKING" signs as needed to ensure vehicles are not in the way of construction progress.
- Notify all affected parties of water, sewer, or electrical outages in writing 24 hours in advance.
- Notify Owner and Engineer when any existing unit treatment processes are to be taken out of service, at least 48 hours in advance.
- Notify Owner, Engineer, and all landowners, 72 hours in advance, of when paving operations will occur.
- The Contractor shall maintain "ONE WAY" traffic through worksite at all times and provide reasonable access to the treatment plant facilities as required by the operational staff to perform necessary operation and maintenance.

12. DRAWINGS

The Engineer has located, to the best of his knowledge, all major objects that may influence construction and has indicated them on the Drawings for bidding purposes only. Because of scale, possible additions, subsurface uncertainties, etc., the Contractor shall be responsible for verifying in the field the exact locations of objects that may influence his construction operations. The Engineer and Owner shall in no way be held responsible for objects not located exactly as shown on the Drawings or for objects installed subsequent to preparation of the Drawings.

13. FEES AND PERMITS

The Owner and Engineer shall obtain the following permits at no expense to the Contractor. The Contractor shall be required to carry out all provisions of these permits as part of this Contract:

- City of Whitefish Reasonable Use Exemption
- Local Conservation District 310 Permit
- MDEQ 318 Authorization
- U.S. Army Corps of Engineers – 404 Permit: The City of Whitefish will make application for a 404 Permit to the ACOE, after the outfall corridor and effluent diffuser site have been assessed for the presence of delineated wetlands. If required, the Contractor shall be responsible for compliance with all provisions of that permit.

The Contractor will be responsible for obtaining and paying for all other permits required by Local, State or Federal jurisdictions. Specifically, the Contractor shall obtain the following types of permits or provide documentation that they are not applicable:

- Stormwater Discharge Associated with Construction Permit – Montana DEQ
- Ground Water Discharge Associated with Construction Permit – Montana DEQ Building
- Electrical and Mechanical Permits – Building Codes Bureau, Montana Department of Commerce
- Electrical Permit
- Building Permits

14. SUPERVISOR, TELEPHONE AND PROJECT SITE FACILITIES

At all times during construction the Contractor shall provide a telephone at the project site. In addition, if the phone is not manned, a system must be utilized to deliver messages to the project superintendent within 15 minutes of a phone call. The superintendent in charge of all operations must be on-site during all construction activities. The superintendent in charge of all operations must be qualified to do such work **and** shall be the same person throughout the project. Substitutions for superintendents can be made with the Owner and Engineers approval. The City reserves the right to stop construction if the Contractor's Project Superintendent is absent from the site during construction activity. Additional Contract Time will not be allowed due to such stop work orders.

The Contractor shall maintain a suitable office at the site which shall serve as headquarters for his superintendent. All communications, drawings, instructions, and other articles will be delivered to the Contractor's field office or to the Contractor's main office as appropriate. Communications delivered to either location shall be deemed to have been delivered to the Contractor. The Contractor shall maintain copies of record drawings, specifications, shop drawings, submittals, and all communications pertinent to the performance of the work at the field office and available for use at all times.

On-site toilet facilities for employees of Contractor and Subcontractors shall be provided and maintained in a sanitary condition. A bulletin board will be maintained on the jobsite for posting wage rates, labor standards and other information to be made available to the contractors employees.

15. CONSTRUCTION WATER

Water for temporary service, water quality tests, leakage tests, storm drain cleaning, and for compaction efforts may be obtained from the City through its hydrant located onsite. Contractor shall coordinate with the City to obtain water and shall install and utilize a City-supplied backflow preventer and meter. The meter shall be utilized to track water usage by the Contractor. ***The Contractor will not be billed for the reasonable use of City water which will only be utilized for construction activities related specifically to the Whitefish Wastewater Treatment Plant Improvements Project.***

16. DISPOSAL OF USED WATER

Disposal of used water shall be the responsibility of the Contractor. Discharges to the surface are subject to permit and regulatory requirements. Discharge of chlorinated water is the responsibility of the Contractor. Discharge to sewer or storm drains must be coordinated with and approved in advance by the Owner. It will be the responsibility of the Contractor to arrange for legal disposal of all groundwater (contaminated or otherwise) during execution of the Work.

17. WATER POLLUTION, EROSION AND SEDIMENT CONTROL

The Contractor shall obtain all required permits and comply with all laws and regulations of the Montana Department of Environmental Quality and with all other federal, state, and local laws and regulations controlling pollution to the environment. The contractor shall apply for these permits as soon as possible after the contract is awarded. The Contractor shall take necessary precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, bitumens, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

Particular care will be required to prevent trench spoils from entering streams or watercourses. Similar care shall be used if removal is required for spoils already in the stream channel. Under no circumstances will equipment be allowed to operate in flowing stream channels, with the exception of booms or buckets extended into the channel to retrieve existing spoils or place riprap at the water line. Machinery wheels or tracks may not enter the channel below water line. Sediment control provisions shall be used whenever work is conducted adjacent to drainages or watercourses to control silt in runoff. Adequate silt barriers or sediment traps shall be used to comply with permit conditions and statutory requirements for all streamside work, both during and after work hours. Measures used may include staked straw bales, sediment ponds, and/or staked silt fence (Mirafi "Enviro-Fence, or equal). Sediment controls shall be considered incidental to the Work, and no separate payment will be allowed. The Contractor will be solely responsible for the selection and implementation of sediment control measures to assure permit and statutory compliance. **An Erosion Control Plan outlining measures to be taken to control erosion and runoff must be submitted by the Contractor to the Engineer and the City of Whitefish for review and approval** prior to any work activities in proximity to the Whitefish River. Scheduling of work tasks must be included in the Plan outlining work procedures, waste disposal practices, earthwork procedures and other activities. Waste materials cannot be placed west of the existing 30" interceptor main on the bank of the Whitefish River.

18. MATERIALS SALVAGE

Some of the existing equipment within the Administration Building, Blower Building and Main Lift Station has been identified in the Drawings to be salvaged for the Owner. Such items shall be carefully recovered and delivered to the City Shop. All other materials removed on the project shall be legally disposed of by the Contractor. Disposal costs shall be part of contract unit prices.

19. PROTECTION OF ADJACENT IMPROVEMENTS

Retain and protect all adjacent improvements not called for removal on the drawings. Restore all damaged items to pre-existing condition.

20. CONSTRUCTION SURVEYS

The Contractor will be responsible for all layout and construction staking utilizing the Engineer's existing control and coordinate data for street, sidewalks, monuments, manholes, and any other construction which requires surveying. Dimensions and elevations indicated in layout of work shall be verified by the Contractor. Discrepancies between Drawings, Specifications, and existing conditions shall be referred to the Engineer for adjustment before work is performed.

Existing Engineer Control: The Engineer has set survey control (horizontal and vertical) for use in the design and ultimately the construction of these improvements. A listing of the coordinates and vertical elevation for each of these control points is included in the Plans.

Several of the Engineer's control points may have been disturbed or accidentally removed before contractor layout begins. The Contractor will be responsible for verifying the accuracy of all control points and laying out all critical project points with the remaining control points. The Contractor will be responsible for preserving and protecting the survey control until proper referencing by the Contractor has been completed. Any survey control obliterated, removed, or otherwise lost during construction will be replaced at the Contractor's expense. Any claims relating to survey location or construction staking accuracy must be supported by original control point data and verified in the field to the satisfaction of the Engineer.

The Engineer shall provide the following staking consisting of stakes or hubs:

Vertical Control – Vertical control will be provided by the existing survey monument benchmarks and control points throughout the site as shown on the Plans.

Piping - Horizontal control will be provided in the form of centerline of stationing as shown on the project drawings. Stakes shall be provided no more frequently than 200' intervals, at structures, manholes, buildings and branch fittings on piping.

The Contractor will provide all additional staking and offsets necessary for vertical and horizontal control such that the project may be completed in accordance with the plans and specifications.

The Contractor shall not order structures or tapping equipment until the field verification of the size and invert elevations is complete and furnished to the Engineer for verification.

The Contractor will utilize the services of a **Professional Land Surveyor**, currently licensed in the State of Montana, for the construction staking for this project.

The Contractor will field verify the vertical elevation of all system manholes. The Contractor will not order manholes until the field verification of rim elevations and also exploratory excavations where specified, are complete and furnished to the Engineer for verification.

Contractor shall be aware of property pins. Damage to these pins will require replacement of such by a registered land surveyor at no cost to the owner.

The Contractor is responsible for the location and elevation of all the construction contemplated by the Contract Documents.

Prior to commencing work, the Contractor shall carefully compare and check all drawings, each with the other that in any way affects the location or elevation of the work to be executed, and should any discrepancy be found, he shall immediately report the same to the Engineer for verification and adjustment. Any duplication of work made necessary by failure or neglect on his part to comply with this function shall be done at the contractor's expense.

21. SITE DEWATERING

Certain functions of the work to be performed may require draining, pumping and dewatering operations necessary to complete the work as specified and as indicated on the drawings. It is the intent of these specifications that such draining, pumping and dewatering operations shall be the obligation of the Contractor. The Contractor shall provide all necessary piping, as required to remove all surface water, groundwater, leakage, and water from excavations. **No separate pay item is designated for dewatering.** This work will be considered incidental to other bid items. Adequate dewatering is defined as the work required to lower the natural groundwater 12" or more below the bottom of excavation in order to get a structurally stable subgrade. If the existing subgrade material is courser rock and is naturally stable, the 12" depth will not be required. Laying and installing pipe in water will not be allowed.

The presence of groundwater can be anticipated. The Bidder/Contractor shall undertake all necessary investigations to determine for himself the conditions and extent of groundwater that is likely to be encountered and shall account for adequate dewatering when preparing the bid and constructing the improvements.

Stabilization – Prior to any embankment/backfill work, subgrades shall be firm, dense, and thoroughly compacted and consolidated and shall be sufficiently stable for equipment or manpower to work. Soil material that has been removed because it is too wet to permit compaction may be stockpiled and removed or spread and allowed to dry. Processing of saturated material will not be directly paid for. If the Contractor chooses to import material in lieu of processing wet materials, Contractor will assume responsibility and expense to do such. Authorization for payable import stabilization will only be per direction of Engineer.

Any discharge of water during pumping and dewatering operations will be subject to approval of the Montana State Department of Environmental Quality. The Contractor shall be responsible for obtaining any necessary discharge permits as well as any damages caused to surrounding structures, land and physical features in the area. Contractor will restore any ground that had been eroded to its natural state. The Contractor shall submit a plan for dewatering to the Engineer.

22. SUB-EXCAVATION AND STABILIZATION

Over-excavation shall be only as specifically authorized by the Engineer. Stabilization bedding and backfill will be imported and payable as specified in the Bid Form or as negotiated. Sub-excavation and stabilization, when required and approved by the Engineer, will be paid at the negotiated contract unit price.

23. IMPORTED TRENCH BACKFILL

Native material is preferable to imported backfill for new pipe installation when the native material is suitable. However, use of on-site excavated soil must be approved by the Project Engineer prior to its placement. Blocky or platy clay, saturated or near saturated soils, will not be permitted for use as backfill material. The Contractor shall provide the Engineer with a Proctor (moisture/density relationship) for the backfill material.

If native material is found unsuitable for trench backfill, the Contractor shall provide Imported Trench Backfill. Imported Trench Backfill will be paid by the cubic yard at the contract unit price or negotiated change order price and wherever possible, shall be subject to a pay limit based on measured dimensions.

Import material meeting the backfill specifications ONLY when directed by Engineer.

24. TIME OF OPEN TRENCHES

The Contractor shall conduct his work so that trenches will remain open for a minimum possible time. No trench excavation shall begin until proper compaction equipment is at the site where excavation is to take place. Open trench shall be barricaded in a manner sufficient to insure public safety.

25. CONTINUOUS WASTEWATER TREATMENT

The Contractor will be required to perform all construction activities so that Cells #1 and #2, the flocculating clarifier and chlorination system of the existing wastewater treatment system function appropriately without diminished treatment performance. No bypasses of raw or partially-treated sewage will be allowed and the Contractor will be required to install the new equipment without affecting the performance of the existing equipment.

Bypass pumping and/or temporary piping at the main lift station will be required to maintain treatment (see Special Provision #38). The costs for any bypass pumping will be incidental to the

cost of the project. The Contractor shall develop and submit a Bypass Pumping Plan of Operation (BPPO) that provides for reliable and redundant bypass pumping to avoid any unpermitted discharges of pollutants to the Whitefish River or surrounds. The BPPO will include information on: pump capacity; head vs. discharge curves; control and alarm systems; backup operations and emergency response. All bypass pumping must be noise attenuated due to the proximity to occupied residences. The BPPO will be submitted by the Contractor for review and approval by the Engineer and Owner at least 30-days prior to expected implementation of the plan. Bypass pumping and work on the lift station should be scheduled during periods where high flow events are not anticipated, generally in later summer and fall.

26. PLAN OF OPERATION

The contractor shall submit a Plan of Operation as a condition of receiving the Notice to Proceed. This Plan will describe the schedule, means/methods and contingency procedures by which each *critical* unit process of the existing treatment facility will be taken out of service to allow for construction of work components constructed under this project. The Plan shall present a logical and well-developed procedure for making the required plant improvements and shall include the following tasks, at a minimum:

a. Implementation of influent and effluent bypass piping at the treatment plant;
b. Isolation and dewatering of treatment Cell #3;
c. Implementation of bypass pumping at the Main Lift Station and cleaning/inspection of the Main Lift Station wetwell;
d. Excavation and site preparation for installation of the foundation stabilization infrastructure (Rigid Inclusions);
e. Acquisition of Aqua-Aerobics Aerobic Granular Sludge (AGS) treatment equipment;
f. Construction of the Biosolids Treatment Basin;
g. Replacement of blowers in the Biosolids Blower Building;
h. Provision of temporary wiring to all loads during changeovers and to facilitate new construction. Install and maintain temporary wiring in accordance with NEC Article 30
i. Coordinate electrical construction sequence with general, process, and mechanical sequencing to maintain treatment and operation of building systems.
j. Remodel of the Administration Building;
k. Completion of the new effluent outfall and diffuser;
l. De-commissioning of the existing flocculating clarifier and Cells #2 and #3.

The Plan of Operation will be reviewed and approved by the Engineer. The Plan will be reviewed and updated every 30 days or as required. The Plan of Operation and the Project Schedule shall be maintained for consistency and accuracy.

27. CONSTRUCTION SCHEDULE

Contactor shall submit a Construction Schedule to the Owner with the signed Agreement or at the preconstruction conference. The Schedule shall be in horizontal bar chart form and shall indicate each significant construction activity. The beginning of each work week as well as all significant construction milestones shall be indicated by a solid vertical line. The Contractor's

construction schedule(s) shall be updated no less frequently than weekly and the Owner & Engineer shall be notified immediately of any issues that may prevent the project from being completed within the designated contract time. Time is of the essence in this project and it is incumbent upon the Contractor to schedule the work activities to allow for adequate procurement, installation, curing, testing and inspection time within the contract time.

28. TRACER TAPE

All non-metallic water mains and services, as well as storm drain and sewer pipe shall be installed with continuous tracer tape installed 12 to 18 inches under the final ground surface. No breaks or splices will be allowed. In addition to tracer tape, install 14 gauge coated copper wire, taped to the top of pipe, and thermite welded to valve body on all water mains. The cost of tracer tape and locator wire shall be part of the overall lump sum and schedule of values.

29. SECURITY

The Contractor shall provide all security measures necessary to assure the protection of his equipment, materials in storage, completed work, and the project in general. This may require the Contractor to hire or employ outside services to guard materials or completed work. All security measures are the Contractors responsibility.

30. CLEANUP

Cleanup for each item of work shall be <u>fully</u> completed and accepted before the item is considered final. If the Contractor fails to perform cleanup within a timely manner the Owner reserves the right to shut down construction activities.

31. DUST CONTROL

The Contractor will be responsible for maintaining the construction zone and all haul routes to meet the Whitefish/Flathead County regulations for air emission control. Contractor will maintain the access road including watering as deemed necessary and ordered by the Engineer. In addition, any open excavations, stockpile areas or fills producing excessive amounts of dust shall be watered to control dust to a reasonable level, as determined by the Engineer.

32. PAVING SCHEDULE

Paving for this Project must be completed within Contract Time unless, in the estimation of the Engineer, weather conditions preclude the placement of asphalt.

33. BRUSH AND TREE REMOVAL

The Contractor shall only remove trees and brush as necessary to complete the work and as specified by the Engineer. The Contractor shall be responsible for the sawing and safely removing trees and bush, removal of all stumps and roots, sawing and removing all limbs. All brush and tree removal shall be completed while providing protection to remaining vegetation,

existing utilities and properties adjacent to removal locations and final cleanup upon removal completion.

34. WAGE RATES

Montana State wage rates as determined by the Montana Department of Labor and Federal Davis-Bacon wage rates shall prevail on all work. The appropriate wage rates are included and shall be applied to this project. The Contractor shall submit weekly payroll reports to the Engineer within seven days following completion of the work week. All required postings and sample forms will be supplied to the Contractor at the Preconstruction Conference.

35. CONTRACTOR EXPERIENCE & PERFORMANCE REQUIREMENTS

Form C-451 Qualifications Statement to be submitted with the Bid will be the used to assess a potential Contractors qualifications.

36. PREQUALIFYING EQUIPMENT AND MATERIALS

Manufacturer's requests for equipment substitutes ("or equals") for the: grit equipment; flow meters; lift station pumps; sludge pumps; UV equipment; biosolids blowers and aeration system; biosolids basin cover; chemical pumps; motors; controls, etc. shall be provided to and received by the Engineer at least fifteen (15) days prior to the bid opening date. The Engineer will either accept or reject the equipment substitutions within 7 days of receipt of the request for substitution. It will be the Manufacturers responsibility to provide sufficient documentation that the substituted equipment is equal or superior to the specified equipment and that the substituted equipment will conform with existing piping, channels, and structural constraints. Any significant redesign work that would be required to incorporate the substituted equipment may be cause for rejection. All redesign work will be at the expense of the manufacturer.

37. TRAFFIC CONTROL

The Contractor shall adhere to all traffic control requirements (if applicable) as set forth by the Manual of Uniform Traffic Control Devices for Streets and Highways (MUTCD). No additional payment will be allowed the Contractor for this work.

38. CLEANING AND INSPECTION OF THE MAIN LIFT STATION WET WELL

The Main Lift Station (MLS) will be taken out of service utilizing the bypass pumping system provided by the Contractor. The 3,000-gallon bypass basin (access located on the south side of Screening Building) and force main access port (located 130' SE of MLS) will be utilized to allow temporary pumping of the raw wastewater stream which would normally be pumped via the MLS. Through the existing lift station access hatch, the main lift station wet well will be emptied by pumping its contents back to the bypass basin. The Contractor shall remove and dispose of accumulated solids and the interior of the structure cleaned utilizing a high pressure wash system. Disposal of solids within the confines of the wastewater plant site will be allowed, at the direction of the Engineer. Upon cleaning, the Contractor and Engineer will inspect the interior of the lift station wet well and observe the condition of the wet well including coatings,

concrete, piping, fittings, anchors and other appurtenances. The opportunity to photo-document the wetwell condition shall be provided. The Owner may pursue negotiation of a construction change order with the Contractor to implement repairs or improvements to the structure as recommended through the inspection process. The Contractor will provide all necessary equipment, piping, fittings, testing equipment, safety equipment as required for the wetwell pumping, cleaning and inspection. All applicable safety standards must be met during performance of the work effort.

39. VERIFICATION OF INVERT ELEVATIONS

Invert elevations for a number of existing pipes and structures must be verified in order to: implement the temporary influent and effluent piping modifications; install new aeration to the Biosolids Basin, and; install the effluent outfall. Elevations of some existing pipelines and utilities are based on existing "record" drawings and surface locating. The contractor must perform necessary exploratory excavation to verify location/depth of existing utilities that are impacted by the proposed improvements.

40. PETROLEUM CONTAMINATED SOILS

While not evident from any of the available geotechnical information or history of the existing treatment facility site, there is a possibility of the Contractor(s) encountering petroleum-contaminated soils within excavations. If this occurs during construction, the Contractor will cease work in this area until a time and materials change order for the extra work can be agreed upon by the Contractor, Owner, Engineer and the Montana DEQ Underground Storage Tank Program or other required entity. The Contractor will proceed with other elements of the project until the change order is processed at no additional cost to the Owner.

41. TIME EXTENSION OR SHUTDOWN FOR WEATHER

A shutdown due to inclement weather may be requested by the Contractor during the winter months. The Contractor shall indicate the number of calendar days being requested in the formal shutdown request. This initial request may be extended during the shutdown period as long as such extension is justifiable and requested at least 30 days prior to the date the original extension was to elapse. Only **ONE** winter shutdown will be granted during the project. The Owner reserves the right to approve or disapprove any shutdown or extension requests. As a condition of approval of a shutdown, the Contractor shall: provide for maintenance of flows; close all open excavations; provide for maintaining traffic; provide for protection of public property at the work site, and; provide for worker and public safety with proper barriers, barricades, warning signs and notices. The Contractor will not be allowed to perform any work during the shutdown period unless prior approval is granted by the Owner.

Time Extension for Abnormal Weather Conditions – The Contractor may request extension of contract time for abnormal weather conditions which will be generally defined as conditions of extreme or unusual weather for a given region, elevation, or season, as determined by Engineer. Extreme or unusual weather that is typical for a given region, elevation, or season should not be considered Abnormal Weather Conditions. It will be

incumbent on the Contractor to demonstrate that Abnormal Weather impacted work progress.

42. STANDARD SPECIFICATIONS

The Montana Public Works Standard Specifications and Drawings, 6th Edition, April 2010, including Appendices, are included in these project documents by reference.

43. GEOGRID AND GEOTEXTILE

The requirements for geogrid and geotexiles are outlined in the project drawings and specifications, identifying the use of the materials where existing soils are removed and structural backfill placed. Generally the geogrid is placed in the first lift of structural fill. Suitable geogrids include Tensar BX1200, Mirafi BXG12, US Fabrics Basegrid 33 or approved equal. A nonwoven geotexile is used to separate resident soils from the structural fill and materials such as Mirafi 140NL, US Fabrics US90NW or Propex Geotex 351 are deemed acceptable. These nonwoven materials shall be used beneath the crushed base course on paved road sections.

44. PROJECT SIGN

The Contractor shall construct and install a project sign in accordance with the Funding Agency Special Provisions (Section 00 95 00). The Contractor shall submit a proposed sign design in accordance with this Section. The temporary sign shall also acknowledge the State Revolving Fund (SRF), Department of Natural Resources and Conservation (DNRC) and Treasure State Endowment Program (TSEP). The applicable dollar amounts for the sign will be provided by the Engineer. The Engineer will review Contractor's submittal and make any comments or corrections at that time. The location of signs shall be determined by the Engineer in the field. No separate payment will be made for this work. The cost of furnishing and installing the signs shall be included in the lump sum costs of the project.

45. WARRANTY

Unless specified otherwise, the Contractor shall warranty the project for one (1) year against defective materials and defective workmanship according to the General Conditions. The project shall not be accepted as substantially complete until ALL project segments are substantially complete. Only one (1) notice of substantial completion will be issued for this project. The warranty period will begin upon date of the notice of substantial completion. The one year warranty will not supersede any project components that may have a longer warranty period.

An eleven (11) month project inspection will be held with the Contractor, Owner, Engineer and Funding Agencies being invited to attend. At the inspection, warranty items will be defined for correction according to the General Conditions.

46. SLUDGE SEEDING

The new Aerobic Granular Sludge (AGS) treatment facility will require the controlled seeding of

waste activated sludge from a local wastewater plant. The Contractor shall be responsible for coordinating with a local activated sludge treatment facility to obtain and transport seed sludge during startup. The Contractor shall provide for seeding two of the reactor basins up to a concentration of 2,000 mg/l MLSS (approximately 6,900 lb. of solids per basin). The City will independently purchase and provide transport of granular sludge from an established AGS facility elsewhere in order to provide further seeding. The Contractor shall closely coordinate with Aqua-Aerobics Systems Inc. (AASI) to schedule, store and introduce the seed sludge and granules in accordance with AASI's established protocols.

47. ASSIGNMENT OF AASI EQUIPMENT PROCUREMENT CONTRACT

The City of Whitefish will assign its equipment procurement contract with Aqua-Aerobics Systems Inc. (AASI) to the Contractor upon award of the Construction Contract, whereupon the Contractor will be responsible for compensating AASI the remaining amount due as provided in the Bid Form (Section 00 41 43). The Contractor shall be responsible for acquisition of the AASI equipment, proper storage, installation, startup and warranty of the equipment for performance and workmanship.

48. HIERACHY OF SPECIFICATION

In the event that any provision of one Contract Document conflicts with the provision of another Contract Document, the provision in that Contract Document first listed below shall govern, except as otherwise specifically stated:

- Agreement
- Addenda to Contract Documents
- Performance and Labor & Materials Bonds
- Bid Proposal
- Bid Security
- Special Provisions
- Invitation to Bid
- Instructions to Bidders
- Drawings
- Technical Specifications
- Supplementary Conditions
- General Conditions

Whenever notes, specifications, dimensions, details, or schedules in the Specifications or Drawings, or between the Specifications and Drawings, or between Change Order or Work Change Directive drawings and Contract Drawings conflict, the Contractor shall furnish the higher performance or higher quality requirement determined by the Engineer.

49. PLANT DECOMMISSIONING

Upon completion and successful startup of the new treatment facilities it will be necessary for the contractor to remove the remaining wastewater effluent in Treatment Cells 2 & 3 by pumping the liquid portion to the screening facility at the plant or to the grit removal facilities. Care should be

taken to not remove sludge, rags or solids from the lagoon cells. Flow of the pumped effluent shall be regulated so as to not upset the new treatment facilities. A separate contract will be developed in the future for sludge removal and restoration of the lagoon cells.

Contents of the flocculating clarifier shall be pumped to the sludge drying beds using the existing sludge pumps.

50. SCHEDULING OF EQUIPMENT INSTALLATION

Scheduling of start-up, demonstration testing, and instructional activities shall be subject of approval of City and Engineer. The Contractor shall coordinate scheduling of start-up, demonstration testing, and instruction of Buyer's personnel by manufacturer's representatives.

Equipment will not be operated except by, or with the guidance of, qualified personnel provided by Manufacturer/supplier having the knowledge and experience necessary to obtain proper results. All items of equipment and systems will be tested for proper operation, efficiency and capacity by qualified personnel. Contractor shall provide authorized and qualified manufacturer's representative to inspect, check, and approve equipment installation prior to start-up and to assist with demonstration testing. Authorized representative shall supervise placing equipment into operation. Contractor will be responsible for planning, supervising, and executing the installation of work.

Upon completion of inspection, adjusting, and balancing the Seller shall demonstrate that each separate piece of equipment of each system and related mechanical or instrumentation and control equipment operate in accordance with the requirements of the Contract Documents. Where no performance requirements are specified, demonstrate the equipment operates in accordance with the manufacturer's requirements and industry standards for the specific application. When necessary for certain items of equipment, the final adjustments and inspections shall be made by factory trained service personnel (other than sales representatives), rather than by installation contractor. The Manufacturer's service personnel will also supervise the test operation. Following successful completion of the demonstration testing the Contractor shall be responsible for the operation of new equipment and/or systems for a minimum period of 30 days.

51. PERFORMANCE TESTING AND PLANT STARTUP

Upon completion of the required training, receipt of the final operation and maintenance manuals, completion of the required start-up and demonstration testing reports and following successful completion of the 30-day operating period, the Engineer shall initiate final acceptance of the project and equipment. All systems must be operational prior to the start of the 30-day performance test. Testing of a partial system will not be accepted. Following review of the relevant information, the Engineer shall recommend approval of the equipment and acceptance of the installation to the City of Whitefish. The City shall provide, in writing, notice

of acceptance of the equipment within a reasonable time after receipt of Engineer's recommendation.

It is recognized that full Plant Startup and Commissioning and achieving desired performance levels may take longer than the allocated 30 day performance period. Up to 90 days, after the plant has been determined to be substantially complete, will be allowed for the plant to achieved stabilized operational conditions and be capable of meeting designed performance standards.

Acceptance by City or approval of the Manufacturer's field representative will not relieve installation contractor of responsibility for defective work.

53. PROPRIETARY EQUIPMENT AND NON-DISCLOSURE AGREEMENT

Contractors are advised that a major element of this project involves the acquisition and installation of proprietary wastewater treatment equipment that is legally protected as such. The Aerobic Granular Sludge treatment equipment was developed by *Royal HaskoningDHV* and is provided through an agreement with Aqua-Aerobic Systems, Inc.. Contractors shall be familiar with and strictly observe the Non-Disclosure Agreement (NDA) that was included through Section 00 25 00 as part of the accepted Bid. There will be no exceptions. Contractor's failure to completely fulfill the NDA requirements could result in significant legal ramifications to that Contractor. Contractor shall indemnify the City against any legal action resulting from the Contractor's breach of its Non-Disclosure Agreement with the equipment manufacturer.

END OF SECTION 00 95 10

DIVISION 1

GENERAL REQUIREMENTS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.01 PROJECT

A. Project Name: Wastewater System Improvements Project.

B. Owner's Name: City of Whitefish.

C. Project Design Team:

1. Anderson-Montgomery Consulting Engineers, Inc.
   1064 N. Warren St.
   Helena, MT 59601

2. Robert Peccia & Associates
   3147 Saddle Drive
   Helena, MT 59601

3. CTA Inc.
   306 Railroad St. West Suite 104
   Missoula, MT 59802

4. Comma Q Architecture
   109 N. Rouse Ave. Suite 1
   Bozeman, MT 59715

D. The Project consists of the following major project elements to be conducted at the wastewater treatment plant site in Whitefish, Montana:

1. Existing Screening Building:
   a. supply non-potable water;
   b. new hose bibs;
   c. re-plumb hot water;
   d. upgrade control/alarm wiring

2. Main Lift Station (MLS):
   a. 3 new 75-HP pumps and motors;
   b. new check valves and air release valves;
   c. upgrade control system;
   d. establish fiber optic communications with Administration Building

3. Grit Removal;
   a. New Grit Handling Building;
   b. Vortex style grit removal basin;
   c. 5-HP grit pump;
   d. Grit flush system;
   e. Grit washer with bagger;

f. Grit receptacle;
g. Washwater return;
h. Control system;
i. Pinch valves;
j. 7.5-HP air compressor

4. Chemical Feed System:

a. 4,385-gal liquid alum storage tank;
b. Exterior tank fill, level monitoring, vent;
c. Four – 72 gph alum metering pumps;
d. Feed piping to feed well and reactor basins;
e. Control system;
f. Sink/eyewash/safety shower

5. Aerobic Granular Sludge Reactor Basins:

a. New Main Process Building with Electrical, UV, and Pump Rooms;
b. Three 60' by 40' concrete basins, process water depth of 23';
c. Feed Well and 20" Piping to Reactors including Control Valves
d. Influent Distribution System
e. Fine Bubble Aeration System and Three 100-HP Hybrid Blowers
f. Air and Water Flow Meters
g. Level Sensors
h. Overflow Launders with Scum Baffle
i. Scum Collection System Using Telescoping Valves
j. Waste Sludge Collection System
k. Process Monitoring Equipment and Instrumentation
l. Basin Drain System
m. Sludge Buffer Basins
n. Water Level Correction Basin
o. Two 5HP Sludge Waste/Return Pumps
p. One 5HP Water Level Control Pump
q. Automatic Control Valves
r. PC Based Process Control and Monitoring System
s. Required MCC and Electrical Components

6. <u>Ultraviolet Disinfection System</u>

a. Concrete Open Channel
b. Duel Banks of Sloped UV Lights
c. In-Place Cleaning System
d. Mechanical Light Removal
e. Ballast, Controls and Light Sensors
f. Bypass Piping, Valves and Slide Gates
g. New Effluent Discharge and River Diffuser
h. Non-Potable Water Basin after UV Channel
i. Two 10-HP Vertical Turbine Pumps using Pressure Controlled VFDs
j. Check valves, Isolation Valves and Flow Meter
k. Hydro-pneumatic Pressure Tank

l. Controls
m. Piping Distribution System

7. <u>Biosolids Treatment System</u>

a. 1.65 MG gallon Membrane lined Biosolids Storage Basin with Insulated Cover
b. Fine Bubble Aeration using Two 40-HP Hybrid Blowers
c. Sludge Mix System Utilizing Submerged Nozzles and Two 60-HP Mixing Pumps
d. Supernatant Discharge to Sidestream Lift Station via Control Structure
e. VFA Piping System to Sidestream Lift Station via Control Structure
f. Sidestream Lift Station with Two 7.5 HP 400 GPM pumps
g. Gravity Biosolids Drain to Sludge Drying Beds with Remote-actuated control Valve
h. New Sand Layer and geofabric in Drying Beds
i. Removal of unused electrical panels from Blower Building and minor repairs.

8. <u>Temporary Piping and Treatment System to Maintain Existing Facilities During Construction</u>

9. <u>Renovation of Existing Administration Building</u>

10. <u>Site Landscaping, Lighting and Transportation/Access Improvements</u>

11. <u>Plant Drain Improvements</u>

12. <u>Fiber Optic Communication System</u>

13. <u>System Commissioning and De-Commissioning of Unit Processes not Utilized</u>

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in this Document.

B. The City of Whitefish will assign the remaining portions of the Equipment Acquisition contract with Aqua-Aerobics to the Contractor. This pre-determined figure will be reflected in the Contractor's bid form.

1.03 WORK BY OWNER

A. The Owner will remove all furnishings, equipment, files and miscellaneous items that represent obstacles to construction, that are currently stored in the in the Screening Building, Main Lift Station, Blower Building and Administration Building before the Contractor begins demolition work. The Owner will facilitate the relocation of existing gas and overhead electrical utilities. Any items that are in the way of demolition/construction within the building(s) shall become the property of the Contractor. It will be the responsibility of the Contractor to dispose of these items as waste as outlined in these documents.

1.04 OWNER OCCUPANCY

A. The existing buildings identified in this summary are all currently occupied by the Owner. Cooperate with the Owner to minimize conflict due to demolition and

construction activities although it is acknowledged that construction progress is will take precedence. Coordinate with the Owner and their operations at all times.

1.05 CONTRACTOR USE OF SITE AND PREMISES

A. The Contractor shall conduct operations and take all necessary precautions to protect staff from exposure to dangers associated with the Work. Coordination and cooperation with the wastewater staff and Public Works Department as a whole is of the utmost importance.

B. Provide secure access to and from designated work area as required by law and per the requirements of the Owner:

1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.

2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Existing building spaces may not be used for storage unless specifically authorized by the Owner.

D. Time Restrictions:

1. Limit conduct of especially noisy and dusty exterior work to the hours of 8 am to 7 pm.

E. Utility Outages and Shutdown:

1. Interruption of any utility services must be coordinated through the Chief Operator. This coordination is to allow the reasonable use of the existing facilities at all times during normal working hours and interfere minimally with the Owner's operational activities.

2. Do not disrupt or shut down utility services without 7 days notice to the City and authorities having jurisdiction.

3. Prevent accidental disruption of utility services to other facilities.

1.06 WORK SEQUENCE

1. It will be necessary to conduct the demolition and construction work in a manner that minimizes disruption to the existing wastewater treatment facility capacity. This includes but is not limited to work involving wastewater treatment Cell #3, Main Lift Station, temporary influent/effluent piping, Blower Building and Administration building where existing processes are being modified/repurposed to transition to the new treatment facility. See Section 01 12 16 for additional information on Work Sequence.

2. The Contractor will closely coordinate with the Owner and Engineer before conducting any work that impacts existing facilities or overall treatment capacity of the existing wastewater treatment facility.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 11 00

SECTION 01 12 16
WORK SEQUENCE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. General Work Sequence.
2. Sequence of Construction.
3. Electrical Sequence of Construction.
4. Damages.

1.02 GENERAL WORK SEQUENCE

A. There is no emergency or other offline storage available at this site for temporary bypass operations. Limited storage capacity may be available in the treatment lagoons through adjustment of lagoon levels to create storage volume. All work will need to be done while maintaining operation of the existing treatment facilities.

B. Coordinate construction schedule and operation with Owner and Engineer. Accommodate Owner occupancy requirements.

C. Contractor shall submit a detailed Plan of Operation estimating all dates when interruption, temporary or bypass, will occur. Dates shall be updated as construction progresses. Special Provision 26 of these Contract Documents describes the Plan.

D. Contractor shall stay within time restraints for certain construction tasks as identified in the Contract Documents.

E. Contractor shall provide Owner and Engineer full access to new and existing facilities for the duration of the project.

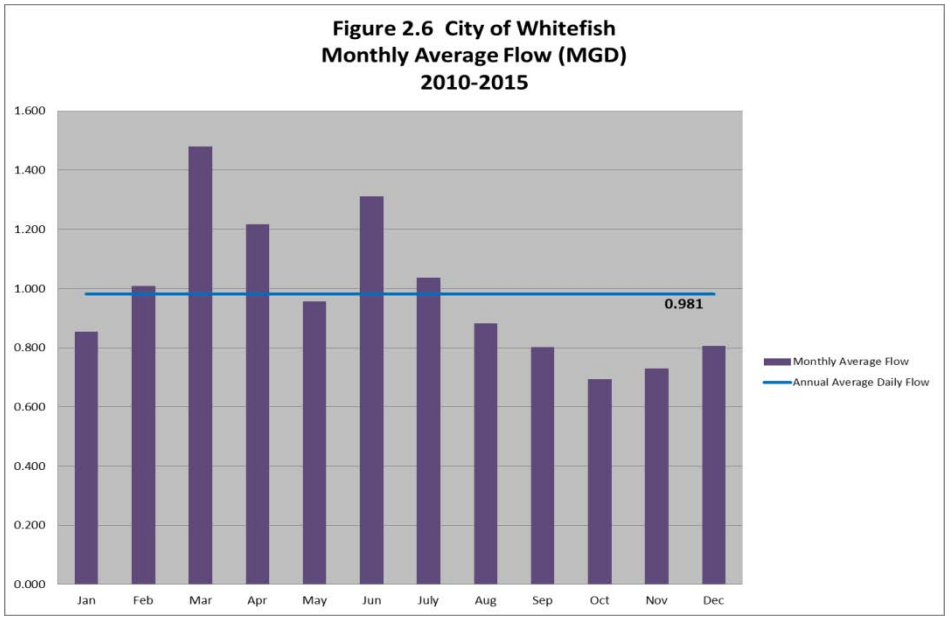
1.03 SEQUENCE OF CONSTRUCTION

A. The following sequence of work will be necessary to provide uninterrupted treatment of incoming wastewater. Contractor shall generally perform tasks in the order indicated and within the time constraints specified. This is not an exhaustive list of all work to be completed, but gives general idea of the sequencing required.

B. The work sequence provided herein is for the Contractor’s information. Contractor shall be free to modify it to meet his or her needs subject to the approval of the Owner and Engineer, and providing such modifications permit the treatment works to meet its MPDES effluent limits and regulations.

C. General:

1. The wastewater treatment plant (WWTP) influent flow and load varies over the year. A high flow season generally begins in March and continues through June. High instantaneous flows can be anticipated to periodically occur during this period. The following Figure 2.6, taken from the 2018 Whitefish Wastewater Preliminary Engineering Report indicates how flow varies on a monthly basis. Flow should be a consideration when performing tasks that impact or modify existing unit processes in the wastewater plant.



2. Initial work activities will be associated with site clearing, installation of a working surface and foundation stabilization for the new plant facilities. This work will require taking existing treatment Cell #3, discharge structures, aeration system components and dike work to install the necessary piping to reroute influent and effluent wastewater. The Civil drawings in the Project Drawings provide information on temporary piping. Generally the temporary piping will remain in service until full startup of new facilities has been completed. Temporary influent and effluent piping and temporary sludge forcemain shall be installed in a manner to minimize downtime on any aspect of the existing treatment system (see drawing sheets C-14, 15 and 16).
3. The aerated lagoon treatment system (without Cell #3), the flocculating clarifier, chemical feed, disinfection equipment, solids pumping and discharge to the sludge drying beds, including all ancillary equipment, must be kept in operation until the new facilities are fully operational and startup has been completed.
4. The existing aerated lagoon blowers must remain in service until the new blowers for the aerated sludge storage lagoon are ready for installation. At this juncture, the north and center blowers will be removed and the remaining existing blower on the south side of the building will remain in service. The two new blowers will be installed and put into operation as soon as possible to support additional aeration in

the treatment lagoons. The new blowers are intended to be connected to existing aeration piping which is being reused, in part, for the new facilities.

D. Headworks:

1. Work at the Headworks should not impact the operation of the screening process.

E. Main Pump Station:

1. Work at the Main Pump Station consists of installing three new pumps, valves, some piping and control system. It is intended that the lift station be bypassed during this work and the bypass period should be scheduled during typical low flow periods and the time of bypass kept to a minimum.

2. A wet well is located near the headworks screening building for setting up bypass pumping. A connection tee is located on the existing pump station forcemain to allow a convenient connection point for the bypass operation. See Sheet C1-1.

3. A detailed bypass operations plan is required as described in the Special Provisions.

F. Aerated Lagoon Cells:

1. Cell #3 of the existing aerated lagoon treatment system will need to be dewatered immediately in the sequence of project construction to allow installation of temporary piping and to initiate work on foundation stabilization for the new structures. Accumulated biosolids in the lagoon cell must be disposed of as discussed in Section 46 06 70 of the Specifications. Liquid in the lagoon cell can either be discharged, if of good quality, or re-processed by returning the contents back to Cell#1, excluding the return of solids. It will be the Contractor's responsibility to determine specifically the specific method for proper handling of the liquid and solids content of the lagoon cell.

2. Cells #1 and #2 will be maintained in service during the course of construction through plant startup. Aeration will be provided with the existing blower system, supplemented with installation of the new biosolids blowers. The Contractor will assist the Owner in optimizing wastewater treatment with the existing aerated lagoon cells and will minimize potential upsets to the system. At the end of construction, the Contractor will be responsible for pumping the liquid contents of the treatment lagoons to be introduced in a judicious manner into the new mechanical facility for treatment and discharge.

3. Flocculating Clarifier: The existing flocculating clarifier, chemical feed equipment, chlorination/dechlorination equipment and sludge pumping systems will need to remain functional for the entire period of construction until the transition to the new plant is completed. At the end of construction, the Contractor will be responsible for pumping the liquid contents of the flocculating clarifier. At this time, demolition work of piping and equipment in the existing Administration Building can be completed.

G. Sludge Drying Beds:

1. The existing sludge drying beds will need to be utilized during the course of construction to accept sludge from the flocculating clarifier and possible sludge from other sources, to facilitate drying. Renovation work on the drying beds can occur sequentially as all three cells will not be required for existing sludge disposal. The Contractor will be responsible for disposal of all sludge accumulated and placed on the drying beds during the period of construction.

H. Effluent Outfall Line to the Whitefish River:

1. The existing outfall line and diffuser must remain in service as long as the flocculating clarifier is still utilized.

I. Improvements to Plant Drain:

1. Two sections of the existing drain line are scheduled to be replaced with larger diameter piping. While this work could be scheduled at the Contractor's convenience, it may be easier to complete with during warmer climatic conditions. Bypass pumping will be required when the line is being replaced.

1.04 ELECTRICAL SEQUENCE OF CONSTRUCTION

A. Coordinate electrical construction sequence with general, process, and mechanical sequencing to maintain treatment and operation of building systems.

B. Provide temporary wiring to all loads during changeovers and to facilitate new construction. Install and maintain temporary wiring in accordance with NEC Article 305.

C. Where new power distribution and/or motor control equipment is to be installed in place of existing equipment, comply with the following.

1. Install and energize new equipment. Relocate existing equipment if space conflicts occur. Provide temporary feeders as required.

2. Transfer loads from existing equipment to new equipment one at a time. Ensure operation of each load prior to proceeding to next load.

3. Provide temporary control and signal wiring to maintain automatic control of automatically-operated equipment. Maintain safety interlocks for all control circuits.

4. After all loads have been transferred, remove existing equipment and wiring. Permanently wire new equipment.

D. For each treatment process having redundant equipment that is to be used during construction, only one of the redundant equipment items shall be disabled at a time (e. g. Influent Pumps).

E. If equipment is not capable of operating in an automatic mode with personnel and equipment safety devices functional, then it shall be the Contractor's responsibility to pay any wages resulting from additional manpower or man hours until the normal mode of operation is achieved.

1.05 SUMMARY

A. All parties involved with the proposed WWTP Improvements Project including the Contractor, and Owner need to strive for a common goal of keeping the existing treatment plant operational and able to treat wastewater in an adequate volume to meet user requirements in accordance with the MPDES discharge permit requirements.

B. In an attempt to prevent any inadvertent disruptions to the WWTP, the Contractor, through the Owner's Resident Project Representative, shall adequately communicate his intended plans and activities with the Treatment Plant Superintendent (Owner), and Engineer. The Owner recognizes the Contractor may require scheduled WWTP shutdowns in order to complete some necessary task. The Owner will make a reasonable attempt to alter operational procedures, including temporary shutdowns of the WWTP, to allow for Contractor work. Contractor shall notify Owner and Engineer of planned shut downs in accordance with the Contract Documents.

PART 2 - PART 2 PRODUCTS (Not Used)

PART 3 - PART 3 EXECUTION (Not Used)

END OF SECTION 01 12 16

SECTION 01 20 00
REQUIRED FORMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures and forms for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

A. Form to be used: Schedule of Values for Contract Payment – follow instructions in Section 01 29 00 Part 1.03

B. Forms filled out by hand will not be accepted.

C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section.

D. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Form to be used: Application for Payment (Section 00 62 76).

B. Forms filled out by hand will not be accepted.

C. Execute certification by signature of authorized officer.

D. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed.

E. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.

F. Submit electronic copy of each Application for Payment.

1.04 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.

B. For minor changes in the work not involving adjustment in the Contract Sum or Contract Time, the Architect will issue instructions directly to Contractor by written order. The Contractor shall carry out such written orders promptly.

C. For required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.

1. Form to be used: Work Change Directive (Section 00 63 49)

2. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.

3. Promptly execute the change.

D. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within seven (7) days.

E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation.

F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

G. Form to be used: Change Orders (Section 00 63 63)

1. Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

2. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

3. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

1.05 APPLICATION FOR SUBSTANTIAL COMPLETION

A. Form to be used: Certificate of Substantial Completion (Section 00 65 16)

B. Substantial Completion is the stage in the progress of the work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can utilize the work for its intended use.

C. Substantial Completion establishes the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance.

1.06 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been

accomplished:

1. All closeout procedures specified in Section 01 77 00.
2. Contractor's Affidavit of Completion, Payment of Debts and Claims, and Release of Liens.
3. Consent of Surety Company to Final Payment.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 20 00

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including general and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 1 Section “Payment Procedures” for administrative requirements.

2. Division 1 Section “Product Requirements” for administrative procedures for handling requests for substitutions made after Contract award.

1.03 VARIATIONS IN WORK

A. Engineer will issue a Field Order authorizing variations in Work, not involving adjustment of the Contract Sum or the Contract Time.

1.04 PROPOSAL REQUESTS

A. Owner-initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Engineer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in the Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

b. Indicated applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Include an updated Contractor’s Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

1.05 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, the Engineer will issue a Change Order for signatures of Owner and Contractor.

B. Change Order Form shall be in accordance with Section 00 63 63 of these Specifications

1.06 WORK CHANGE DIRECTIVE

A. Work Change Directive: Engineer may issue a Work Change Directive on EJCDC Document C-940 form – see Section 00 63 49 of these specifications. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

B. Work change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change n the Contract Sum or the Contract Time.

C. Documentation: The Contractor shall maintain detailed records on a time and material basis for work required by the Work Change Directive.

D. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Format and Preparation of Applications.
2. Schedule of Values
3. Submittal Procedures.
4. Substantiating Data.

B. Related Sections include:

1. Section 00 52 00 – Agreement.
2. Section 00 72 00 – General Conditions.
3. Section 01 26 00 – Contract Modification Procedures.
4. Section 01 33 00 – Submittal Procedures.
5. Section 01 77 00 – Closeout Procedures.

1.02 FORMAT AND PREPARATION OF APPLICATIONS

A. Utilize: Engineers Joint Contract Document Committee (EJCDC) Application for Payment Form (C-620, 2013 or 2018 Edition).

B. Preparation

1. Present required information in typewritten form.
2. Execute certification by signature of authorized officer.
3. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored Products.
4. List each authorized Change Order as an extension on Continuation Sheet, listing Change Order number and dollar amount as for an original item of Work.
5. Prepare Application for Final Payment as specified in Section 01 77 00.

1.03 SCHEDULE OF VALUES

A. Submit:

1. Typed schedule of values in format similar to EJCDC Application for Payment (C-620, 2013 or 2018 Edition).
2. In duplicate within 15 days after date of Owner-Contractor Agreement.
3. See Article 2.03.A.3 of the General Conditions.

B. Format:

1. Utilize the Table of Contents within Contract Documents.
2. Identify line items corresponding with number and title of Specification Section.
3. Provide sufficient information regarding means of measurement of quantities or progress completed for verification by Engineer.

C. Identify site mobilization including bonds and insurance separately. Payment for mobilization will be based on the percentage of the original contract amount in place as described in the following schedule:

Percentage of Original Contract Amount In-Place	Percentage of Lump Sum Price for Mobilization Earned
5	20
10	50
25	60
65	75
90	90
100	100

D. Payment: Payment for MOBILIZATON will be made on the percentage of the contract unit price bid per lump sum as indicated in the Bid Form.

1. Include within each line item a direct proportional amount of Contractor's overhead and profit.

E. Revise Schedule of Values to list approved Change Orders, and submit with each Application for Payment.

1.04 PROGRESS PAYMENTS

A. See 15.01 of the General conditions (S.C.)

1.05 SUBMITTAL PROCEDURES

A. Submittals

1. Five (5) copies of each Application for Payment.
2. Updated construction schedule with each Application for Payment.
3. Payment Periods: As stipulated in the Agreement.
4. Submit with transmittal letter as specified for Submittals in Section 01 33 00.
5. Administrative actions which must precede or coincide with submittal of final application for payment include:

a. Submit lien waivers, warranties and bonds, and project record documents with final application for payment.

b. Completion of all work not included in substantial completion as defined in General and Supplementary Conditions.

c. Completion of project closeout procedures as indicated in Section 01 77 00.

d. Removal of temporary facilities and services.

e. Removal of surplus materials, rubbish, or similar elements.

f. Final cleaning.

g. Transmittal of project construction record documents to Owner and Engineer.

h. Consent of surety for final payment.

1.06 SUBSTANTIATING DATA

A. When Engineer requires substantiating information, submit data justifying dollar amounts in question.

B. Provide one (1) copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

C. Provide copies of invoice(s) for payment of materials stored on-site. Payment will not be made for materials that are not stored on-site or within a bonded warehouse that has been approved by Engineer and Owner.

D. Contractor shall supply substantiating information in compliance with federal and state requirements for monthly utilization reports and weekly prevailing wage and labor rates for laborers on-site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this section.

1.02 SUMMARY

A. This Section specifies administrative provisions for coordination construction operations on Project including, but not limited to, the following:

1. Preconstruction Conference.
2. General project coordination procedures.
3. Conservation.
4. Coordination Drawings.
5. Administrative and supervisory personnel.
6. Project meetings.

B. Related Sections include the following:

1. Division 1 Section 01 70 00 - Execution Requirements - for procedure for coordinating general installation and field-engineering service, including establishment of benchmarks and control points.
2. Division 1 Section 01 77 00 - Closeout Procedures- for coordinating Contract Closeout.
3. Division 1 Section 01 32 00 - Construction Progress Documentation - for administrative requirements governing preparation and submittal of Contractor’s Construction Schedule and Submittals Schedule.

1.03 COORDINATION

A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different specification divisions and sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner, Engineer and separate contractors if coordination of their work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Installation and removal of temporary facilities and controls.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Preconstruction conferences.
6. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and minerals.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

a. All materials salvaged in the project shall become the property of the Owner unless otherwise specified. Material identified as salvage shall be delivered by the Contractor to a suitable storage location as directed by the Engineer.

1.04 SUBMITTALS

A. Staff Names: At the preconstruction conference submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office and mobile telephone numbers by which Contractor's representatives can be reached immediately. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of the contact list in temporary field office and by each temporary telephone.

1.05 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1.06 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless

otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: Engineer and Owner will schedule a preconstruction conference at the Project site or other convenient location. The meeting shall be conducted by the Engineer who shall review work responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and his superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
2. Contractor shall bring a written, detailed construction schedule to the preconstruction conference.
3. Agenda: The Owner, Engineer and Contractor shall discuss items of significance that could affect progress, including the following:
    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing.
    d. Designation of responsible personnel.
    e. Subcontractor list.
    f. Testing Responsibilities.
    g. Traffic Control.
    h. Procedures for processing field decisions and Change Orders.
    i. Procedures for processing Applications for Payment.
    j. Distribution of the Contract Documents.
    k. Submittal procedures.
    l. Preparation of Record Documents.
    m. Use of the premises.
    n. Responsibility for temporary facilities and controls.

o. Office, work, and storage areas.

p. Delivery and storage of materials and equipment.

q. Security.

r. Progress and restoration.

s. Working hours.

t. Specific TSEP, SRF, EPA and DNRC requirements.

u. Specific County regulations.

v. Montana DEQ requirements.

w. Coordination with private landowners.

C. Progress Meetings: Conduct progress meetings at regular intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of the Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meetings. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Review present and future needs of each entity present, including the following:

i. Interface requirements.

ii. Sequence of operations.

iii. *Maintenance of treatment capacity*.

iv. Status of submittals.

v. Deliveries.

vi. Off-site fabrications.

vii. Access.

viii. Site utilization.

ix. Temporary facilities and controls.

x. Work hours.

xi. Hazards and risks.

xii. Progress, restoration and cleanup.

xiii. Quality and work standards.

xiv. Change Orders.

xv. Documentation of information for payment requests.

3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

   a. Schedule Updating: Revise Contractor's construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including, but not limited to, the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.

B. Related Sections include the following:

1. Division 1 Section 01 29 00 - Payment Procedures - for submitting the Schedule of Values.
2. Division 1 Section 01 31 00 - Project Management & Coordination - for submitting and distributing meeting and conference minutes.
3. Division 1 Section 01 33 00 – Submittals - for submitting schedules and reports.
4. Division 1 Section 01 40 00 - Quality Requirements - for submitting a schedule of tests and inspections.
5. Division 1 Section 01 77 00 – Closeout Procedures - for submitting digital photographic documentation as part of the Project Record Documents at Project closeout.

1.03 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.

B. Event: The starting or ending point of an activity.

C. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.

3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

D. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

E. Milestone: A key or critical point in time for reference or measurement.

F. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.04 SUBMITTALS

A. Qualification Data: For firms and persons specified in Section 01 40 00 – Quality Requirements - to demonstrate their capabilities and experience. Include lists of completed project names and addressed, names and address of Engineers and Owners, and other information specified.

B. Preliminary Construction Schedule: Submit two printed copies: one a single sheet of reproducible media, and one print.

C. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.

D. Daily Construction Reports: Submit two copies at monthly intervals.

1.05 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.01 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an earlier or later completion date. Contract time can only be authorized through the formal Change Order process. See Section 01 26 00 and Standard General Conditions Article 9.07.

2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrications, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittals" in schedule. Coordinate submittal review times in contractor's Construction Schedule with Submittals Schedule.

4. Startup and Testing Time: Include time for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.

B. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final completion.

D. Contract Modifications: for each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.02 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule at the preconstruction conference.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for construction.

2.03 REPORTS

A. Daily Construction Reports: Engineer's Resident Project Representative (RPR) and the Contractor Quality Control (CQC) representative shall prepare **daily** construction reports recording the following information concerning events at Project site:

1. List of subcontractors at Project site.

2. List of separate contractors at Project site.

3. Approximate count of personnel at Project site.
4. High and low temperatures and general weather conditions.
5. Accidents.
6. Meetings and significant decisions.
7. Developing disputes.
8. Unusual events.
9. Stoppages, delays, shortages, and losses.
10. Meter readings and similar recordings.
11. Emergency procedures.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Work Change Directives received.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial Completions and occupancies.
18. Substantial Completion authorized.

PART 3 - EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE UPDATING

A. At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, order, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate actual completion percentage for each activity.

3.02 CONTRACTOR'S CONSTRUCTION SCHEDULE DISTRIBUTION

A. Distribute copies of approved schedule to Engineer, Owner, separate testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed

their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for submitting shop drawings, Product Data, and other miscellaneous submittals.

1.03 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Engineer's responsive action.

B. Informational Submittals: Written information that does not require Engineer's approval. Submittals may be rejected for not complying with requirements.

1.04 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Engineer for Seller's use in preparing submittals. ***It is important to note the proprietary nature of Aqua-Aerobics Inc. (AASI) equipment and the need for Sellers to enter into a Non-Disclosure Agreement prior to accessing any CAD drawings marked "Confidential".***

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, deliver, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Section 01 32 00 - Construction Progress Documentation - for list of submittals and time requirements for scheduled performance of related construction activities.

D. Direct Transmittal from Prime Seller: Engineer will not accept submittals from anyone but the Prime Seller – authorized by the Contractor's official signature.

E. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with Engineer's review of subsequent submittals. Engineer will advise Seller when a submittal being processed must be delayed to permit coordination with subsequent submittals. Engineer will advise Seller when a submittal being processed must be delayed for coordination.
2. Allow 15 days for processing each resubmittal.
3. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit review and processing.

F. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 4 by 5 inches on label or beside title block to record Prime Contractor's (Sellers's) review and approval markings and action taken by Engineer.
3. Include the following information on label for processing and recording action taken:
    a. Project name.
    b. Date.
    c. Name and address of Engineer.
    d. Name and address of Seller.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Unique identifier, including revision number.
    i. Number and title of appropriate Specification Section.

G. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

H. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

I. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will discard submittals received from sources other than Seller.

1. On an attached separate sheet, prepared on Seller's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on

previous submittal, and *deviations from requirement* of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.

2. Include Seller's certification stating that information submitted complies with requirements of the Contract Documents.
3. Transmittal Form: Provide locations on form for the following information:
    a. Project name.
    b. Date.
    c. Destination (To:).
    d. Source (From:).
    e. Names of subcontractor, manufacturer, and supplier.
    f. Category and type of submittal.
    g. Submittal purpose and description.
    h. Submittal and transmittal distribution record.
    i. Remarks.
    j. Signature of transmitter.

J. Distribution: Furnish copies of submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Use only final submittals with mark indicating action taken by Engineer in connection with construction.

PART 2 - PRODUCTS

2.01 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Number of Copies: Submit four (4) hard copies and one electronic copy (bearing the Contractor's legal signature) of each action submittal, unless otherwise indicated. Engineer will return two hard copies. Contractor will mark up and retain one returned copy as a Project Record Document.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:
    a. Manufacturer’s written recommendations.
    b. Manufacturer’s product specifications.
    c. Manufacturer’s installation instructions.
    d. Standard color charts.
    e. Manufacturer’s catalog cuts.
    f. Wiring diagrams showing factory-installed wiring.
    g. Printed performance curves.
    h. Operational range diagrams.
    i. Mill reports.
    j. Standard product operation and maintenance manuals.
    k. Compliance with recognized trade association standards.
    l. Compliance with recognized testing agency standards.
    m. Application of testing agency labels and seals.
    n. Notation of coordination requirements.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
    1. Preparation: Include the following information, as applicable:
        a. Dimensions.
        b. Identification of products.
        c. Fabrication and installation drawings.
        d. Roughing-in and setting diagrams.
        e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
        f. Shopwork manufacturing instructions.
        g. Templates and patterns.
        h. Schedules.
        i. Design calculations.
        j. Compliance with specified standards.
        k. Notation of coordination requirements.
        l. Notation of dimensions established by field measurement.

2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 inches by 11 inches but no larger than 30 by 40 inches.

D. Coordination Drawings: Comply with requirements in Section 01 31 00 - Project Management and Coordination.

E. Contractor's Construction Schedule: Comply with requirements in Section 01 32 00 - Construction Progress Documentation for Construction Manager's action.

F. Submittals Schedule: Comply with requirements in Section 01 32 00 - Construction Progress Documentation."

G. Application for Payment: Comply with requirements in Section 01 29 00 - Payment Procedures.

H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specifications Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

2.02 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specifications Sections.

1. Number of Copies: submit two (2) hard copies and one electronic copy of each informational submittal, unless otherwise indicated. Engineer will not return copies.

2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

3. Test and Inspection Reports: Comply with requirements in 01 40 00 – Quality Requirements.

B. Contractor's Construction Schedule: Comply with requirements in Section 01 32 00 - Construction Progress Documentation.

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addressed, names and addresses of Engineers and Owners, and other information specified.

D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

G. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.

H. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

I. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.

J. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product.

K. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

L. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

M. Maintenance Data: Prepare written and graphic instructions and procedure for operation and normal maintenance of products and equipment. Comply with requirements in Section 01 77 00 - Closeout Procedures.

N. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculation. Include page numbers.

O. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guideline, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerance.
3. Sequence of installation or erection.
4. Required installation tolerance.
5. Required adjustments.
6. Recommendations for cleaning and protection.

P. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

Q. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance and bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amount of deductibles, if any, and term of the coverage.

R. Material Safety Data Sheets: Submit information directly to Owner. If submitted to Engineer, Engineer will not review this information but will return it with not action taken.

PART 3 - EXECUTION

3.01 CONTRACTOR'S REVIEW

A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Seller's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.02 ENGINEER'S ACTION

A. General: Engineer will not review submittals that do not bear Seller's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicated action taken, as follows:

   1. No Exceptions Noted.

   2. Exceptions Noted

   3. Returned for Correction.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor and/or Equipment Supplier of responsibility for compliance with the Contract Document requirements.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Documents requirements.

3. Requirements for Contractor/Supplier to provide quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Section 01 32 00 - Construction Progress Documentation - for developing a schedule of required tests and inspections.

2. Divisions 2 through 16 Technical Sections for specific test and inspection requirements.

1.03 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.04 SUBMITTALS

A. Qualification Data: For testing agencies specified in Section 01 40 00 - Quality Requirements - to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and re-inspecting.

C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project,

whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in those types of tests and inspections to be performed.

F. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.

1. Contractor responsibilities include the following:

a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.

b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection and similar quality-assurance service to Engineer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.06 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency or Engineer to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.

2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to the Contractor.

B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
6. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
7. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

C. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
5. Do not perform any duties of Contractor.

D. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspecting equipment at Project site.

E. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Owner-Provided Temporary Utilities.

B. Contractor-Provided Temporary Utilities.

C. Security requirements.

D. Vehicular access and parking.

E. Waste removal facilities and services.

F. Field offices.

1.02 OWNER_PROVIDED TEMPORARY UTILITIES

A. Owner will provide the following:

1. Electrical power, consisting of connection to Owner’s existing electric infrastructure. Any damage due to making or maintaining this connection shall be completely repair with no cost to the Owner.

2. Water supply, consisting of connection to Owner’s existing water infrastructure. Any damage due to making or maintaining this connection shall be completely repair with no cost to the Owner.

3. The contractor will be expected to use Owner provided utilities in a conservative manner.

B. Existing facilities may not be used.

C. Contractor shall use trigger-operated nozzles for water hoses, to avoid waste of water.

1.03 CONTRACTOR-PROVIDED TEMPORARY UTILITIES

A. Telecommunications Services

1. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Temporary Sanitary Facilities

1. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

2. Maintain daily in clean and sanitary condition.

C. Barriers

1. Provide barriers to prevent unauthorized entry to demolition areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of

site and to protect existing facilities and adjacent properties from damage from demolition operations.

2. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

D. Fencing

1. Construction: Commercial grade chain link fence.

2. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks. Keep fenced enclosure locked at all times.

E. Bypass Pumping

1. Bypass pumping shall only be implemented after the submittal and approval of a Bypass Pumping Plan of Operation (BPPO) in accordance with Article 25 of SPECIAL PROVISIONS Section 00 95 10.

2. The Contractor shall provide for dependable bypass pumping for as long as necessary for replacement of the Main Lift Station pumping apparatus and for any other instances where bypass or transfer pumping (for the contents of existing treatment cells #1, #2, and #3, the flocculating clarifier, hydrostatic testing, etc.) is required to conduct the Work. All costs for pumping shall be included in the lump sum bid price and specifically identified in the applicable division within the Schedule of Values.

1.04 SECURITY

A. Provide security (as outlined above and in Article 29 of SPECIAL PROVISIONS Section 00 95 10) to protect the project site, existing facilities, and Owner's operations from unauthorized entry, vandalism, injury or theft.

B. Coordinate with Owner's security program.

1.05 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Designated existing on-site roads may be used for construction traffic. Coordinate with Construction Manager and MSH on-site representative.

F. Provide temporary parking areas to accommodate Contractor personnel.

1.06 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site at regular intervals..

C. If materials to be recycled or must be stored on-site, provide suitable non-combustible storage areas unless otherwise approved by the authorities having jurisdiction.

1.07 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, ventilating equipment, and equipped with sturdy furniture.

B. Locate offices a minimum distance of 30 feet from existing structures.

1.08 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 50 00

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following administrative and procedural requirements: selection of products for use in Project: product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include, but are not limited to, the following:

1. Section 01 77 00 - Closeout Procedures - for submitting warranties for contract closeout.

2. Divisions 2 through 16 for specific requirements for warranties on products and installation specified to be warranted.

1.03 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of dated of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are no considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specifications: Where a specific manufacturer's product is named including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorse by manufacturer to Owner.

E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

F. Reference herein to the name "Contractor" will be considered the same as the name "seller".

1.04 SUBMITTALS

A. Substitution Request: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified material or product cannot be provided.

b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

e. Samples, where applicable or requested.

f. List of similar installations for completed projects with project names and addressed and names and addresses of Engineers and owners.

g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

h. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.

i. Cost information, including a proposal of change, if any, in the Contract Sum.

j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.

k. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Change Order.

b. Use product specified if Engineer cannot make a decision on use of a proposed substitution within time allocated.

B. Basis-of-Design Product Specifications Submittal: Comply with requirements in Division 1 Section "Submittal Procedures" Show compliance with requirements.

C. Contractor will be responsible for any project redesign and/or construction costs that may become necessary as a result of the product substitution.

1.05 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

5. Store products to allow for inspection and measurement of quantity or counting of units.

6. Store materials in a manner that will not endanger Project structure.

7. Store products that are subject to damage by the elements, under cover in a watertight enclosure above ground, with ventilation adequate to prevent condensation.

8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

9. Protect stored products from damage.

1.07 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 33 00 – Submittal Procedure and Section 01 77 00 - Closeout Procedures.

PART 2 - PRODUCTS

2.01 PRODUCT OPTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include the following:

1. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

a. Substitutions may be considered unless otherwise indicated.

2. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.

a. Substitutions may be considered, unless otherwise indicated.

2.02 PRODUCT SUBSTITUTIONS

A. Timing: Engineer will consider requests for substitution if received within 30 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Engineer.

B. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducing additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

2. Requested substitution does not require extensive revisions to the Contract Documents.

3. Requested substitution is consistent with the Contract Documents and will produce indicated results.

4. Substitution request is fully documented and properly submitted.

5. Requested substitution will not adversely affect Contractor's Construction Schedule.

6. Requested substitution has received necessary approvals of authorities having jurisdiction.

7. Requested substitution is compatible with other portions of the Work.

8. Requested substitution has been coordinated with other portions of the Work.

9. Requested substitution provides specified warranty.

2.03 COMPARABLE PRODUCTS

A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents;

2. That it is consistent with the Contract Documents and will produce the indicted results, and that it is compatible with other portions of the Work.

3. Detailed comparison of significant qualities of proposed product with those named n the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

4. Evidence that proposed product provides specified warranty.

5. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
6. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 70 00
EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Sections include, but are not limited to, the following:

1. Section 01 33 00 - Project Management and Coordination - for procedures for coordinating field engineering with other construction activities.
2. Section 01 33 00 - Submittal Procedures - for submitting surveys.
3. Section 01 77 00 - Closeout Procedures for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.03 SUBMITTALS

A. Qualification Data: Land surveyors must demonstrate their capabilities and experience. Include lists of completed projects with project names and addressed, names and addresses of Engineers and Owners, and other information specified.

1.04 QUALITY ASSURANCE

A. Land Surveyor Qualifications; A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services is necessary for all required legal surveys.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3.02 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocated existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of propose utility interruptions.

2. Do not proceed with utility interruptions without Engineer’s written permission.

C. Field Measurements: Take field measurements as required to locate and execute the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Space Requirements: Verify space requirements and dimensions of items shown on Drawings.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.03 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.

4. Check the location, level and plumb, of every major element as the Work progresses.

5. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.

6. Close site surveys with an error of closure equal to or less than the standard established by authorities in the surveying discipline.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.04 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocated existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide

temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.05 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do no use tools or equipment that produces harmful noise levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

G. Hazardous Materials: Use products, cleaners and installation materials that are not considered hazardous.

3.06 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of material lawfully.

1. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

F. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortors, oils, putty, and similar materials.

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original Condition.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.07 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualifications requirements in Division 1 Section "Quality Requirements."

3.08 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

3.09 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction.

1. Repair includes replacing defective parts, refinishing damaged surfaces, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

END OF SECTION 01 70 00

SECTION 01 75 00
STARTING AND ADJUSTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Starting Systems.
2. Adjusting
3. Pre-functional Testing

B. Related Sections include:

1. Section 01 40 00 – Quality Control.
2. Section 01 77 00 – Closeout Procedures.
3. Section 01 79 00 – Classroom and Demonstration Testing.
4. Section 01 91 00 – General Commissioning Requirements.

1.02 QUALITY ASSURANCE

A. Provide authorized and qualified manufacturer's representative to inspect, check, and approve equipment installation prior to start-up, at start-up and to assist with prefunctional testing.

B. Authorized representative shall supervise placing equipment into operation.

C. Prior to Functional Testing, provide written confirmation that systems have been tested, adjustments have been made, and equipment prefunctional testing is complete. Functional testing shall not commence until written approval of prefunctional testing is provided by Engineer.

D. Provide access to equipment and systems. Operate systems at designated times and under conditions required.

E. Contractor shall submit four (4) copies of written start-up report for each system or equipment item following each start-up and each prefunctional test.

1.03 SCHEDULING

A. Contractor shall submit four (4) copies of start-up and prefunctional testing checklists at least 15 calendar days prior to proposed dates. List times and dates for each system or equipment item. Include names of Contractors and subcontractors personnel, manufacturer, and/or authorized representative proposed to perform services. Provide documentation to verify their qualifications.

B. Contractor shall coordinate scheduling of start-up and prefunctional testing. Scheduling shall be subject to approval of Owner and Engineer.

C. Contractor shall notify Owner and Engineer of changes in scheduling at least five (5) days

in advance prior to scheduled start-up of individual systems or equipment. Scheduling changes shall be subject to approval by Owner and Engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 PREPARATION

A. Confirm wiring to motors and controls are operational.

B. Inspect equipment for cleanliness and remove or clean foreign matter.

C. Lubricate each piece of equipment according to manufacturer's instructions. Check alignment, drive rotation, equipment speed, control sequence, and other conditions which may cause damage. Provide adjustment as required.

D. Confirm that equipment is properly anchored and supported.

E. Confirm wiring to motors and controls are operational.

F. Confirm that auxiliary systems such as seal water and spray water systems are operational.

G. Confirm that tests, meter readings, and specific electrical characteristics, including motor amperage agree with those specified.

H. Confirm that control system is operational in automatic mode.

I. Inspect hand and automatic valves, clean bonnets and stems, tighten packing glands to ensure no leakage. Adjust valves as necessary for proper operation. Verify valve proper valve positioning for prior to start-up and testing of associated equipment.

J. Provide instruments required for testing, adjusting, and balancing operations.

K. All costs associated with starting, testing, adjusting, and balancing equipment including power and fuel costs shall be responsibility of the Contractor.

3.02 START UP

A. Provide services of an Experienced, Competent and Authorized Representative of Manufacturer for minimum of (8) hours. Additional starting services shall be provided if called for in individual specification sections. Representative shall, at a minimum, perform the following:

1. Inspect equipment covered by these Specifications.
2. Supervise any adjustments and installation checks.
3. Assist in start-up of equipment and operation checks and tests, including prefunctional testing.
4. Conduct manufacturer's recommended startup and checkout procedures.
5. Furnish Owner and Engineer with a written report prepared by equipment supplier certifying that equipment:
    a. Has been properly installed.

b. Is in accurate alignment.

c. Is free from an undue stress imposed by connecting piping, anchor bolts, etc.

d. Has been operated under full load conditions and that it operated satisfactorily.

3.03 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.04 PREFUNCTIONAL TESTING

A. Contractor shall develop prefunctional checklists with the start-up plans.

B. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.

1. No sampling of identical or near-identical items is allowed.

2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.

3. The following types of information will be gathered via the completed Checklist forms:

a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.

b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.

c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."

d. Serial number of installed unit.

e. List of inspections to be conducted to document proper installation prior to Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer’s start-up checklist items and minor testing.

C. Contractor is responsible for filling out Prefunctional Checklists. Witnessing by the Engineer and/or Owner is not required unless otherwise specified.

1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.

2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.

3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.

4. If any Checklist line item is not relevant, record reasons on the form.

5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
7. Submit completed Checklists to Engineer within two days of completion.

D. Prefunctional testing to be completed by Contractor to ensure equipment and systems integral to them are complete and ready for functional testing. Completed checklist shall contain language

END OF SECTION 01 75 00

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Closeout Procedures.
2. Substantial Completion
3. Final Completion
4. Certificate of Occupancy
5. Final Cleaning.
6. Project Record Documents.
7. Spare parts and Maintenance Products.
8. Warranties and Bonds.
9. Maintenance Service.

B. Related Sections include:

1. Section 01 31 00 – Project Management & Coordination.
2. Section 01 50 00 – Temporary Facilities and Controls.
3. Section 01 75 00 – Starting and Adjusting.
4. Section 01 78 23 – Operation and Maintenance Data.

1.02 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.

B. Provide submittals to Engineer that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

D. Owner will occupy all portions of the Project.

1.03 SUBSTANTIAL COMPLETION

A. Prior to substantial completion Contractor shall review Contract Documents for items which are not complete or need to yet be completed including submittal of all manuals, and testing reports. Contractor shall make a list of incomplete work, a value of the incomplete work, and reasons why work is incomplete. Contractor shall complete all items required to be completed as part of substantial completion.

B. Contractor shall provide a written notice to Engineer that the work, or specific portions of the work, is substantially complete and ready for review. If there are any items remaining to be corrected or completed Contractor shall submit a list of these items along with the notice of substantial completion. Along with the list of items the Contractor should provide a written explanation of why these items are not considered necessary for substantial completion.

C. Upon receipt of Contractor's notice of substantial completion, Engineer will proceed with inspection for substantial completion.

D. Following the substantial completion inspection by the Engineer and Engineer's subconsultants, Engineer will either prepare certificate of substantial completion, or notify the Contractor in writing that substantial completion has not been meant listing the various reasons.

E. Contractor shall promptly complete the items required to meet substantial completion and submit a second notice of substantial completion to the Engineer.

F. Engineer will review the work a second time do determine the status of substantial completion.

G. When Engineer considers the project to be substantially complete, Engineer will prepare the preliminary certificate of substantial completion along with a substantial completion punch list of items to be completed prior to final payment. Engineer will deliver preliminary certificate and punch list to Owner and consider any objections by the Owner as provided in the Conditions of the Contract.

H. Upon agreement by Owner and Engineer of substantial completion and punch list items, Engineer will execute and deliver to the Contractor and Owner a final certificate of substantial completion along with substantial completion punch list of items to be completed prior to final payment.

I. A maximum of two (2) reviews of substantially complete work will be completed by Engineer and Engineer's subconsultants for any one portion of work under the Contract. Should a third or subsequent reviews be necessary the following requirements will be met:

   1. Owner will compensate Engineer for additional reviews.

   2. Owner will deduct the amount of compensation paid to the Engineer for additional reviews from the payment to the Contractor.

   3. Compensation shall be at Engineer's standard hourly rates plus actual cost of reimbursables.

1.04 FINAL COMPLETION

A. Following substantial completion Contractor shall complete remaining work and items to be corrected as part of substantial completion punch list as well as final cleaning and transferring site to Owner.

B. When Contractor considers that all work is complete, Contractor shall provide written notice of final completion to Engineer.

C. Following receipt of final completion certification, Engineer and Engineer's subconsultants shall review the work to verity that the requirements for final completion have been met.

D. Upon review of work for final completion Engineer will either request the Contractor to make closeout submittals or will notify Contractor that the work is not complete with a list of incomplete or defective work.

E. Contractor shall promptly take steps to correct all listed deficiencies and incomplete work before sending a second written notice of final completion certification to Engineer.

F. If final completion was not met following first review, Engineer will review work a second time to determine if the requirements for final completion have been met.

G. A maximum of two (2) reviews of final complete work will be completed by Engineer and Engineer's subconsultants for any one portion of work under the Contract. Should a third or subsequent reviews be necessary the following requirements will be met:

1. Owner will compensate Engineer for additional reviews.
2. Owner will deduct the amount of compensation paid to the Engineer for additional reviews from the payment to the Contractor.
3. Compensation shall be at Engineer's standard hourly rates plus actual cost of reimbursables.

H. When Engineer considers all work to be complete in accordance with the Contract Documents, Engineer shall request the Contractor to make closeout submittals.

1.05 CERTIFICATE OF OCCUPANCY

A. In accordance with State Building Codes, when WORK is complete and ready for occupancy, CONTRACTOR shall contact local building official and request a final building code review for the purposes of obtaining a Certificate of Occupancy for the new Water Treatment Plant.

B. CONTRACTOR shall, in accordance with Supplementary Conditions submit copy of Certificate of Occupancy with final Application for Payment.

1.06 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains, and foreign substances, polish transparent and glossy surfaces, mop all floors.

C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

D. Replace filters of operating equipment.

E. Clean debris from roofs, gutters, downspouts, and drainage systems.

F. Clean site; sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.07 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling current and future reference by Owner and Engineer.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Provide GPS survey during construction for horizontal and vertical locations of all underground piping and utilities at fittings, valves, building connections, pull boxes, junction boxes, manholes, and other appurtenances.
4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
5. Field changes of dimension and detail.
6. Details not on original Contract drawings.

G. Submit documents to Engineer with claim for final Application for Payment.

1.08 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Provide spare parts, maintenance, and extra Products in quantities specified in individual specification sections.

B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.09 WARRANTIES AND BONDS

A. Provide duplicate notarized copies.

B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in D size three ring binders with durable plastic cover.

D. Submit prior to final Application for Payment.

E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of components during the warranty period.

B. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

D. Maintenance service shall not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

1.11 FINAL ADJUSTMENT OF ACCOUNTS

A. Contractor shall submit a final statement of accounting to Engineer. Statement shall reflect all adjustments to the contract sum and include the following:

1. Original contract sum.
2. Additions and deductions resulting from:
    a. All previous change orders
    b. Allowances
    c. Unit prices
    d. Deductions for uncorrected work
    e. Penalties and bonuses
    f. Deductions for liquidated damages
    g. Deductions for multiple reviews
    h. Other adjustments
3. Total contract sum as adjusted.
4. Previous payments.

5. Sum remaining due.

B. Engineer will prepare a final change order, reflecting approved adjustments to the contract sum which were not previously made by change orders.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 77 00

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Quality Assurance.
2. Format.
3. Contents of Each Volume.
4. Manual for Equipment and Systems.
5. Instruction of Owner's personnel.
6. Submittals.
7. Asset Management Submittals.
8. Schedule of Submittals.

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures.
2. Section 01 40 00 – Quality Requirements.
3. Section 01 77 00 – Closeout Procedures.

1.02 QUALITY ASSURANCE

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.03 FORMAT

A. Prepare data in the form of an instructional manual. Arrange data in numerical format in accordance with the Specification Divisions.

1. Binders:
   a. Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers.
   b. 2 inch maximum ring size.
   c. When multiple binders are used, correlate data into related consistent groupings.
2. Cover; Identify:
   a. Each binder with typed title OPERATION AND MAINTENANCE INSTRUCTIONS.

b. Title of Project.

c. Subject matter of contents.

d. Volume number.

e. Year of construction.

3. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.

B. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

C. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages. Folded paper should be unfoldable without removal from binder.

D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

a. Significant design criteria.

b. List of equipment.

c. Parts list for each component.

d. Operating instructions.

e. Maintenance instructions for equipment and systems.

3. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.

b. Air and water balance reports.

c. Certificates.

d. Photocopies of warranties.

e. Bonds.

1.04 CONTENTS OF EACH VOLUME

A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer, Subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts,

and data applicable to installation. Delete inapplicable information.

D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

F. Warranties: Prepare and submit per Section 01 77 00.

G. Bonds: Prepare and submit per Section 01 77 00.

1.05 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed. Refer to applicable Division 16 specification Sections.

C. Include color coded wiring diagrams as installed. Refer to applicable Division 26 specification Sections.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage, and local sources of supply.

N. Additional Requirements: As specified in individual Product specification sections.

O. Provide a listing in Table of Contents for design data, with tabbed dividers and space for

insertion of data.

P. Electronic Copies: Compact discs (CD) OR USB drives shall be provided with all manuals in electronic format in a portable document format (*.pdf). The documents shall be placed as required under the appropriate tabs and labels as previously required for the compact disk. Each file shall be adequately labeled to identify the contents without requiring the document to be opened. Additionally all files shall be named consistently and in a uniform system for cataloguing files.

1.06 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.07 SUBMITTALS

A. Submit electronic copy of preliminary draft or proposed formats and outlines of contents before Substantial Completion. Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit electronic copies of completed volumes fifteen (15) working days prior to final inspection. One (1) copy will be returned after final inspection, with Engineer comments. Revise content of all document sets as required prior to final submission.

D. Submit four (4) sets of revised final volumes in final form within ten (10) days after final inspection.

1.08 ASSET MANAGEMENT SUBMITTALS

A. Contractor shall submit additional information on equipment and asset information in an excel spreadsheet. Engineer shall supply Contractor with the excel spreadsheet with equipment and tags and Contractor shall be responsible for coordinating with manufactures and vendors to fill out the spreadsheet for the equipment types and information indicated below. Information shall be provided for all process equipment, valves, gates, instruments, mechanical equipment, electrical equipment, hoists, and any other equipment deemed necessary to document by the Owner. Information shall include but not limited to:

1. Product Name & Model
2. Manufacturer Contact Information (Phone/Email/Address)
3. Supplier Contact Information (Phone/Email/Address)

4. Asset Cost
5. Asset Installation Cost
6. Warranty Expiration Date
7. Warranty Length
8. Pump Information (Impeller Size/Inlet Size/Outlet Size)
9. Blower Information (Discharge Pressure/Air Flow/Speed/Design Air Temperature)
10. Mixers (Impeller Diameter/RPM/Max Thrust)
11. Conveyors (Screw Size/Capacity)
12. Valves (Size/Type/Material/Mount Type/Actuator Type)
13. Flow Meters (Type/Size/Mount Type/Range)
14. Gates (Type/Material/Seal Type/Actuator Type)
15. Actuators (Torque Range/Output Speed/Position Range)
16. UV (Design Flow / Minimum Does/Design UVT/Power Rating)
17. Filters (Type/Opening Size/Capacity)
18. Screens (Type/Opening Size/Design Flow)
19. Grit Removal (Type/Design Flow)
20. Chemical and Polymer Skid Systems (Inlet Size/Outlet Size/Capacity)
21. Instruments (Size/Accuracy/Range/Voltage/Current Output)
22. Cranes and Hoists (Capacity/Hook Height/Clear Span)
23. Electrical Equipment (KVA/Voltage/Phase/Horizontal Amps/Vertical Amps)
24. Heating Equipment (BTU Input/KW Input/Airflow/Voltage/Phase/Wattage)
25. Ventilation Equipment (Vent Size/Design Air Flow/Drive Type/Fan Diameter)
26. Cooling Equipment (BTU Input/KW Input/Airflow/Voltage/Phase/Wattage)
27. Compressors (Type/Max Pressure)
28. Plumbing Equipment (BTU Input/Capacity)
29. Safety Equipment (Fire Extinguishers/Smoke Detectors/Gas Detectors/Eye Wash/Safety Harness)
30. Fence & Door Operators (Voltage/Size)
31. Motor Information (Horsepower/RPM/Voltage/Phase/Frame/Full Load Amps/Manufacturer/Manufacturer Contact Information /Model/Serial Number)
32. Gear Reducer Information (Manufacturer/Manufacturer Contact Information /Model/Serial Number)

B. Contractor shall also provide preventative maintenance forms for specific maintenance requirements for pieces of equipment. The preventative maintenance forms shall include steps to take to perform maintenance and shall be provided in an electronic format in a form which can be input into an asset management system. Engineer shall supply contractor with a typical form and Contractor shall be responsible for filling out preventative maintenance forms for the equipment types specified above and coordinating with manufactures and vendors to fill out forms.

C. Contractor shall supply an installed photo of all equipment in spreadsheet to be included in the asset management software system.

D. Contractor shall coordinate RFID tags from equipment to integrate into the asset management system selected by the Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SCOPE

A. Throughout progress of the work, maintain an accurate record of changes in the Contract Documents, as described below. Upon completion of the work, submit all recorded changes to the Engineer.

1.02 QUALITY ASSURANCE

A. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff.

1.03 ACCURACY OF RECORDS

A. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of drawings and other documents where such entry is required to describe the change properly.

B. Accuracy of records shall be such that future search for items shown in the Contract Documents may rely reasonably on information obtained from the approved Project Record Documents.

C. Make entries within 24 hours after receipt of information that the change has occurred or has been observed.

1.04 PRODUCT HANDLING

A. Protect the job set of Record Documents from deterioration loss and/or damage at all times.

B. If the recorded data is lost, use means necessary to secure the data to the Engineers satisfaction. Acquisition of required data will be at contractor’s expense.

1. Such means shall include, if necessary in the opinion of the Engineer, removal and replacement of concealing materials.

2. In such case, restore work to the requirements or the contract documents.

PART 2 - MATERIALS

2.01 RECORD DOCUMENTS

A. Job Set: Promptly following receipt of the Engineer's Notice To Proceed, secure from the Engineer at no charge to the Contractor/Equipment Supplier one complete set of all documents.

PART 3 - INSTALLATION/WORKMANSHIP

3.01 MAINTENANCE OF JOB SET

A. Immediately upon receipt of the job set described above, identify each of the documents with the title, "RECORD DOCUMENTS - JOB SET".

B. Preservation:

1. Considering the contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed, devise a suitable method for protecting the job set acceptable to the Engineer.

2. Do not use the job set for any purpose except entry of new data and for review by the Engineer.

C. Making entries on drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describing the change by graphic line and note as required.

2. Date all entries.

3. Call attention to the entry by a "cloud" drawn around the area or areas affected.

4. In the event of overlapping changes, use different colors for the overlapping changes.

D. Make entries in the other pertinent documents as approved by the Engineer.

E. Conversion of schematic layouts:

1. In some cases on the drawings, arrangements of conduits, circuits, piping, ducts, and similar items, are shown schematically and are not intended to portray precise physical layout.

2. Final physical arrangement is determined by the Contractor, subject to the Engineer's approval.

3. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the drawings.

4. Show on the job set of Record Drawings, by dimension accuracy within one inch, the centerline of each run of items as described above.

5. Clearly identify the item by accurate note such as "cast iron drain", "galv. water", and the like.

6. Show, by symbol or note, the vertical location of the item ("under slab", "in ceiling plenum", "exposed", and the like).

7. Make all identification sufficiently descriptive that it may be related reliably to the Specifications.

3.02 FINAL PROJECT RECORD DOCUMENTS

A. Review and submittal:

1. Submit the completed set of Project Record Documents to the Engineer.

2. Participate in biweekly review meetings.

3. The Engineer will transfer the information from the project record document to the original project documents which will be noted as record drawings.

3.03 CHANGES SUBSEQUENT TO ACCEPTANCE

A. The Contractor is not responsible for recording changes in the work subsequent to final completion, except for changes resulting from work performed under warranty.

END OF SECTION 01 78 39

SECTION 01 79 00
CLASSROOM AND DEMONSTRATION TRAINING

PART 1 - GENERAL

1.01 SUMMARY

A. Classroom training and demonstration training of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of City of Whitefish personnel in operation and maintenance is required for:

1. All software-operated systems.
2. HVAC systems and equipment.
3. Plumbing equipment;
4. Main Lift Station equipment;
5. Electrical systems and equipment;
6. Grit handling systems;
7. Granular Activated Sludge treatment systems;
8. Ultraviolet Disinfection System;
9. Sidestream Lift Station;
10. Non-potable Water System;
11. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 – Submittals

B. Section 01 91 00 – General Commissioning Requirements

C. Section 01 77 00 – Closeout Procedures.

1.03 SUBMITTALS

A. Draft Training Plans: City of Whitefish will designate personnel to be trained; tailor training to needs and skill-level of attendees.

1. Submit to Engineer for transmittal to City of Whitefish.
2. Submit not less than four weeks prior to start of training.
3. Revise and resubmit until acceptable.
4. Provide an overall schedule showing all training sessions.
5. Include at least the following for each training session:

a. Identification, date, time, and duration.

b. Description of products and/or systems to be covered.

c. Name of firm and person conducting training; include qualifications.

d. Intended audience, such as job description.

e. Objectives of training and suggested methods of ensuring adequate training.

f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.

g. Media to be used, such as slides, hand-outs, etc.

h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

B. Training Manuals: Provide training manual for each attendee; allow for minimum of three attendees per training session.

1. Include applicable portion of O&M manuals.

2. Include copies of all hand-outs, slides, overheads, video presentations, etc. that are not included in O&M manuals.

3. Provide one extra copy of each training manual to be included with operation and maintenance data.

C. Training Reports:

1. Identification of each training session, date, time, and duration.

2. Sign-in sheet showing names and job titles of attendees.

D. Video Recordings: Submit digital video recording of each demonstration and classroom training session for City of Whitefish's subsequent use.

1. Format: DVD Disc.

2. Label each disc and container with session identification and date.

3. Include only one training session on each DVD.

1.04 SCHEDULE

A. Classroom training shall occur after completion of Pre-functional Testing and prior to Performance and Operation Testing.

B. Demonstration training shall occur after written acceptance of Functional Test completion.

1.05 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.

1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.

2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 DEMONSTRATION TRAINING

A. Demonstrations conducted during system start-up and prefunctional testing do not qualify as demonstrations for the purposes of this section, unless approved in advance by Engineer and City of Whitefish in writing.

B. Demonstration Training for City of Whitefish personnel shall not be conducted during Functional Testing unless approved in advance by Engineer and City of Whitefish in writing.

C. Demonstration training may be conducted prior to or during Performance and Operational Testing.

D. Provide highly-qualified personnel who are knowledgeable about the project and the specific equipment and systems to perform demonstration and instruction of Owner personnel.

E. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.

F. Utilize operation and maintenance manuals as basis for demonstration training.

G. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.

3.02 CLASSROOM TRAINING

A. Engineer will prepare the Training Plan based on draft plans submitted by Contractor.

B. Conduct training on-site unless otherwise indicated.

C. City of Whitefish will provide classroom and seating at no cost to Contractor.

D. Do not start training until Prefunctional Testing is complete, unless otherwise specified or approved by the Engineer.

E. Provide training in minimum two hour segments.

F. Training schedule will be subject to availability of City of Whitefish's personnel to be trained; re-schedule training sessions as required by City of Whitefish; once schedule has been approved by City of Whitefish failure to conduct sessions according to schedule will be cause for City of Whitefish to charge Contractor for personnel "show-up" time.

G. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.

2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.

3. Typical uses of the O&M manuals.

H. Product- and System-Specific Training:

1. Review the applicable O&M manuals.
2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
4. Provide hands-on training on all operational modes possible and preventive maintenance.
5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

I. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 01 79 00

SECTION 01 91 00
COMMISSIONING

PART 1 - GENERAL

1.01 SUMMARY

A. Requirements for functional testing, performance and operational testing, and commissioning of equipment and systems.

B. Description of the commissioning process and responsibilities common to all parties.

C. Commissioning, including Functional Tests, performance and operational testing, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion

1.02 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

1. Plumbing Systems
2. HVAC Systems
3. Special Ventilation
4. Electrical Systems
5. Electronic Safety and Security
6. Process Integration Equipment
7. Process Interconnections
8. Material Processing and Handling Equipment
9. Process Gas and Liquid Handling Equipment
10. Water and Wastewater Equipment
11. Other equipment and systems identified elsewhere in Contract Documents as requiring commissioning.

B. The commissioning process will be directed by the Contractor and monitored by the Engineer.

C. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper performance of equipment and systems
3. Verify that O&M documentation is complete.
4. Verify that Owner's operating personnel are adequately trained.

1.03 RELATED REQUIREMENTS

A. Section 01 75 00 - Starting and Adjusting

B. Section 01 78 23 - Operation and Maintenance Data

C. Section 01 79 00 - Classroom and Demonstration Training

1.04 SUBMITTALS

A. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.

B. Product Data: If submittals to Engineer do not include the following, submit copies as soon as possible:

1. Manufacturer's product data, cut sheets, and shop drawings.

2. Manufacturer's installation instructions.

3. Startup, operating, and troubleshooting procedures.

4. Fan and pump curves.

5. Factory test reports.

6. Warranty information, including details of City of Whitefish's responsibilities in regard to keeping warranties in force.

C. Startup Plans and Reports.

D. Completed Checklists.

E. Commissioning Plan.

F. Commissioning Reports.

1.05 DEFINITIONS

A. Commissioning Plan: An overall plan, developed by the Contractor in conjunction with Owner and Engineer, that provides the structure, schedule, and coordination planning for the commissioning process.

B. Functional Tests (FT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) and/or remote monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operations. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying temperatures, alarm, power failure, local/remote, etc. FTs are performed after prefunctional tests and startups are completed.

C. Performance and Operational Testing (POT): Test of systems after written acceptance of the FT. The POT test period will be used develop adequate process conditions to fully establish compliance with the performance requirements of the Contract Documents. Contractor shall supervise, control and be responsible for the operation and maintenance of equipment and systems during POT providing qualified and appropriately licensed personnel.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will not become the property of City of Whitefish.

B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:

1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.

2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.

3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.

C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to City of Whitefish; such equipment, tools, and instruments are to become the property of City of Whitefish.

D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.

1. Dataloggers required to for Functional Tests will be provided by the Contractor and will not become the property of [].

PART 3 - EXECUTION

3.01 COMMISSIONING PLAN

A. The Contractor will develop the Commissioning Plan with input from the Owner and Engineer.

1. Engineer to attend meetings called by the Contractor for purposes of completing the commissioning plan.

2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

B. Contractor is responsible for compliance with the Commissioning Plan.

C. Commissioning Schedule:

1. Submit anticipated dates of startup of each item of equipment and system to Engineer within 60 days after award of Contract.

2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.

3. Prefunctional Checklists and Functional Tests are to be performed in sequence from

components, to subsystems, to systems.

4. Provide sufficient notice to Engineer for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 STARTUP PLANS AND REPORTS

A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.

B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.

C. Submit directly to the Engineer.

3.03 FUNCTIONAL TESTS

A. Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near- identical units is allowed by the final test procedures.

B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before Substantial Completion.

C. Engineer will witness Functional Tests, Contractor shall provide adequate notice to Engineer in advance of functional testing.

D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to City of Whitefish; if a deficiency is not corrected and re-tested immediately, the Engineer will document the deficiency and the Contractor's stated intentions regarding correction.

1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.

2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Engineer; the Contractor will reschedule the test and the Contractor shall re-test.

3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.

4. Contractor shall bear the cost of City of Whitefish and Engineer's personnel time witnessing re-testing.

E. Functional Test Procedures:

1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be

determined by the Engineer and Contractor.

2. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Engineer is Functional Testing.

F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.04 FUNCTIONAL TEST PROCEDURES – GENERAL

A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

C. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

D. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.

E. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.

F. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.

G. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.

H. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:

1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Engineer's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.

2. Other points will be monitored by the Contractor using dataloggers.

3. At the option of the Engineer, some control system monitoring may be replaced with datalogger monitoring.

4. Provide hard copies of monitored data in columnar format with time down left column

and at least 5 columns of point values on same page.

5. Graphical output is desirable and is required for all output if the system can produce it.
6. Monitoring may be used to augment manual testing.

3.05 PERFORMANCE AND OPERATIONAL TESTING

A. Contractor shall supervise, control, and be responsible for the operation and maintenance of the new equipment and/or system during a period of at least fifteen (15) days or until performance requirements are met, whichever is greater, after the written acceptance of the FT for each individual item that is placed into operation. The Contractor shall remain responsible for making required changes, repairs and replacements to the installation during this period. Final written acceptance of the equipment shall not be given until after fifteen (15) days of continuous successful operation.

B. The POT test period will be used develop adequate process conditions to fully establish compliance with the performance requirements of the Contract Documents. Included in this requirement, but not limited to, are the following:

1. Establishing and maintaining an adequate microbial population in the aeration system to meet NPDES permit limits.
2. Developing sufficient waste activated sludge to operate biosolids treatment, thickening and dewatering equipment.
3. Generating sufficient materials to verify operation of materials handling equipment such as grit handling systems, scum piping and thickened biosolids conveying equipment.

C. During the POT, the Contractor shall provide supervisory and appropriately licensed personnel satisfactory to the Engineer. It is the intent that during the POT period, the Owner's personnel will become completely familiar with the operation and maintenance of the systems undergoing POT. See Section 01 79 00 - Classroom and Demonstration Training for additional requirements.

D. During the POT, the Owner will arrange to have a complement of operating personnel available, and these operators will be paid by the Owner.

3.06 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 78 23 for additional requirements.

B. Add design intent documentation furnished by ENGINEER to manuals prior to submission to City of Whitefish.

C. Submit manuals related to items that were commissioned to Engineer for review; make changes recommended by Engineer.

D. Contractor will add commissioning records to manuals prior to submission back to City of Whitefish.

END OF SECTION 01 91 00

DIVISION 2

EXISTING CONDITIONS, SITEWORK

SECTION 02 41 00
SITE DEMOLITION, DISPOSAL & SALVAGE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Removal and disposal of all construction indicated on the plans or specified in these documents.

2. Removal and disposal of paving, curbing, sidewalks, driveways, crosswalks, utility structures, piping, below grade foundations, improvements to avoid conflict with new construction, disconnection, capping and removal of utilities no longer in use, pollution control during demolition including noise control and removal and legal disposal of materials.

B. Related Sections include the following:

1. Division 1 Section “Payment Procedures" for a schedule of unit prices.

2. Division 32 Section "Landscaping" for finish grading, including placing and preparing topsoil for lawns and plantings.

3. Division 31 Section “Earthwork” for excavation and embankment, site stripping, grubbing, removing topsoil, and protecting trees to remain.

1.03 SUBMITTALS

A. Schedule: Submit schedule indicating proposed methods and sequence of operations for selective demolition work to Engineer for review prior to commencement of work. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.

B. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.

C. Coordinate with Owner's continuing occupation of portions of existing building, and with Owner's reduced usage of any portion thereof.

D. Submit project record documents under provisions of Section 01 77 00.

1.04 REGULATORY REQUIREMENTS

A. Conform to all applicable codes for worker safety, confined space entry, dust

control, and water and sludge discharges and disposal.

B. Obtain required permits from authorities.

C. Notify affected utility companies before starting Work and comply with applicable requirements.

D. Do not close or obstruct roadways except as permitted by Owner. Do not close or obstruct egress width to exits without prior written permission of Owner.

E. Do not disrupt or compromise effectiveness of WWTF operations without written permission of Owner.

F. Conform to procedures applicable if hazardous materials or situations discovered.

1.05 PROJECT CONDITIONS

A. Dust Control: The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the site or building and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding, and pollution.

B. Protection of Existing Work: Before beginning any cutting or demolition work, the Contractor shall carefully survey the existing facilities and examine the plans and specifications to determine the extent of the work. The Contractor shall take all necessary precautions to ensure against damage to existing facilities to remain in place, to be reused, or to remain the property of the Owner, and any damage to such work shall be repaired or replaced as approved by the Engineer at no additional cost to the Owner. The Contractor shall carefully coordinate the work of this section with all other work and construct and maintain shoring, bracing and supports, as required.

C. Protection of Buildings from the Weather: The interior of buildings and all materials and equipment shall be protected from the weather at all times.

D. Protection of Trees: Trees which might be damaged during demolition and which are indicated to be left in place shall be protected. Any tree designated to remain that is damaged during the Work under this contract shall be replaced.

E. Burning: The use of burning at the project site for the disposal of refuse and debris will not be permitted.

F. Occupancy: Owner will be continuously occupying areas of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities which will severely impact Owner's normal operations.

G. Condition of Structures: Owner assumes no responsibility for actual condition of items to be demolished.

1. Conditions existing at time of commencement of contract will be maintained by Owner insofar as practicable. However, variations may occur by Owner's removal and salvage operations prior to start of selective demolition work.

H. Partial Demolition and Removal: Materials of marketable value that are removed in accordance with the provisions of the Project, but that are not to be possessed by the Owner, shall become the property of the Contractor and shall be removed from the right-of-way. Transport salvaged items from site as they are removed.

1. Storage or sale of removed items on site will not be permitted.

I. Protections: Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.

1. Confine Work and stockpiling to within Owner’s property or easement as approved by Engineer. Leave undisturbed all street and utility appurtenances not indicated for removal or renovation.

2. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to and from occupied portions of buildings.

3. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of element to be demolished, and adjacent facilities or work to remain.

4. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.

5. Protect floors with suitable covering when necessary.

6. Construct temporary insulated solid dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks if required.

7. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces, and installation of new construction to insure that no water leakage or damage occurs.

8. Maintain, during operation and at completion, pavement removal areas in such condition that they will be well drained at all times.

9. Protect and maintain survey monuments or any construction staking from disturbance during pavement removal.

J. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no cost to Owner.

K. Explosives: Use of explosives will not be permitted.

L. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

M. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 INSPECTION

A. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Photograph existing conditions to structure surfaces, equipment or to surrounding properties which could be misconstrued as damage resulting from selective demolition work; file with Owner's Representative prior to starting work.

3.02 PREPARATION

A. Become familiar with required lines of removal and saw cutting.

B. Identify underground utilities.

C. Provide, erect, and maintain adequate barriers and warning lights.

D. Keep streets, sidewalks, and driveways in usable condition; avoid property owner inconvenience insofar as practicable; do not trespass on private property.

E. Verify traffic control in place prior to commencement of pavement removal.

F. Inspect and record existing conditions onsite and at adjacent areas prior to starting construction. Commencement of this Section's Work means acceptance of existing conditions.

3.03 PAVING REMOVAL

A. Saw cutting may be required on concrete and asphalt pavements. Pavement removal beyond the limits established in the notes on the Drawings shall be replaced at the Contractor's expense.

B. Saw cut vertically; remove on straight lines approximately parallel or perpendicular to centerline of pavement.

C. Saw cut vertically full depth to obtain a clean break. After saw cutting, use pneumatic jackhammer or similar device prior to breaking out pavement.

D. Break out remainder of pavement.

E. Disturbances, breakage, or damage to areas not designated for removal shall be restored at Contractor's expense prior to making final payment.

F. Leave underlying sub-base material in a condition suitable for traffic if construction sequence involves delays and if local situation requires access by the public.

G. Pavement removed beyond the limits established shall be replaced to the same specifications as the adjacent removal at Contractor's expense.

3.04 TOLERANCES

A. Saw cut full depth to achieve a clean break.

B. If line of removal falls within 2 feet of an existing joint, adjust line of removal to be the existing joint.

C. Remove entire width of sidewalk if removal width is less than sidewalk width.

3.05 DEMOLITION

A. General: Remove and legally dispose of paving, curbing, sidewalks, driveways, crosswalks, utility structures, piping, below grade foundations, improvements to avoid conflict with new construction, disconnection, and capping and removal of utilities no longer in use.

1. Demolition of existing structures and piping shall only commence after provisions are made to ensure continuing existing utility services.

B. Structures: Existing structures indicated shall be completely removed to two feet below grade. The excavations shall be backfilled and final graded in accordance with other sections of these specifications.

C. Pavement: Cut, remove and dispose of existing pavement to the lines indicated on the plans or as directed by Engineer. Make straight and an approximately vertical cut of edges along which new pavement is to be placed.

D. Driveways and Sidewalks: Remove and dispose of existing concrete

E. Piping: Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the plans, the Engineer shall be notified. Buried piping may be left in place provided that exposed pipe ends are plugged.

1. Pipes shall be plugged with a low slump concrete the entire diameter of the pipe to a minimum depth of 18 inches.

F. Driveways and Sidewalks: Remove and dispose of existing concrete driveways and/or sidewalks which interfere with construction of improvements or which do not match new grade as shown on the contract documents or as directed by Engineer.

1. Remove to a distance of 8 inches behind curbs, or to greater distance if required to properly match the new curb and gutter grade.

2. Saw cut along a neat line to a depth of at least 25 percent of the concrete thickness and take care in removing the concrete assuring the slab breaks on the sawed neat line.

G. Filling: Excavations and other hazardous openings shall be filled in accordance with appropriate sections of these specifications.

3.06 DISPOSAL

A. General: Upon completion of demolition, all debris shall be disposed of in a legal manner, and the site shall be fine graded to the prevailing adjacent grades and contours.

3.07 SALVAGE

A. Title to Materials: Title to all materials and equipment to be demolished, excepting Owner salvage and historical items, is vested in the Contractor upon receipt of Notice to Proceed. The Owner will not be responsible for the condition, loss or damage to such property after Notice to Proceed.

B. Material for Contractor Salvage: Material for salvage shall be stored as approved by the Engineer. Salvage materials shall be removed from Owner's property before completion of the contract. Material for salvage shall not be sold on the site. Salvage material may not be reused in the project without written approval of the Engineer.

C. Unsalvageable Materials: Materials, other than those permitted to remain in place, shall be disposed of in a legal manner. On-site disposal will not be allowed.

END OF SECTION 02 41 00

SECTION 02 42 00
REMOVAL AND SALVAGE OF CONSTRUCTION MATERIALS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Removal and salvage of Selective Site Demolition and Structure Demolition.

B. Related sections include, but are not limited to:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

2. Section 02 41 00 – Demolition

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 SALVAGE MATERIALS

A. Salvage Items: Where indicated on Drawings as "Salvage", carefully remove indicated items, clean, store and turn over to Owner and obtain receipt.

B. Historic artifacts, including cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historic significance remain the property of the Owner. Notify Owner's Representative if such items are encountered and obtain acceptance regarding method of removal and salvage for Owner.

3.02 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site.

1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution.

2. Burning of removed materials is not permitted on project site.

END OF SECTION 02 42 00

DIVISION 3

CONCRETE & GROUT

SECTION 03 05 10
COLD WEATHER CONCRETING PROCEDURES

PART 1 - GENERAL

1.01 DEFINITIONS

A. Cold weather is defined as a period when for more than 3 successive days the mean daily temperature falls below 40°F or any day when the temperature is expected to fall or falls below freezing.

1.02 SUBMITTALS

A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.

1. Not less than 30 days prior to expected placement of concrete under cold weather conditions, a complete procedure shall be submitted for review covering all aspects of protection of concrete and its ingredients from the detrimental effects of cold weather. Concrete placement during cold weather shall not commence prior to return of the approved procedure.

1.03 PERFORMANCE REQUIREMENTS

A. Cold weather placement shall comply with ACI 350.5 and ACI 306.1, and this specification section.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

A. The concrete temperature, during placement in cold weather, shall not be less than 55 °F. Temperature measurements of the concrete as delivered to the job site shall confirm this requirement.

PART 2 - MATERIALS

2.01 WATER AND AGGREGATE

A. Water and aggregate may be preheated for cold weather placement; however, their temperature shall not exceed 150 °F. All methods and equipment for heating of water and aggregate shall be subject to the approval of the Engineer and shall conform to ACI 306.

PART 3 - EXECUTION

3.01 GENERAL

A. No concrete shall be placed on frozen ground.

B. The ground, against which concrete is to be poured, must be protected against freezing after its preparation, or the concrete placement shall be delayed until the ground has fully thawed out.

C. When temperatures are expected to be below 32 °F the night before the concrete is placed, all reinforcing steel, forms and the ground shall be preheated, for a minimum of 12 hours, under a minimum temperature of 50 °F.

D. When temperatures are expected to be below 32 °F any time before the concrete has reached strength of 1000 psi, the concrete must be adequately protected against frost damage by heating blankets, straw or insulation materials for a minimum of 7 days or until at least 1000 psi concrete strength has been reached. The concrete temperature shall at no time fall below 40 °F based on recording temperature monitors placed at a maximum of 50 feet on centers, each way, and around the circumference of the floor, wall, roof slab and wall-footing. Contractor shall provide heat as required to keep the concrete temperature as specified throughout the entire curing period of 7 days.

E. Weather prediction made by the nearest NOAA station, and corrected for the local elevation and environmental conditions, may be used to determine whether cold weather protection shall be required. Thermometers will be used by the Engineer and these readings shall determine whether cold weather protection shall be required and whether cold weather protection is adequate.

F. When combustion type heaters are used to maintain concrete temperatures within an enclosure, the exhaust gases shall be vented from the heater to the outside atmosphere so that the concrete is not exposed to the products of combustion.

G. There will not be any additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

END OF SECTION 03 05 10

SECTION 03 05 20
HOT WEATHER CONCRETING PROCEDURES

PART 1 - GENERAL

1.01 DEFINITIONS

A. Hot weather is defined as any combination of high air temperature, low relative humidity and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise resulting in abnormal concrete properties. During hot weather, any or all of the methods specified herein for temperature control of concrete shall be used as required to maintain the concrete temperature below the limits specified.

1.02 SUBMITTALS

A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.

1. Not less than 30 days prior to expected placement of concrete under hot weather conditions, a complete procedure shall be submitted for review covering the aspects of protection of concrete and its ingredients from the detrimental effects of hot weather. Concrete placement during hot weather shall not commence prior to the return of the approved procedure.

1.03 PERFORMANCE REQUIREMENTS

A. Hot weather placement shall comply with ACI 350.5 and ACI 305.1, and this specification section.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Aggregate piles, cement bins and batch plant bins shall be shaded from direct rays of sunlight.

B. Aggregate piles shall be cooled by wetting and evaporation. Aggregate wetting shall be performed in such a manner that it will not cause wide variations in moisture content impairing slump uniformity.

1.05 GENERAL PRACTICES AND MEASURES

A. The following list of practices and measures, as described in ACI 305, may be used to reduce or avoid the potential problems of hot weather concreting:

1. Use concrete materials and proportions with satisfactory records in field use under hot weather conditions.

2. Use cool concrete.

3. Use a concrete consistency that permits rapid placement and effective consolidation.

4. Transport, place, consolidate, and finish the concrete with least delay.

5. Plan the job to avoid adverse exposure of the concrete to the environment; schedule placing operations during times of the day or night when weather conditions are

favorable.

6. Protect the concrete against moisture loss at all times during placing and during its curing period.

B. There will not be any additional reimbursement made to the Contractor for costs incurred for placing concrete in hot weather.

PART 2 - MATERIALS

2.01 BATCHING AND MIXING

A. Concrete mix water shall be refrigerated or ice shall be added to the mix up to 100 percent of the water requirement. Ice, when introduced into the mixer, shall be in such form that it will be completely melted and dispersed throughout the mix at the completion of the mixing time. The mixing time shall be held to the minimum practicable consistent with producing concrete meeting the specified requirements.

B. All methods and equipment for cooling of water and aggregate shall be subject to the approval of the Engineer and shall conform to ACI 305.

PART 3 - EXECUTION

3.01 CONCRETE TEMPERATURE

A. The temperature of concrete, as delivered at the time and location of placement, shall not exceed 100 °F under any conditions. The temperature of concrete as delivered at the time and location of placement under the following combined ambient conditions, except concrete that will be deposited within wall or column forms, shall not exceed the following temperatures:

Relative humidity less than %	Ambient temperature greater than °F	Maximum concrete temperature °F
80	90	100
70	90	95
60	90	90
50	90	85
40	90	80
30	80	75
20	75	70

3.02 DELIVERY

A. Concrete shall be placed in the Construction within 90 minutes after the completion of mixing.

3.03 PREPARATION FOR PLACING

A. Elevated forms and reinforcing steel for beams and similar members shall be cooled by fog spraying and evaporation immediately prior to placing concrete. Forms shall be free of standing water when concrete is placed herein.

3.04 PLACING

A. Concrete shall be placed in shallower layers than under normal weather conditions if necessary to assure coverage of the previous layer while it will respond readily to vibration.

3.05 FINISHING

A. Fog spray shall be used during finishing operations whenever necessary to avoid surface plastic-shrinkage cracking. Fog spray shall also be used after finishing and before the specified curing is commenced to avoid surface plastic-shrinkage cracking.

3.06 PROTECTION AND CURING

A. Forms shall be kept covered and continuously moist. Once forms are loosened and during form removal, concrete surfaces shall be protected from drying and shall be kept continuously wet by fog spraying or other approved means.

END OF SECTION 03 05 20

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

B. Related Requirements:

1. Section 32 13 13 "Concrete Paving" for formwork related to concrete pavement and walks.

1.03 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:
    a. Special inspection and testing and inspecting agency procedures for field quality control.
    b. Construction, movement, contraction, and isolation joints
    c. Forms and form-removal limitations.
    d. Shoring and reshoring procedures.
    e. Anchor rod and anchorage device installation tolerances.

1.05 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Void forms.

4. Form ties.

5. Waterstops.

6. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.

2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 and ACI 350.5 when not indicated in Drawings.

a. Location of construction joints is subject to approval of the Engineer.

3. Indicate location of waterstops.

4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Waterstops, Joint Fillers, Joint Sealers, Backing Rods, and Bond Breaker:

1. Certified mill certificates showing that the material meets all of the requirements specified here-in. The Engineer, at their option, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by the Owner. If any materials should fail to meet these Specifications, all costs for further testing of the replacement materials shall be borne by the Contractor.

C. Minutes of preinstallation conference.

1.07 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.09 OBSTRUCTIONS

A. Contractor shall pay particular attention to removing all obstructions such as concrete, nails, etc., from joints when movements of floor, wall and roof sections can be expected under temperature or other conditions.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 and ACI 350.5, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
3. Forms for circular structures shall conform to the circular shape of the structure.
4. Do not use earth cuts as forms for vertical or sloping surfaces unless required or permitted in drawings.
5. Formwork shall be essentially watertight and shall prevent loss of mortar from concrete. Seal all joints or gaps with an acceptable material.

2.02 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
    a. Plywood, metal, or other approved panel materials.
    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
        1) APA HDO (high-density overlay).
        2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
        3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
        4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
    c. Do not use form-facing materials with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the texture of concrete surfaces.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class.

1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

2.03 WATERSTOPS

A. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. JP Specialties, Inc.

b. Sika Corporation.

2. Profile: Ribbed without center bulb.

3. Dimensions: 6 inches by 3/8 inch thick; nontapered.

B. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Sika Corporation.

b. Or approved equal.

2. Profile: As indicated.

3. Dimensions: As indicated; nontapered.

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Products: Subject to compliance with requirements, provide the following:

a. Sika Corporation.

b. Or approved equal.

2.04 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Chamfer Strips: Smooth wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Rustication Strips: Smooth wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2. Form release agent for form liners shall be acceptable to form liner manufacturer.

E. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1-1/2 inch to the plane of exposed concrete surface.

2. Furnish ties that, when removed, leave holes at least 1 inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls.

PART 3 - EXECUTION

3.01 INSTALLATION OF FORMWORK

A. Comply with ACI 301 and ACI 350.5.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Environmental Surface Finish-1.0 (ESF-1.0): 1 inch

a. No formwork facing material is specified

b. Patch voids greater than 1-1/2 in. wide or 1/4 in. deep

c. Remove projections greater than 1/2 in.

d. Tie holes needed to be patched

e. Surface tolerance Class C (ACI 117)

f. Leave surfaces with the texture imparted by the forms

g. Mockup not required

2. Environmental Surface Finish-2.0 (EFS-2.0): 1/4 inch

a. Patch voids greater than 3/4 in. wide or 1/4 in.

b. Remove projections greater than 1/4 in.

c. Patch tie holes

d. Surface tolerance Class B (ACI 117)

e. Mockup not required

3. Environmental Surface Finish-3.0 (ESF-3.0): 1/8 inch

a. Patch voids greater than 3/4 in. wide or 1/4" deep

b. Remove projections greater than 1/8 in.

c. Patch tie holes

d. Surface tolerance Class A (ACI 117)

e. Provide mockup of concrete surface appearance and texture

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.

2. Exposed Concrete: Symmetrically align joints in forms.

a. For ESF 3.0 surfaces, set the facing materials in an orderly and symmetrical arrangement, and keep the number of seams to a practical minimum. Facing materials shall be supported with studs or other backing capable of maintaining deflection with the tolerances specified in Part 1. Fit adjacent panels with tight joints.

3. Taper form ties shall be placed with the larger end on the side of the structure that will be in contact with liquid.

a. Seal tie holes in formwork to prevent leakage where ties penetrate the formwork.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.

2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips

2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.

2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.

2. Obtain written approval of Engineer prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.

2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

3. Place joints perpendicular to main reinforcement.

4. Locate joints for beams and slabs in the middle third of spans, unless indicated otherwise in plans.

5. Locate horizontal joints in walls at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

6. Space vertical joints in walls as indicated on Drawings.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.

2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

4. Clean embedded items immediately prior to concrete placement.

5. Fill voids in inserts to prevent entry of concrete.

6. Coat surfaces of aluminum embedments to prevent reaction with the concrete.

3.03 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.

2. Locate waterstops in center of joint unless otherwise indicated on Drawings.

3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 03 30 00 "Cast-In-Place Concrete."

4. Secure waterstops in correct position at 12 inches on center in such a manner that bending over one way or another is prevented.

a. Vertical waterstops shall be anchored back to the reinforcement with wire ties or by other acceptable means.

b. At flexible waterstops placed horizontally, the waterstop shall be folded upward along its entire length while concrete is placed and consolidated up to the level of the waterstop, and then the waterstop shall be pressed into the top of of the fresh concrete. Then complete concrete placement and consolidation so as to provide full encasement of the water stop in concrete.

5. Waterstops at vertical joints shall terminate 3 in. below the tops of exposed walls.

6. Field fabricate joints in accordance with manufacturer's instructions using heat welding.

a. Miter corners, intersections, and directional changes in waterstops.

b. Align center bulbs.

c. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop, and shall be watertight.

7. Clean waterstops immediately prior to placement of concrete.

8. Waterstops with a center bulb shall have the ends of the center bulb plugged with a flexible material, such as foam rubber, to prevent concrete intrusion at ends where the bulb will be exposed to concrete extrusions.

9. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.

2. Locate waterstops in center of joint unless otherwise indicated on Drawings.

3. Protect exposed waterstops during progress of the Work.

3.04 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70% of its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.

2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.

2. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.05 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 350 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.06 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed, and for compliance within tolerances specified in ACI 117.

2. Waterstops:

a. It is required that all waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the ENGINEER to provide for the required inspections. Not less than 24 hours' notice shall be provided to the ENGINEER for scheduling such inspections. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the CONTRACTOR at its own expense.

b. The following waterstop defects represent a partial list of defects which shall be grounds for rejection.

1) Offsets at joints greater than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.

2) Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.

3) Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.

4) Misalignment of joint which result in misalignment of the waterstop in excess of ½-inch in 10 feet.

5) Porosity in the welded joint as evidenced by visual inspection.

6) Bubbles or inadequate bonding which can be detected with a pen knife test. (If, while prodding the entire joint with the point of a pen

knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)

3. Waterstop Samples:

   a. Field samples of fabricated fittings (crosses, tees, etc.) may be selected at random by the ENGINEER at their discretion, for testing by a laboratory at the OWNER'S expense. When tested, they shall have a tensile strength across the joints equal to at least 75 percent of the manufacturer's reported tensile strength of the product. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this contract.

END OF SECTION 03 10 00

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 03 41 00 "Precast Structural Concrete" for reinforcing used in precast structural concrete.
2. Section 32 13 13 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:
    a. Special inspection and testing and inspecting agency procedures for field quality control.
    b. Construction contraction and isolation joints.
    c. Steel-reinforcement installation.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
    a. Include a written description of where each bar support will be used.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure where not indicated in Drawings.

1. Location of construction joints is subject to approval of the Engineer.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

B. Material Certificates:

1. Mill test certificates shall be submitted to the Engineer to certify that the reinforcing steel meets the specified requirements. Mill test certificates shall be furnished and paid for by the Contractor.

2. In addition, the Engineer may require that test samples be taken and test certificates be furnished by a reputable material testing laboratory at the Owner's expense.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

D. Minutes of preinstallation conference.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth, oil, or other materials that may decrease bond to concrete.

PART 2 - PRODUCTS

2.01 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 , deformed. Grade 40 steel shall be allowed for #3 and smaller bars.

B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.

D. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 , deformed bars, assembled with clips.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.02 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from stainless steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice" and ACI 315, and as follows:

a. Where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

1) For plastic protected wire, plastic shall have a thickness of 3/32 inches or greater at points of contract with formwork and the plastic shall extend along the wire at least 1/2 inches from the point of contact iw the formwork.

2) For stainless steel protected wire-reinforcement supports, the non-stainless steel portion of the supports shall not extend closer than 3/4 inches from the form surface.

b. Precast concrete (adobes) shall, as a minimum, be no less in compressive strength or cement content than the concrete in which it will be cast, and a surface area of not less than 4 square inches. Water absorption and porosity of precast concrete supports shall be equal to or less than water absorption and porosity of concrete being placed. Adobes manufactured from plastic or with low cement contents will not be accepted. Brick, broken concrete masonry units, spalls, rocks or similar materials shall not be used for support of reinforcing steel.

c. All-plastic reinforcement supports shall incorporate perforations in plane areas to compensate for the difference in the coefficient of thermal expansion between the plastic and concrete.

C. Mechanical Splice Couplers: ACI 318 Type 2, same material of reinforcing bar being spliced; tension-compression type.

1. Products: Subject to compliance with requirements, available products by one of the following:

a. Dayton Superior.

b. Or approved equal.

D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

2.03 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice," and in accordance with fabricating tolerances of ACI 117.

B. Bend reinforcement cold unless heating is approved by the Engineer prior to fabrication.

C. Minimum inside bend diameters shall conform to the requirements of ACI 350.5 unless otherwise permitted. The beginning of the bend shall not be closer to the concrete surface than the minimum diameter of the bend.

D. Kinked bars shall not be used.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.

2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.02 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

2. The supports shall be of sufficient quantity, strength and stability to maintain the reinforcement in place throughout the concreting operations. Bar supports shall be placed no further than 4 feet apart in each direction.

3. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 350.

1. Placing tolerances shall not reduce cover requirements except as specified in ACI 117.

2. No "bury" or "carrier" bars will be allowed unless specifically approved by the Engineer.

E. Reinforcing Tying:

1. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

2. There shall be at least three ties in each bar length (this shall not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity).

3. Slab bars shall be tied at every intersection around the periphery of the slab. Wall bars and slab bar intersections shall be tied at not less than every second intersection, but at not greater than the following maximum spacings:

a. Slab Bars: Bars No. 5 and smaller = 30 inches; Bars No. 6 through No. 9 = 48 inches; Bars Bars No. 10 through No. 11 = 60 inches

b. Wall Bars: Bars No. 5 and smaller = 24 inches; Bars No. 6 through No. 9 = 30 inches; Bars No. 10 through No.11 = 48 inches.

F. Reinforcing partially embedded in concrete shall not be field bent unless indicated on the Drawings.

G. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.

2. Stagger splices in accordance with ACI 350.

3. Lapped spliced bars shall be fastened together with steel tie wire.

4. Unless specified or shown otherwise on the Drawings, the bars at a lap splice shall be in contact with each other.

5. Unless shown otherwise on the Drawings, where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a minimum length equal to the lap splice length indicated on the Drawings. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.

6. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

a. Mechanical splices for reinforcement not shown on the Project Drawings shall not be used unless accepted by the Engineer.

7. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

H. When there is a delay in depositing concrete, reinforcement shall be re-inspected and cleaned when necessary.

I. Reinforcement relocation - When necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embedded items, submit the resulting arrangement of reinforcement for acceptance by the Engineer.

J. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.

3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

4. Lace overlaps with wire.

5. The welded wire fabric shall be bent as shown or required on the Drawings to fit the work. Welded wire fabric shall be rolled or otherwise straightened to make a perfectly flat sheet before placing in the Work.

3.03 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement.

2. Continue reinforcement across construction joints unless otherwise indicated.

3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.04 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.05 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel-reinforcement placement.

2. Reinforcing support type, spacing, and quantity of reinforcing supports.
3. Steel-reinforcement mechanical splice couplers.
4. Steel-reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 03 05 10 "Cold Weather Concreting Procedures" for procedures to protect concrete work during cold weather.
2. Section 03 05 20 "Hot Weather Concreting Procedures" for procedures to protect concrete work during hot weather.
3. Section 03 10 00 "Concrete Forming and Accessories" for form-facing materials, form liners, and waterstops.
4. Section 03 20 00 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
5. Section 03 60 00 "Grouting" for cement grout, cement mortar, dry-pack mortar, epoxy grout, non-shrink grout.
6. Section 32 11 23 "Aggregate Base Courses" for drainage fill under slabs-on-ground.
7. Section 32 13 13 "Concrete Paving" for concrete pavement and walks.
8. Section 07 11 00 “Dampproofing”.
9. Section 07 13 00 “Sheet Waterproofing”.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixtures.

c. Ready-mix concrete manufacturer.

d. Concrete Subcontractor.

2. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.

b. Construction joints, control joints, isolation joints, and joint-filler strips.

c. Semirigid joint fillers.

d. Cold and hot weather concreting procedures.

e. Concrete finishes and finishing.

f. Curing procedures.

g. Forms and form-removal limitations.

h. Shoring and reshoring procedures.

i. Concrete repair procedures.

j. Concrete protection.

k. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)

l. Protection of field cured field test cylinders.

1.05 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.

2. Fly ash.

3. Slag cement.

4. Silica fume.

5. Aggregates.

a. Include types, pit or quarry locations, producers' names, gradations, specific gravities, and evidence of not more than 90 days old demonstrating compliance with Product specification.

6. Admixtures:

a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

7. Bonding agents.
8. Liquid floor treatments.
9. Curing materials.
10. Joint fillers.
11. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
9. Intended placement method.
10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
    a. Include new field test data verifying adequacy of modified proportions.

C. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.

3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Adhesives.
7. Semirigid joint filler.
8. Joint-filler strips.
9. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Silica fume.
5. Aggregates.

D. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

E. Preconstruction Test Reports: For each mix design.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

1. An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
2. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329, as documented according to ASTM E548 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.08 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.

b. Slump.

c. Air content.

d. Seven-day compressive strength.

e. 28-day compressive strength.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 350.5.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 350.5 unless modified by requirements in the Contract Documents.

2.02 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II , .
2. Fly Ash: ASTM C618, Class F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Silica Fume: ASTM C1240 amorphous silica.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:
   a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
   b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
   c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride .

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
3. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
4. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

F. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.03 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Corporation.

b. Dayton Superior.

c. Euclid Chemical Company (The); an RPM company.

d. W.R. Meadows, Inc.

2.04 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Corporation.

b. Dayton Superior.

c. Euclid Chemical Company (The); an RPM company.

d. Sika Corporation.

e. W.R. Meadows, Inc.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F: Black.

b. Ambient Temperature between 50 deg F and 85 deg F: Any color.

c. Ambient Temperature Above 85 deg F: White.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. BASF Corporation; MasterKure CC 250 XS
    b. Dayton Superior; Cure & Seal 25% J22UV
    c. Euclid Chemical Company (The); an RPM company; Luster Seal 300
    d. Laticrete International, Inc.; L&M Lumiseal Plus
    e. W.R. Meadows, Inc; CS-309-30.
    f. Lambert Corporation; UV Super Seal
    g. Approved equal.

2.05 RELATED MATERIALS

A. Joint Sealers: two-part, self-leveling, uniform, stiff consistency, non-staining, polyurethane elastomeric sealant which cures at ambient temperature, conforming to ASTM C-920 and does not contain solvents.
    1. The material shall be of a type that will effectively and permanently seal joints subject to movements in concrete.
    2. The mastic shall tenaciously adhere to primed concrete surfaces, shall remain permanently mastic and shall be NSF approved for use with potable water.
    3. For sloping joints, vertical joints and overhead horizontal joints, only “non-sag” compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 12-1/2
    4. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore “A” hardness range of 25 to 35, shall be used.
    5. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
    6. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        a. PERMAPOL RC-270SL RESERVOIR SEALANT, as manufactured by PRODUCTS RESEARCH & CHEMICAL CORP., Gloucester City, New Jersey (800-257-8454)
        b. SIKAFLEX/2C POLYURETHANE ELASTOMERIC SEALANT, as manufactured by SIKA CHEMICAL CORP., Santa Fe Springs, CA (213-941-0231)
        c. SELECT SEAL U-227 RESERVOIR GRADE, as manufactured by SPC, Upland, CA (7l4-985- 577l)

d. Or approved equal.

B. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

C. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.

D. Backing Rod: Backing rod shall be an extruded closed cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

E. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

F. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

G. Bond Breaker: Bond breaker shall be SUPER BOND BREAKER WATER BASE as manufactured by Burke Company, San Mateo, California; SELECT EMULSION CURE 309, as distributed by Select Products Co., Upland, CA (clear or white pigmented) or equivalent. Fugitive dye may be used in bondbreakers if recommended by the manufacturer.

2.06 REPAIR MATERIALS

A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.07 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 350.5.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.

2. Slag Cement: 50 percent by mass.

3. Silica Fume: 10 percent by mass.

4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

2.08 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings and topping slabs for precast roof slabs.

1. Exposure Class: ACI 318 F1, S0, W0, C0.

2. Minimum Compressive Strength: 3500 psi at 28 days.

3. Maximum w/cm: 0.55.

4. Slump Limit: 8 inches , plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site .

5. Air Content:

a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size .

6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

B. Class B : Normal-weight concrete used for grade beams, exterior columns, and non-fluid retaining foundation walls.

1. Exposure Class: ACI 318 F2, S0, W0, C0.
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm: 0.45 .
4. Slump Limit: 8 inches , plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site .
5. Air Content:
    a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size .
6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

C. Class C : Normal-weight concrete used for fluid-retaining slabs-on-ground and walls, and roof slabs over fluid-containing tanks.
1. Exposure Class: ACI 318 F2, S2, W1, C2.
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm: 0.42.
4. Minimum Cementitious Materials Content: 560 lb/cu. yd. .
    a. Provide Portland Cement - Type II combined with a minimum of 20 percent, by weight, of cementitious material with either of the following:
        1) Fly Ash supplemented with Silica Fume, or
        2) Ground-Granulated Blast-Furnace Slag supplemented with Silica Fume.
5. Slump Limit: 8 inches , plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site .
6. Air Content:
    a. Exposure Classes F2 and F3: 6 percent, plus or minus, 1.5 percent measured at the point of delivery for concrete containing 3/4-inch nominal maximum size aggregate.
7. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.

D. Class D : Normal-weight concrete used for interior slabs-on-grade (excluding the Pump Room slab), topping for metal decks, and equipment bases.
1. Exposure Class: ACI 318 F0, S0, W0, C0.
2. Minimum Compressive Strength: 4000 psi at 28 days.

3. Maximum w/cm: 0.45.

4. Minimum Cementitious Materials Content: 540 lb/cu. yd.

5. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

6. Air Content:

   a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

E. Class E: Normal-weight concrete used for slab-on-grade in Pump Room.

1. Exposure Class: ACI 318 F0, S0, W1, C0.

2. Minimum Compressive Strength: 4500 psi at 28 days.

3. Minimum Cementitious Materials Content: 560 lb/cu. yd. .

   a. Provide Portland Cement combined with a minimum of 15 percent, by weight, of cementitious material with either of the following:

      1) Fly Ash supplemented with Silica Fume, or

      2) Ground-Granulated Blast-Furnace Slag supplemented with Silica Fume.

4. Slump Limit: 8 inches, plus or minus 1 inch 1 for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

5. Air Content:

   a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors. .

6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

F. Class F: Controlled Low Strength Material (CLSM) for flowable backfill.

1. Design and produce non-excavatable CLSM in accordance with the following requirements:

   a. Unconfined compressive strength greater than 150 psi determined by ASTM D4832.

   b. Air Content between 5% and 30% determined by ASTM D6023.

   c. Unit weight of 100-130 lbs/cu. ft. determined by ASTM D6023.

d. Consistent flow producing a self-leveling product free of segregation determined by ASTM D6103.

e. Do not use materials in CLSM with a plasticity index over 4.

f. Furnish aggregates in accordance with the following gradation:

1) 3/4-inch sieve: 100 percent passing

2) No. 4 sieve: 65- 100 percent passing

3) No. 30 sieve: 40 - 80 percent passing

4) No. 200 sieve: 10 - 30 percent passing.

G. Class I: Grout used for Grout Shaping of flumes, wet wells, etc.

1. Exposure Class: ACI 318 F0, S2, W0, C0.

2. Minimum Compressive Strength: 4000 psi at 28 days.

3. Maximum w/cm: 0.50 .

4. Slump Limit: 4 inches, plus or minus 1 inch.

5. Air Content:

a. Exposure Class F0: None required.

6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

2.09 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

1. 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.

4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.03 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.04 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Engineer.

2. Place joints perpendicular to main reinforcement.

a. Continue reinforcement across construction joints unless otherwise indicated.

b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

6. Space vertical joints in walls as indicated on Drawings . Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.

7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.

2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.

2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.05 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a layer no deeper than 24 inches, and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 350.5.
    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.06 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes (see Section 03 10 00 - Concrete Forming and Accessories for required finishes):
1. ACI 350 Environmental Surface Finish ESF-1.0: As-cast concrete texture imparted by form-facing material.
    a. Apply to concrete surfaces not exposed to view for non- fluid-retaining elements.

2. ACI 350 Environmental Surface Finish ESF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Locations: Apply to concrete surfaces exposed to view and all fluid-retaining elements.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.07 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.

2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.

3. Apply scratch finish to surfaces to receive grout shaping.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.

2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.

3. Apply float finish to surfaces to receive trowel finish and fluid-retaining slabs.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.

2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

4. Do not add water to concrete surface.

5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.

6. Apply a trowel finish to surfaces exposed to view .

7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

   a. Slabs on Ground:

      1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch .

   b. Suspended Slabs:

      1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch .

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings . While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Engineer before application.

2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

2. Coordinate required final finish with Engineer before application.

3.08 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.

2. Mix, place, and cure concrete, as specified, to blend with in-place construction.

3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 6 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.

3. Minimum Compressive Strength: 4000 psi at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. Prior to pouring concrete, place and secure anchorage devices.

   a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

   b. Cast anchor-bolt insert into bases.

   c. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Aluminum Inserts and Embeds. All aluminum materials inserted in concrete shall have the contact surface coated with bitumastic.

3.09 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 350.5 and ACI 306.1 for cold weather protection during curing.

2. Comply with ACI 350.5 and ACI 305.1 for hot-weather protection during curing.

3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.

2. Curing period shall not be less than seven days.

3. If forms remain during curing period, moist cure after loosening forms.

4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

   a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.

   b. Continuous Sprinkling: Maintain concrete surface continuously wet.

c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.

d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.

1) Method by itself is not permitted for fluid-retaining structures.

e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions. This method is not permitted for fluid-retaining structures.

1) Recoat areas subject to heavy rainfall within three hours after initial application.

2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.

2. Interior Concrete Floors for non- fluid retaining slabs:

a. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.

b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.

b) Continuous water-fog spray.

b. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

2) Recoat areas subjected to heavy rainfall within three hours after initial application.

3) Maintain continuity of coating, and repair damage during curing period.

4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

c. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.

2) Recoat areas subjected to heavy rainfall within three hours after initial application.

3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3. Slabs for fluid-retaining structures:

a. Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire are of floor.

1) Lap edges and ends of absorptive cover not less than 12 inches.

2) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

b. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

1) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

2) Cure for not less than seven days.

c. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

1) Water.

2) Continuous water-fog spray.

3.10 TOLERANCES

A. Conform to ACI 117.

3.11 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than 14 days' old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.

4. Rinse with water; remove excess material until surface is dry.

5. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Install cork type joint filler in joints in fluid-retaining elements.

2. Defer joint filling until concrete has aged at least six month(s).

3. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 JOINT SEALING

A. Joints, not requiring waterstops or when so indicated on the Drawings, shall be sealed.

B. Joint sealed areas shall be sandblasted or roughened and blown clean of dust and sand with compressed air before the material may be applied.

C. Joints shall be primed (if required) and the sealant shall be applied in accordance with the manufacturer's recommendations.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Engineer.

2. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Repair cracks in liquid containing concrete structures with widths greater than 0.010 inches, unless otherwise spedified or directed by the Engineer.

C. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, of stiff consistency using only enough water for handling and placing. Mix the repair mortar and turn the mortar frequently with a trowel without adding water.

D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch.

b. Make edges of cuts perpendicular to concrete surface. Do not feather edges.

c. Clean, dampen with water plus another 6 inches around the patch area perimeter, and brush-coat holes and voids with bonding agent.

d. Fill and compact with patching mortar before bonding agent has dried. Strike off mortar, leaving the patch slightly higher than the surrounding surface to permit initial shrinkage. Leave the patch undisturbed for 1 hour before finishing.

e. Keep the patch damp for 7 days.

f. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.

b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Engineer.

E. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
    a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.

    b. Dampen cleaned concrete surfaces and apply bonding agent.

    c. Place patching mortar before bonding agent has dried.

    d. Compact patching mortar and finish to match adjacent concrete.

    e. Keep patched area continuously moist for at least 72 hours.

F. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

G. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.15 WATER HOLDING STRUCTURES LEAKAGE TESTING

A. Complete in accordance with ACI 350.1.

B. All concrete structures that are designed to hold or pass water shall be hydraulically tested after curing has completed. All structures shall be prepared for testing by plugging the outlets or providing proper standpipes. The structure shall be filled to the proper operating depth and maintained at that level for (7) days. No leakage will be allowed

C. All cracks, leaks, and irregularities shall be properly and aesthetically repaired by the contractor at no additional expense to the Owner. All repairs shall be completed to the satisfaction of the Owner.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform inspections and inspection reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.

2. Testing agency shall immediately report to Engineer, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.

3. Testing agency shall report results of tests and inspections, in writing, to Owner, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.

2) Name of testing agency.

3) Names and certification numbers of field and laboratory technicians performing inspections and testing.

4) Name of concrete manufacturer.

5) Date and time of inspection, sampling, and field testing.

6) Date and time of concrete placement.

7) Location in Work of concrete represented by samples.

8) Date and time sample was obtained.

9) Truck and batch ticket numbers.

10) Design compressive strength at 28 days.

11) Concrete mixture designation, proportions, and materials.

12) Field test results.

13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.

14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.

2. Verification of use of required design mixture.

3. Concrete placement, including conveying and depositing.

4. Curing procedures and maintenance of curing temperature.

5. Verification of concrete strength before removal of shores and forms from beams and slabs.

6. Batch Plant Inspections: On a random basis, as determined by Engineer.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 20 cu. yd., but less than 45 cu. yd, plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.

    b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; .

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of four 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.

    b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.

    b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.

    c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified

compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi or less, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.

9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

10. Additional Tests:

    a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.

    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.

        1) Acceptance criteria for concrete strength shall be in accordance with ACI 350.5 section 1.6.7.3.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.17 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.

2. Diaper hydraulic equipment used over concrete surfaces.

3. Prohibit vehicles from interior concrete slabs.

4. Prohibit use of pipe-cutting machinery over concrete surfaces.

5. Prohibit placement of steel items on concrete surfaces.

6. Prohibit use of acids or acidic detergents over concrete surfaces.

7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 30 00

SECTION 03 41 00
PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Precast structural concrete.
2. Precast structural concrete with commercial architectural finish.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for concrete topping and placing connection anchors in concrete.
2. Section 05 12 00 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
3. Section 05 50 00 "Metal Fabrications" for kickers and other miscellaneous steel shapes.
4. Section 07 11 00 “Dampproofing”.
5. Section 07 13 00 “Sheet Waterproofing”.

1.03 DEFINITIONS

A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Engineer.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.

C. Shop Drawings:

1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.

4. Indicate separate face and backup mixture locations and thicknesses.
5. Indicate type, size, and length of welded connections by AWS standard symbols.
6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
8. Include and locate openings larger than 4 inches for walls and 8 inches for slabs. Where additional structural support is required, include header design.
9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
10. Indicate relationship of precast structural concrete units to adjacent materials.
11. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
12. Indicate estimated camber for precast floor slabs with concrete toppings.
13. Indicate shim sizes and grouting sequence.
14. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

D. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Show precast structural concrete unit types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from precast structural concrete.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer fabricator testing agency.

B. Welding certificates.

C. Material Certificates: For the following:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Insulation.

6. Structural-steel shapes and hollow structural sections.

7. Accessories.

D. Material Test Reports: For aggregates, by a qualified testing agency.

E. Source quality-control reports.

F. Field quality-control and special inspection reports.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant as follows:

a. Group CA, Category C2A - Prestressed Hollowcore and Repetitively Produced Products.

B. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S2 - Complex Structural Systems.

C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

D. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.07 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.

B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

1. Store units with dunnage across full width of each bearing point unless otherwise indicated.

2. Place adequate dunnage of even thickness between each unit.

3. Place stored units so identification marks are clearly visible, and units can be inspected.

C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Missoula Concrete Construction.
2. Oldcastle Infrastructure
3. Teton Prestress Concrete

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design precast structural concrete units.

B. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.

C. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.

D. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.

a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of minus 40 to plus 105 deg F.

2.03 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Units of face design, texture, arrangement, and configuration indicated . Furnish with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

C. Surface Retarder: Chemical set retarder, capable of temporarily delaying setting of newly placed concrete mixture to depth of reveal specified.

2.04 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, fabricated from as-drawn steel wire into flat sheets.

D. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.05 PRESTRESSING TENDONS

A. Pretensioning Strand: ASTM A416/A416M, Grade 250 or Grade 270 , uncoated, seven-wire , low-relaxation strand.

2.06 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.

2. Silica Fume: ASTM C1240, with optional chemical and physical requirement.

3. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.

a. Gradation: Uniformly graded.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate to match approved finish sample.

D. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

4. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.

5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

7. Plasticizing Admixture: ASTM C1017/C1017M, Type I.

8. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

9. Corrosion-Inhibiting Admixture: ASTM C1582/C1582M.

2.07 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

B. Carbon-Steel-Headed Studs: ASTM A108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.

C. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.

D. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

E. Welding Electrodes: Comply with AWS standards.

F. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.08 BEARING PADS

A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D2240; minimum tensile strength 2250 psi, ASTM D412.

2.09 ACCESSORIES

A. Reglets: Stainless steel, Type 302 or Type 304, felt or fiber filled, or with face opening of slots covered.

B. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

2.10 GROUT MATERIALS

A. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

2.11 INSULATED FLAT-WALL PANEL ACCESSORIES

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type VI, 1.80 lb/cu. ft. ; square ship-lap edges; with thickness of 4 inches.

B. Wythe Connectors: Epoxy-coated carbon-fiber grid manufactured to connect wythes of precast concrete panels.

2.12 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 20 percent for precast enclosing the Grit Washing room.

2. Limit use of fly ash to 20 percent replacement of portland cement by weight and ground granulated blast-furnace slag to 50 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C1218/C1218M.

D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi.

2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: For structural precast concrete with an architectural finish, limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.13 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces of structural precast concrete with an architectural finish that is exposed to view in the finished work.

2. Edge and Corner Treatment: Uniformly chamfered.

C. Install Rustication Joint molds per Architectural Drawings. Use form "Low Profile 877" by Victory Bear or approved equal

2.14 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 4 inches for walls and 8 inches for slabs in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.

2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.

3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. The Grit Washing room is considered a corrosive environment. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.

1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.

2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.

3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.

4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.

5. Protect strand ends and anchorages with a minimum of 1-inch- thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.

H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

K. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.

L. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.

M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.

N. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

O. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Engineer's approval.

2.15 CASTING INSULATED WALL PANELS

A. Cast, screed, and consolidate wythe supported by mold.

B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.

C. Ensure bottom wythe and insulation layer are not disturbed after bottom wythe reaches initial set.

D. Cast, screed, and consolidate top wythe to meet required finish.

E. Maintain temperature below 150 deg F in bottom concrete wythe.

2.16 FABRICATION TOLERANCES

A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.17 COMMERCIAL FINISHES

A. Commercial Grade: Remove fins and protrusions larger than 1/8 inch and fill holes larger than 1/2 inch. Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to 3/16 inch.

B. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

C. Apply roughened surface finish according to ACI 318 to precast concrete units that receive concrete topping after installation.

2.18 COMMERCIAL ARCHITECTURAL FINISHES

A. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform and straight. Finish exposed-face surfaces of precast concrete units to match approved design reference sample and as follows:

1. Textured-Surface Finish: 1/2" x 1/2" vertical rake per Architectural Drawings, impart by form liners or inserts.

2. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.

2.19 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.

1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712/C1712M.

1. Test and inspect self-consolidating concrete according to PCI TR-6.

C. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

D. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C42/C42M.

1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Engineer.

2. Test cores in an air-dry condition or, if units are wet under service conditions, test cores after immersion in water in a wet condition.

3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.

4. Report test results in writing on same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports include the following:

a. Project identification name and number.

b. Date when tests were performed.

c. Name of precast concrete fabricator.

d. Name of concrete testing agency.

e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's approval. Engineer reserves the right to reject precast units that do not match approved

samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.02 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.

B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.

1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.

2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.

4. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.

C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Field cutting of precast units is not permitted without approval of Engineer.

E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.

F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.

2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A780/A780M.

3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.

4. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.

2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:

a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."

b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."

c. Twist-off Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.

d. Direct-Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.

3. For slip-critical connections, use method and inspection procedure approved by Engineer and coordinated with inspection agency.

H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.

1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.

2. Fill joints completely without seepage to other surfaces.

3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.

4. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

5. Keep grouted joints damp for not less than 24 hours after initial set.

3.03 ERECTION TOLERANCES

A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.

3.04 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Erection of precast structural concrete members.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.

D. Testing agency will report test results promptly and in writing to Contractor and Engineer.

E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.05 REPAIRS

A. Repair precast structural concrete units if permitted by Engineer.

1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

D. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.06 CLEANING

A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 41 00

SECTION 03 60 00
GROUT AND REPAIR MORTAR

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This section includes, but not limited to, the following:

1. Grouting of structural base plates, equipment baseplates and other miscellaneous uses of non-shrinking grout.

2. Epoxy grouting of anchor bolts and reinforcing bars to be installed in hardened concrete.

3. Repair of deteriorated concrete surfaces

B. Related Sections include, but are not limited to, the following:

1. Division 5 Section “Metal Fabrications & Miscellaneous Metal”

2. Division 3 Section “Reinforcing Steel”

3. Division 3 Section “Structural Concrete”

1.03 SUBMITTALS

A. The Contractor shall submit manufacturers’ information indicating the application, formulation, and installation procedures for each brand and type of grout to be used.

1.04 PRODUCT HANDLING

A. Delivery of Materials: Materials shall be delivered to the project site in original, new and unopened containers bearing the manufacturer’s name and label showing at least the following information:

1. Name of material.

2. Federal specification number, if applicable.

3. Manufacturer’s name.

4. Contents by volume for major constituents.

5. Handling instructions.

6. Application instructions.

B. Storage of Materials: Materials shall be stored to prevent moisture contamination,

damage, and deterioration of grout materials.

C. Protection: Materials and Work shall be protected before, during and after installation of the grout.

PART 2 - PRODUCTS

2.01 NONSHRINKING GROUT

A. Nonshrinking Grout shall be: Sika Grout 212; Master Builders "Masterflow 713 Grout"; Savereisen Cement "F-100 Level Fill Grout"; U.S. Grout "Five Star Grout"; or USM "Upcon" or equal.

2.02 EPOXY GROUT

A. Adhesive: Two-component liquid equal to: Thermal-Chem “Mortar Resin Products M3”; Minwax “Por-Rok Anchoring Cement”, or equal.

B. Aggregate: As recommended by the epoxy grout manufacturer.

2.03 REPAIR MORTAR

A. The material to be used for repair of the Bar Screen structure shall be two-component, polymer-modified, cementitious, non-sag mortar equal to SikaTop-123 Plus” with FerroGard 901 penetrating corrosion inhibitor.

2.04 QUICK SETTING HYDRAULIC CEMENT

A. Quick setting hydraulic cement shall be SikaSet Plug, or equal

2.05 WATER

A. Clean and free of deleterious substances.

PART 3 - EXECUTION

3.01 NONSHRINKING GROUT

A. General: Nonshrinking grout shall be furnished factory-premixed so only water is added at the project site. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout as recommended by the manufacturer.

B. Preparation: Concrete to receive nonshrinking grout shall be saturated with water for 24 hours prior to grouting.

C. Placement: Grout shall be placed in strict accordance with the directions of the manufacturer so all spaces and cavities below the top baseplates or against concrete slabs or walls are completely filled without voids. Forms shall be provided where structural components of baseplates or launders will not confine the grout.

D. Finishing: The grout shall be finished smooth in all locations where the top surface or edge of the grout will be exposed to view after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut

off flush at the baseplate, bedplate, member, or piece of equipment.

E. Curing: Nonshrink grout shall be protected against rapid loss of moisture by covering with wet rags or polyethylene sheets. After edge finishing is complete, the grout shall be wet cured for at least 7 days.

3.02 EPOXY GROUT

A. General: Components shall be packed separately at the factory and field mixed. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

B. Preparation: Where indicated on the Drawings, anchor bolts and reinforcing bars shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be ¼ inch larger than the maximum dimension of the bolt head, and ½ inch larger than the bar diameter. The embedment depth for epoxy-grouted anchor bolts and reinforcing bars shall not be less than ten bolt or bar diameters unless indicated otherwise on the Drawings.

1. Holes shall be prepared for grouting as recommended by the grout manufacturer.

C. Installation: Anchor bolts and reinforcing bars shall be clean, dry, and free of grease and other foreign matter at the time of installation. The bolts and bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to insure that all spaces and cavities are filled with epoxy grout, without voids.

3.03 REPAIR MORTAR

A. General: Components shall be packed separately at the factory and field mixed. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

B. Preparation: Where indicated on the Drawings, the interior and exterior surfaces of the Bar Screen structure shall be cleaned and completely free of deleterious substances. The surfaces shall be free of standing or adhered water and shall be prepared in strict accordance with the manufacturer's requirements before the repair mortar is mixed and applied.

C. Installation: All surfaces shall be clean, dry, and free of grease and other foreign matter at the time of installation. The mortar shall be placed and finished in accordance with the recommendations of the manufacturer. Particular care shall be taken to insure that all spaces and cavities are filled with repair mortar, without voids.

3.04 QUICK SETTING HYDRAULIC CEMENT

A. General. Contents shall be packaged at the factory and mixed with water in the field to obtain the desired consistency. Proportioning and mixing shall be in

accordance with the manufacturer's recommendations.

B. Preparation. The concrete area to receive quick setting hydraulic cement should be thoroughly cleaned and lightly dampened just prior to application.

C. Installation. The quick setting hydraulic cement shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to insure that all spaces and cavities are filled without voids.

3.05 USES OF GROUT

A. Non-shrink grout shall be used beneath all equipment bases and other locations shown on the Drawings or specified herein. Grouting thicknesses and application shall meet the equipment manufacturer's requirements.

B. Epoxy grout shall be used at locations shown on the Drawings or specified herein. Repair of rock pockets or surface defects in concrete work approved for repair by the Engineer shall generally be repaired with epoxy grout unless otherwise directed by the Engineer. Anchor bolts approved by the Engineer for installation in concrete shall be set in epoxy grout unless otherwise directed by the Engineer. This grout shall not be used in contact with potable water.

C. Quick setting hydraulic cement shall be used at locations shown on the Drawings or specified herein. All penetrations/joints in concrete manholes, vaults, or structures where a watertight seal is required shall use this type of grout.

END OF SECTION 03 60 00

DIVISION 5

METALS

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shear stud connectors.
3. Shrinkage-resistant grout.

1.02 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.03 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Forged-steel hardware.
6. Shop primer.
7. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

C. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2.02 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles : ASTM A36/A36M .

C. Plate and Bar: ASTM A36/A36M .

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.03 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.

B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating .
2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.

C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.04 RODS

A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C .

2.05 PRIMER

A. Steel Primer:

1. Comply with 09 90 00 "Painting and Coatings" and 09 90 02 "High Performance Painting and Coatings."

2.06 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.07 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

B. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

2.08 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened .

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.09 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.

2. Surfaces to be field welded.

3. Galvanized surfaces unless indicated to be painted.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner .

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates and Bearing Plates : Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.03 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightenedunless indicated otherwise in Drawings .

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.04 FIELD QUALITY CONTROL

A. Special Inspections: Engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.

2. Verify weld materials and inspect welds.

3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

END OF SECTION 05 12 00

SECTION 05 31 00
STEEL DECKING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Composite floor deck.

1.02 ACTION SUBMITTALS

A. Product Data: For the following:

1. Composite floor deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.02 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASC Profiles, Inc.
2. New Millennium Building Systems, LLC.
3. Nucor Corp.
4. Verco Decking, Inc., a Nucor company.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for

Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Profile Depth: 1-1/2 inches.
3. Design Uncoated-Steel Thickness: 0.0474 inch.

2.03 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

C. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

D. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

E. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

F. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

G. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.02 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

END OF SECTION 05 31 00

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Interior non-load-bearing wall framing.

1.02 ACTION SUBMITTALS

1.03 INFORMATIONAL SUBMITTALS

1.04 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. ClarkDietrich.
2. SCAFCO Steel Stud Company.
3. Steeler, Inc.
4. The Steel Network, Inc.

2.02 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

2.03 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST33H.
2. Coating: G60, A60, AZ50, or GF30.

B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 33.
2. Coating: G60.

2.04 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.

2. Flange Width: 1-5/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

2.05 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.06 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel headless, hooked bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.

2. Type: Torque-controlled expansion anchor or.

3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

D. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.07 MISCELLANEOUS MATERIALS

PART 3 - EXECUTION

3.01 PREPARATION

A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.02 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

G. Install insulation, specified in Section 07 21 00 "Building Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.03 INSTALLATION OF INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 24 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.04 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.05 REPAIRS

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

END OF SECTION 05 40 00

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Metal floor plate.
3. Metal Canopies.
4. Miscellaneous steel trim.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete.

1.02 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fasteners.
    a. Furnish ICBO Evaluation reports, product data, and installation instructions for post-installed anchors.
2. Shop primers.
3. Shrinkage-resisting grout.
4. Slotted channel framing.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.03 INFORMATIONAL SUBMITTALS

A. Adhesive Anchors. Furnish the following:

1. Manufacturer's past project experience data on at least three similar projects supplied with proposed system within the last three years, to include client name, address, contact person, phone number, project location, and description of work.
2. Test reports for each batch of adhesive delivered to site. Provide manufacturer's written certification that each batch delivered meets these Specifications, the intended uses on project, and capability to bond to damp or wet concrete surfaces.

3. Manufacturer's written letter of certification identifying contractor employees qualified for installing adhesive anchors, trained through jobsite instruction conducted by manufacturer.

4. Furnish specific written statement from EPA and health agencies that the adhesive product is acceptable for use in potable water structures or conveyances prior to use on this project.

B. All Concrete Anchors. Provide specific instructions or all phases of installation including hole size, preparation, placement, and procedures. Provide also specific instructions for safe handling and installation of all anchors to Contractor staff handling and installing these anchors.

1.04 QUALITY ASSURANCE

A. Qualifications. Qualify welding operators in accordance with requirements of current AWS Standard Qualification Procedure D1.1, Chapter 5.

1. Qualification Tests. Performed by a recognized testing laboratory.

B. Certification. Certify welders of structural and reinforcing steel for all positions of welding in accordance with such procedure.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Shipment.

1. Insofar as practical, factory assemble items specified herein.

2. Package and clearly tag parts and assemblies that are of necessity shipped unassembled, in a manner that will protect materials from damage, and facilitate identification and field assembly.

B. Storage of Adhesive Products.

1. Store components on pallets or shelving in a covered storage area with locking door.

2. Control temperature within 41 degrees F to 77 degrees F and dispose of product if shelf life has expired.

3. If stored at temperatures above manufacturer's recommended maximum, test components prior to use to determine if they still meet specified requirements.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Like Items of Materials. End products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.

B. Lifting Lugs. Provide on equipment and equipment components weighing over 100 pounds.

2.02 GENERAL

A. Furnish miscellaneous items.

1. Miscellaneous metal work and castings as shown, or as required to secure various parts together and provide a complete installation.

2. Items specified herein are not intended to be all-inclusive. Provide metal work and castings shown, specified, or which can reasonably be inferred as necessary to complete the project.

2.03 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A588, Grade 50.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 316L.

E. Rolled-Stainless Steel Floor Plate: ASTM A793, Type 316L.

F. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.

2. Material: Galvanized steel, ASTM A653/A653M, structural steel, Grade 33 , with G90 coating; 0.108-inch nominal thickness.

H. Aluminum Structural Shapes & Plates: Alloy 6061-T6, meeting referenced specifications & ASTM sections found in Aluminum Association current Construction Manual Series

I. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

J. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

K. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.04 FASTENERS

A. General: Unless otherwise indicated, provide ASTM A193, Type 316stainless steel fasteners if not permanently embedded in concrete, but located outdoors in areas subject to the weather; chemical handling areas; equipment rooms subject to drainage, leakage, and washdown; and in galleries and trenches.

1. Provide stainless steel fasteners for fastening aluminumand stainless steel .

2. ASTM A307 or A36 with ASTM A153 galvanized if not permanently embedded in concrete, and not used for structural steel or piping, but located indoors where wash down, leakage, and drainage are not likely to occur (e.g., in personnel

buildings excluding laboratories, on motor floors, in electrical equipment rooms, and in control rooms).

3. For Flanges of Piping, Valves, and Other Similar Connections. As specified in other sections, or as shown.

4. Tie Rod assemblies:

   a. ASTM A307A or A36 with ASTM A153 galvanized for threaded rods.

   b. ASTM A668 Class A with ASTM A153 galvanized for clevises and turnbuckles.

   c. ASTM A307A or A36 with ASTM A123/A153 galvanized for clevis pins.

B. Anchor Bolts:

1. Nonsubmerged Use:

   a. Galvanized Steel. For equipment and machinery, where permanently anchored into concrete, unless otherwise shown.

   b. Diameter, Length, and Bend Dimensions. As required by equipment or machinery manufacturer. Unless otherwise required by calculations for seismic or other loadings, provide 5/8-inch minimum diameter and other geometry as shown.

   c. Furnish minimum two nuts and a washer of same material for each bolt.

   d. Provide sleeves as required or as shown for location adjustment.

2. Submerged Use:

   a. Submerged use is defined as any connection below a point 1 foot 6 inches above maximum water surface elevation in a water holding basin.

   b. As specified for nonsubmerged use, for anchoring equipment, machinery or other connection except as follows:

      1) 316 stainless steel.

3. For anchoring fabricated metal work or structural building columns, or other components where connections will be protected or dry.

   a. Galvanized steel.

   b. Minimum Size. 5/8-inch diameter by 12-inch long, unless otherwise shown or required by calculations.

   c. Furnish two nuts and one washer per bolt of same material as bolt, unless otherwise shown.

4. For anchoring fabricated metal work or structural building, or structural frame components in areas of wet use, wash down areas, or areas outside heated buildings.

   a. Galvanized steel.

b. Minimum Size. 5/8-inch diameter by 12-inch long, unless otherwise shown or required by calculations.

c. Furnish two nuts and one washer per bolt of same material as bolt, unless otherwise shown.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchorsas indicated in Drawings.

1. Manufacturer:

a. Dewalt Anchors

b. Hilti, Inc.

c. Simpson Strong-Tie

d. Or approved equal.

2.05 ANCHOR BOLT SLEEVE

A. Fabricated Steel Sleeve.

1. Material. A36 steel.

2. Dimensions, welding, and sizes as shown.

2.06 MISCELLANEOUS MATERIALS

A. Weld Electrodes: Provide weld electrodes that are compatible with the connected base metal(s).

1. Use E70xx electrode to weld carbon steel base metals.

2. Use low-alloy E80xx-W to weld weathering steel base metals.

3. Use 308L electrode to weld austenitic stainless steel (types 301, 302, 304, 305 stainless steel) base metals.

4. Use 316L electrode to weld type 316 and 316L stainless steel base metals.

B. Shop Primers: Provide primers that comply with Section 09 90 00 "Painting and Coating" and Section 09 90 02 "High Performance Painting and Coating".

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Stainless Steel Fastener Lubricant (Antiseizing)

1. Provide for stainless steel nuts and machined bolts, anchor bolts, concrete anchors, and all other threaded fasteners.

2. Lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper as manufactured by:

a. Loc Tite Co., Permatex.

b. Or equal.

E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.07 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 8 inches from ends and corners of units and 24 inches o.c.

2.08 MISCELLANEOUS FRAMING AND SUPPORTS

A. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.09 METAL FLOOR PLATE

A. Fabricate from rolled-stainless steel floor plate of thickness indicated below:

1. Thickness: As indicated.

B. Provide stainless steel angle supports as indicated.

C. Provide flush stainless steel bar drop handles for lifting removable sections, one at each end of each section.

2.10 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Prime miscellaneous steel trim with primer specified in Section 09 90 02 "High-Performance Painting & Coating."

2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 09 90 00 "Painting and Coating" primers specified in Section 09 90 02 "High Performance Painting and Coating" unless indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

1. Do not begin installation until concrete or masonry receiving anchors have attained design strength.

2. Do not install an anchor closer than six times its diameter to either an edge of concrete or masonry, or to another anchor, unless specifically shown otherwise.

E. Apply specified antiseizing lubricant to threads prior to making up connections.

F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.02 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with expansion anchors .

D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

3.03 ELECTOLYTIC PROTECTION

A. Aluminum.

1. Where in contact with dissimilar metals, or embedded in masonry or concrete, protect surfaces as specified in Section 09 90 00 “Painting and Coating”.

2. Allow paint to dry before installation of the material.

3. Protect painted surfaces during installation.

4. Should coating become marred, prepare and touch up per paint manufacturer's written instructions.

B. Where titanium equipment is in contact with concrete or dissimilar metals, provide full-face neoprene insulation gasket, 3/32-inch minimum thickness and 70 durometer hardness.

3.04 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.05 REPAIRS

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

SECTION 05 51 19
METAL GRATING STAIRS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Industrial Class stairs with fiberglass-grating treads and landing surfaces.

2. Aluminum railings and guards attached to metal stairs.

B. Related Requirements:

1. Section 05 52 13 "Pipe and Tube Railings" for stair railings and guards.

1.03 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width.

D. Schedule installation of railings and guards so wall attachments are made only to completed walls.

1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For grating stairs and the following:

1. Gratings.

2. Shop primer products.

3. Grout.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment to other work.

2. Indicate sizes of metal/fiberglass sections, thickness of metals, profiles, holes, and field joints.

3. Include plan at each level.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.

2. Protect steel members and packaged materials from corrosion and deterioration.

3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements", to design , railings, and guards, including attachment to building construction.

B. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Concentrated load of 200 lb. applied in any direction within 2 inches of the top edge of the rail on any point along the member.

2. Infill of Guards:

a. Concentrated load of 150 lb. applied downward or any outward direction on any point along the member.

b. Infill load and other loads need not be assumed to act concurrently.

3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Fiberglass for Grating Treads and Landings: ASTM E-84 pultruded fiberglass, as follows:

1. SPF Polyester resin for bearing bars and crossbars of gratings and shapes.

2. Yellow.

3. Grit surfacing.

4. Integral nosing one side of panel.

5. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. MS-I-ST-6015 treads by McNichols Grating Products.

b. MS-I-6015 grating (at Stair Landings) by McNichols Grating Products.

c. Or approved equal.

2.03 FASTENERS

A. General: Provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.

1. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.04 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Shop Primers: Provide primers that comply with Section 09 90 00 "Painting and Coating."

2.05 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.

2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.

2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Weld exposed corners and seams continuously unless otherwise indicated.

5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.

2. Locate joints where least conspicuous.

3. Fabricate joints that are exposed to weather in a manner to exclude water.

4. Provide weep holes where water may accumulate internally.

2.06 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual", for Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel channels.

a. Stringer Size: As indicated on Drawings.

b. Provide closures for exposed ends of channel stringers.

c. Finish: Painted.

2. Construct platforms and tread supports of steel channel headers and miscellaneous framing members as indicated on Drawings.

a. Provide closures for exposed ends of channel framing.

b. Finish: Painted.

3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.

C. Risers: Open.

D. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.

1. Material and Finish: Steel plate to match finish of other steel items.

2. Fabricate to dimensions and details indicated.

2.07 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings".

2.08 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF METAL STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces.

a. Clean bottom surface of baseplates.

b. Set steel-stair baseplates on wedges, shims, or leveling nuts.

c. After stairs have been positioned and aligned, tighten anchor bolts.

d. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.

e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.

2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

3. Comply with requirements for welding in "Fabrication, General" Article.

3.03 INSTALLATION OF RAILINGS AND GUARDS

A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
4. Secure posts, rail ends, and guard ends to building construction as follows:
    a. Anchor posts to steel by bolting to steel supporting members.

3.04 REPAIR

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00 "Painting and Coating".

END OF SECTION 05 51 19

SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Aluminum railings.

1.03 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.04 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Woven-wire mesh infill panels.
3. Fasteners.
4. Post-installed anchors.
5. Shop primer.
6. Intermediate coats and topcoats.
7. Bituminous paint.
8. Nonshrink, nonmetallic grout.
9. Metal finishes.
10. Paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated-design professional engineer.

B. Welding certificates.

C. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.08 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.

1. Railings must be configured to conform to all OSHA standards.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, without damage or permanent set:

1. Handrails, Combination Hand/Stair Rails, and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft.applied in any direction (applies only at guards with infill).

b. Concentrated load of 200 lb. applied in any direction.

c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards (where required):

a. Concentrated load of 50 lb. applied horizontally on an area of 1 sq. ft.

b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.03 ALUMINUM RAILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Superior Aluminum Products, Inc ("Series 500" railing) or approved equal.

2. Thompson Fabricating, LLC ("TUFRAIL" railing) or approved equal.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

D. Extruded Tubing: ASTM B221, Alloy 6063-T5/T52.

E. Extruded Structural Pipe : ASTM B429/B429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

F. Plate and Sheet: ASTM B209, Alloy 6061-T6.

G. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.

H. Castings: ASTM B26/B26M, Alloy A356.0-T6.

I. Woven-Wire Mesh Infill Panels: Intermediate-crimp, square pattern, 2-inch woven-wire mesh, made from 0.162-inch- diameter aluminum wire complying with ASTM B211/B211M, Alloy 6061-T94.

2.04 FASTENERS

A. Fastener Materials:

1. Aluminum Railing Components: Type 316 stainless steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

2. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.06 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.

2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.

2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water.

1. Provide weep holes where water may accumulate.

2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded or nonwelded connections unless otherwise indicated.

H. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection, using an epoxy structural adhesive, if this is manufacturer's standard splicing method.

J. Form changes in direction as follows:

1. By bending or by inserting prefabricated elbow fittings.

K. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.

2. Coordinate anchorage devices with supporting structure.

O. Railing posts are not permitted to be set in concrete.

P. Attach railing posts to vertical face of concrete elements using brackets fastened with post-installed concrete anchors.

Q. Attach railing posts to top of structural steel using brackets bolted to top of structural steel.

R. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames.

1. Fabricate wire mesh and frames from same metal as railings in which they are installed.

2. Orient wire mesh with wires perpendicular and parallel to top rail .

S. Toe Boards: Shall conform to OSHA standards. Provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to be a miminum of 4" high. Toe boards shall be set 1/4" above the walking surface.

2.07 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611; AA-M10C22A41 or AA-M12C22A41.

PART 3 - EXECUTION

3.01 EXAMINATION

3.02 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.

2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.

3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.

4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.04 ANCHORING POSTS

A. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum railings, attach posts to vertical faces of supporting concrete and to top surface of supporting structural steel members, using fittings designed and engineered for this purpose.

3.05 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends, using nonwelded connections.

3.06 REPAIR

3.07 CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.08 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 52 13

SECTION 055313
BAR GRATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes metal bar gratings and metal frames and supports for gratings.

B. Related Requirements:

1. Section 05 12 00 "Structural Steel Framing" for structural-steel framing system components.
2. Section 05 51 00 "Metal Stairs" for grating treads and landings of steel-framed stairs.
3. Section 05 52 13 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.03 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Metal bar gratings.
2. Clips and anchorage devices for gratings.
3. Paint products.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

1.05 INFORMATIONAL SUBMITTALS

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.07 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. McNichols Company - GHB Series Heavy Duty Welded Bar Grating.

2. Or approved equal.

2.02 PERFORMANCE REQUIREMENTS

2.03 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

B. Welded Steel Grating :

1. Bearing Bar Spacing: 1-3/16 inches o.c.

2. Bearing Bar Depth: 1-3/4 inches.

3. Bearing Bar Thickness: 1/4 inch.

4. Crossbar Spacing: 2 inches o.c.

5. Grating Mark: GHB-175-2 by McNichols Company (or approved equal).

6. Traffic Surface: Serrated .

7. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

2.04 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A 510.

2.05 FASTENERS

A. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563 and, where indicated, flat washers.

B. Post-Installed Anchors: chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.06 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.07 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

I. Do not notch bearing bars at supports to maintain elevation.

2.08 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

B. Galvanize steel frames and supports in the following locations:

1. Exterior.

2. Interior.

2.09 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

3.02 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.03 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 53 13

SECTION 05 53 16
PLANK GRATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes extruded-aluminum plank gratings and metal frames and supports for gratings.

B. Related Requirements:

1. Section 05 12 00 "Structural Steel Framing" for structural-steel framing system components.

2. Section 05 52 13 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.03 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded-aluminum plank gratings.

2. Paint products.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

1.05 INFORMATIONAL SUBMITTALS

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.07 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

2.02 EXTRUDED-ALUMINUM PLANK GRATINGS

A. Products: Subject to compliance with requirements, provide the following:

1. McNichols Company - Diamondback Interlocking Plank.

2. Approved equal.

B. Provide extruded-aluminum plank gratings in type, size, and finish indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.

1. Type: Extruded-aluminum planks approximately 12 inches wide with multiple flanges approximately 1.2 inches o.c., acting as bearing bars connected by a web that serves as a walking surface. Top surface has raised serrated ribs to increase slip resistance running parallel to the plank length. The sides of the plank channel have dovetail interlocking slots. Dovetail interlocking rods slide into the slots in the channel to connector or lock adjacent panels.

2. Depth: 2 inches.

3. Perforations: None.

4. Finish: Mill finish, as fabricated.

2.03 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B 221, alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.

2.04 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.

B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.05 MISCELLANEOUS MATERIALS

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.06 FABRICATION

A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Fit exposed connections accurately together to form hairline joints.

C. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

D. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with metal sheet or bars having a thickness not less than grating material.

1. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

E. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.07 GRATING FRAMES AND SUPPORTS

A. Frames and Supports: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

2.08 ALUMINUM FINISHES

A. Class I, Clear Anodic Finish: AA-M12C22A41 complying with AAMA 611.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

E. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.02 INSTALLING METAL PLANK GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.

B. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at midspan.

END OF SECTION 05 53 16

DIVISION 6

WOODS, PLASTICS, COMPOSITES

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking and nailers.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1.03 INFORMATIONAL SUBMITTALS

1.04 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

4. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction, Stud, or No. 3 grade.

1. Application: All interior partitions.

2. Species:

a. Western woods; WCLIB or WWPA.

B. Framing Other Than Non-Load-Bearing Partitions: No. 2 grade.

1. Application: Framing other than interior partitions.

2. Species:

a. Spruce-pine-fir; NLGA.

2.04 MISCELLANEOUS LUMBER

A. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

2.05 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.06 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Simpson Strong-Tie Co., Inc.

2. USP Structural Connectors.

B. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.07 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3. ICC-ES evaluation report for fastener.

3.02 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 16 00
SHEATHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wall sheathing.

1.02 ACTION SUBMITTALS

1.03 INFORMATIONAL SUBMITTALS

1.04 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

2.02 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.03 WALL SHEATHING

A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, sheathing.

B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1 sheathing.

2.04 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M .

2.05 MISCELLANEOUS MATERIALS

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3 (1), "Fastener Schedule for Structural Members," and Table R602.3 (2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.02 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
   a. Nail to wood framing.
   b. Screw to cold-formed metal framing.
   c. Space panels 1/8 inch apart at edges and ends.

3.03 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with nails .
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 06 16 00

DIVISION 7

THERMAL & MOISTURE PROTECTION

SECTION 07 11 00
DAMPPROOFING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section covers the work necessary to furnish and install, complete, all belowgrade dampproofing.

1.02 RELATED SECTIONS

A. Division 3 – Concrete & Grout

1.03 GENERAL

A. See the GENERAL CONDITIONS and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

1.04 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 30 00, SUBMITTALS in Division 1, GENERAL REQUIREMENTS.

B. Submit the following:

1. Manufacturer’s Literature: Submit manufacturer's literature, specifications, and application instructions for dampproofing materials.

2. Certificate: Submit manufacturer's certificate of conformance with these Specifications.

PART 2 - PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and catalog number is for the purpose of establishing the standard of quality desired only. Products of other manufacturers will be considered in accordance with the General Conditions.

2.02 DAMPPROOFING

A. Asphalt compound of brush or spray consistency conforming to Federal Specification SS-A-701 or ASTM D449, Type A; A.C. Horn Dehydratine 4; J & P Petroleum Products Tex-Mastic No. 720; W.R. Meadows, Inc. Spray-Mastic; Sonneborn Hydrocide 700B; or equal.

PART 3 - EXECUTION

3.01 ENVIRONMENTAL REQUIREMENTS

A. Do not start work until the following environmental requirements are met.

B. Do not proceed with application of materials when ambient temperature is less than 50 degree F.

C. Do not apply dampproofing in rainy conditions or within 3 days after surfaces become wet from rainfall or other moisture.

D. Do not apply materials when low temperature of 40 degrees F or less is predicted within a period of 24 hours after application.

3.02 INSPECTION

A. Examine surfaces to receive dampproofing to assure conditions are satisfactory for application of materials.

3.03 SURFACE PREPARATION

A. Clean surfaces to remove dust, dirt, oil, wax, efflorescence, and other foreign materials, in accordance with dampproofing manufacturer's instructions.

B. Remove efflorescence by scrubbing surface with muriatic acid and thoroughly rinsing with water.

C. Allow 3 days drying time following washing down of substrate surfaces.

D. Fill all cracks, voids, and honeycombs with mortar to provide sound surface for dampproofing.

3.04 APPLICATION

A. Apply dampproofing with a brush, or with manufacturer-approved low pressure airless spray equipment with a coarse nozzle.

B. Apply materials at rate and as recommended by the manufacturer and in two coats.

C. Start application at top of wall and work down surface, keeping a wet edge at all times, forming a continuous, unbroken film, free from pinholes and other surface breaks.

3.05 ADJUST AND CLEAN

A. Clean spillage and overspray from adjacent surfaces as recommended by manufacturer.

3.06 FIELD QUALITY CONTROL

A. After dampproofing has dried, spray coat surfaces with water.

B. Recoat surfaces that show water absorption, as recommended by manufacturer. To prevent blistering, protect surfaces from heat and direct sunlight until dried, then backfill.

3.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original sealed containers, clearly marked with manufacturer's name, brand name, and type of material.

B. Store materials in area where temperatures are not less than 50 degrees F or over 85 degrees F, unless otherwise authorized by manufacturer.

3.08 APPLICATION SCHEDULE

A. *Apply dampproofing to all exterior surfaces of all cast-in-place and pre-cast concrete structures below finish ground level to at least 4" above finished ground surface.* Also apply to foundation where the floor steps down to form the pump room area. See Structural drawings. Do not apply to interior of water holding basins.

END OF SECTION 07 11 00

SECTION 07 13 00
SHEET WATERPROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rubberized Asphalt Sheet Membrane Waterproofing System

1.02 RELATED SECTIONS

A. Section 03 30 00 – Cast in Place Concrete

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM) International - Annual Book of ASTM Standards

1. ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
2. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
3. ASTM C836 – Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for use with Separate Wearing Course.
4. ASTM E154 – Standard Test Methods for Water Vapor Retarders used in contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
5. ASTM D5385 – Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

B. Sheet Metal & Air Conditioning Contractors' National Association (SMACNA) - Architectural Sheet Metal Manual.

C. American Society of Civil Engineers (ASCE).

1.04 SUBMITTALS

A. Product Data: Provide copies of manufacturer's product data information and samples for each type of membrane product.

B. Manufacturers Application Instructions: Provide manufacturer's application instructions that indicate preparation required, installation procedures, and detail drawings.

1.05 MANUFACTURER & CONTRACTOR QUALIFICATIONS

A. Manufacturer Qualifications: Provide all primary membrane products, including sheet waterproofing membrane, primers and mastics offered by a single manufacturer.

B. Installer Qualifications: Installer must be licensed or otherwise authorized by all federal, state and local authorities for installation of all membrane products to be installed under this section.

1.06 REGULATORY REQUIREMENTS

A. Install all membrane products in accordance with all applicable federal, state and local building codes.

B. All work shall be performed in a manner consistent with current OSHA guidelines.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver product and other materials to site in manufacturer's unopened labeled packaging. Promptly verify quantities and conditions. Immediately remove damaged products from site.

B. Store all products in manufacturer's unopened, labeled packaging until they are ready for installation.

C. Store rolls on a flat surface. Maximum stacking height shall not exceed TAMKO's recommendations. Store all rolls on end and do not double stack pallets.

D. Store and dispose of solvent-based materials in accordance with all applicable federal, state and local regulations.

E. Store products in weather protected environment out of direct sunlight, below 90°F, above 32°F clear of ground and moisture. All waterproof tarps shall be opaque.

1.08 WEATHER CONDITIONS

A. Proceed with work only when existing and forecasted weather conditions will permit work to be performed in accordance with TAMKO's application instructions.

B. Membrane must not be left exposed to sunlight for more than 30 days after installation.

1.09 LIMITED WARRANTY AND ARBITRATION AGREEMENT

A. Manufacturer's Limited Warranty: Provide to the owner a TAMKO® Waterproofing, Fenestration Flashings, Underlayment's and Accessories Limited Warranty and Arbitration Agreement for the product listed below which includes a binding arbitration provision.

1. TAMKO® TW-60 Self-Adhering Sheet Waterproofing Membrane: TAMKO Waterproofing, Fenestration Flashings, Underlayment's and Accessories Limited Warranty and Arbitration Agreement. Available at www.tamko.com

2. Term: The period of time this Limited Warranty lasts is five (5) years for TW-60 Self-Adhering Sheet Waterproofing Membrane.

3. The limited warranty does not cover any cost or expenses associated with removal, excavation, or replacement of concrete or other materials in connection with the testing, repair, removal, or replacement of the product.

4. Exclusions: See TAMKO® Waterproofing, Fenestration Flashing, Underlayment's and Accessories Limited Warranty and Arbitration Agreement for exclusions and other important details. Contact TAMKO for a copy of the Limited Material Warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS – Basis of Design: TAMKO® TW-60 Self-Adhering Sheet Waterproofing Membrane

A. Acceptable Manufacturer: TAMKO Building Products, Inc., 220 West 4th Street, Joplin, MO 64801. Toll Free: 1-800-641-4691.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

PART 3 - EXECUTION

3.01 LOCATION

A. Apply the outside face of wall where interior slab-on-grade is below the exterior finish. See structural drawings for exact locations.

3.02 EXAMINATION

A. Examine substrates, areas and conditions, with installer present for compliance with requirements for installation tolerances and other conditions affecting performance.

1. The surface must be dry and have a smooth (not broomed) finish and be free of form release agents, voids and sharp protrusions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If preparation is the responsibility of another installer, notify the architect or building owner of unsatisfactory preparation before proceeding.

3.03 PREPARATION

A. Any holes or voids must be repaired with non-shrink grout. Cracks greater than 1/16” in width shall be cut out to a minimum of ¼” with a minimum depth of ¼” and sealed using a sealant suitable for use with rubberized asphalt per sealant manufacturer, prior to the installation of the sheet membrane.

B. Concrete must be properly cured and dry. Curing time is a minimum of 7 days for normal structural concrete and a minimum of 14 days for lightweight structural concrete. Curing agents containing wax, oil, or pigment should not be used.

C. Masonry (CMU) surfaces must have a thorough parge coat and mortar joints must be flush to the face of the concrete block or brick, and have a thorough parge coat.

D. Forms should be removed as quickly as possible. On a horizontal deck, do not apply membrane when forms are in place unless the forms are vented.

E. Expanded/Extruded Polystyrene (EPS/XPS) or Insulated Concrete Forms (ICF). Ultraviolent radiation in sunlight causes a rapid deterioration of the surface of these materials which can create a chalky or dusty layer which could interfere with membrane adhesion. If this occurs, or if the surface is dirty, brush off all dirt and dust to provide a clean dry surface for the application of the membrane. Joints and voids in the surface over ¼” wide should be filled with non-shrink grout, expandable foam or compatible crack filler.

3.04 PRIMING

A. Priming is required on concrete, masonry, metal, EPS/XPS and ICF surfaces. Thoroughly mix the primer. Apply at recommended coverage rates with a sprayer or long nap roller and allow drying as specified in the primer's application instructions.

1. TAMKO® TWP-1 Primer: Apply primer to a properly prepared, clean surface. All surfaces that are to receive a waterproofing membrane shall be primed at the rate of 250 to 300 sq. ft. per gallon. Apply an even coat, and allow drying. Refer to manufacturer's written application instructions for specific application rates and drying time.

2. TAMKO® TWP-2 Primer: Apply primer to a properly prepared, clean surface. All surfaces that are to receive a waterproofing membrane shall be primed at the rate of 350 to 400 sq. ft. per gallon. Apply an even coat, and allow drying. Refer to manufacturer's written applications instructions for specific application rates and drying time.

3.05 APPLICATION

A. Horizontal: Starting at the low point of the surface and working to the high point, install the sheet waterproofing membrane by simultaneously rolling the sheet into place while removing the release film. Side laps should be a minimum of 2 1/2", and end laps should be a minimum of 5". Stagger all end laps. All edges terminating on a surface other than the waterproofing membrane should be sealed with TWM-1 Mastic or another compatible termination sealant. Roll the entire membrane as soon as possible with a minimum 75 lb. hard-surface or rubber-faced roller.

B. Vertical: Install waterproofing membrane in lengths of 8' or less. Overlap edge seams a minimum of 2 ½". On walls greater than 8' apply in 8' sections, starting at the lowest point with the higher section overlapping the lower section a minimum of 5". Use heavy hand pressure or a suitable roller to press membrane firmly against wall and to seal all overlaps.

3.06 TERMINATIONS

A. Concrete or Masonry Surfaces: TW-60 sheet should be installed over the top of a wall or over the edge of a slab. If the membrane must terminate on a vertical surface, use a reglet, termination bar, or counter flashing. Press terminating edge firmly with a hammer handle, roller, or similar tool. Apply TWM-1 Mastic or another compatible termination sealant to all edges terminating on a surface other than TW-60. TW-60 Sheet Membrane shall be installed on the base of the foundation wall, over the edge of the footing and the terminating edge pressed firmly against the vertical surface of the footing. Apply TWM-1 Mastic or another compatible termination sealant to all terminating edges including both vertical and horizontal.

Note: Failure to use adequate pressure at terminating edges will result in poor seal, potential leaks and may affect coverage under the limited warranty. The use of a terminating sealant is not a substitute for a good membrane seal.

3.07 MEMBRANE PROTECTION

A. Protection of the waterproofing membrane on vertical and horizontal surface is required immediately after installation with an appropriate protection course. For balcony and breezeway installations, use of protection course is not required.

3.08 CLEAN UP

A. In areas where adjacent finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions. Remove all debris, tools and equipment.

END OF SECTION 07 13 00

SECTION 07 21 00
BUILDING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Thermal Batt Insulation
2. Extruded polystyrene rigid board insulation
3. Spray insulation

1.02 SUBMITTALS

A. General: Submit in accordance with Section 01 33 00.

B. Product Data: Submit product data and manufacturer's instructions for each product.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Furnish each insulation type from one manufacturer for entire Project, unless otherwise acceptable to Architect.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 60 00.

B. Identify products with appropriate markings of applicable testing and inspecting organization.

C. Storage and Protection:

1. Store materials raised off floor or ground and under cover to keep dry.
2. Protected from weather, direct sun light, contamination, sources of ignition, and damage from construction operations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Thermal & Sound Control Batts and Rolls

1. Manufacturer
   a. Owens Corning or equal.
2. General Requirements:
   a. Glass fiber composition, friction fit type, un-faced. Verify thickness based on wall type.
   b. Minimum R-value per Wall Type descriptions (see drawings)
3. Location

a. All framed wall cavities.

B. Extruded polystyrene rigid board insulation

1. Manufacturer:

a. Owens Corning Foamular 250 or approved equal

2. General Requirements:

a. Thickness/R value per drawings.

3. Location:

a. New framed wall at Administration building

b. At foundation perimeter, adjacent to exterior grade, apply min. R-10 insulation to 24” below grade.

C. Closed Cell Spray Foam Insulation

1. Manufacturer:

a. Johns Manville Corbond III or approved equal.

2. Location:

a. Door and window gaps

b. May be used as substitution for batt insulation at exterior Administration wall.

D. Polyiso roofing insulation

1. See Membrane Roofing specification

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions and proceed with work in accordance with Section 01700.

B. Verify that work of other trades which will be covered by insulation is complete, approved, and tested.

3.02 INSTALLATION

A. General:

1. Install in strict accordance with manufacturer’s recommendations including specific requirements per product type below.

B. Protect finished work in accordance with Section 01 70 00.

C. Chamfer top of foundation insulation for full slab coverage.

END OF SECTION 07 21 00

SECTION 07 25 00
WEATHER BARRIERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings

1.02 SUMMARY

A. Section Includes:

1. Commercial weather barrier assemblies.
2. Flexible flashing.
3. Weather barrier flashing.
4. Fluid-applied flashing.
5. Weather barrier accessories.
6. Drainage material.

B. Related Requirements:

1. Section 07 90 00 – Joint Sealers
2. Section 07 21 00 – Building Insulation

1.03 DEFINITIONS

A. Weather Barrier: A combination of materials and accessories that do the following:

1. Prevents the accumulation of water as a water-resistive barrier.
2. Minimizes the air leakage into or out of the building envelope as a continuous air barrier.
3. Provides sufficient water vapor transmission to enable drying as a vapor-permeable membrane.

B. Water-Resistive Barrier: A combination of materials and accessories that prevent the accumulation of water within the wall assembly per International Building Code Section 1403.2.

C. Continuous Air Barrier: The combination of interconnected materials, assemblies, and sealed joints and components of the building envelope that minimize air leakage into or out of the building envelope per ASHRAE 90.1 section 5.4.3.1.

D. Vapor Diffusion: A slow movement of individual water vapor molecules from regions of higher to lower water vapor concentration (higher to lower vapor pressure).

E. Vapor Permeable Membrane: The property of having a water-vapor permeance rating of 10 perms or greater, when tested in accordance with the desiccant method using

Procedure A of ASTM E 96 per definition in International Building Code. Vapor permeable material permits the passage of moisture vapor through vapor diffusion.

1.04 SUBMITTALS

A. Product Data: For each type of product.

1. For weather barrier, include data on air and water-vapor permeance based on testing in accordance with referenced standards.

2. Provide SDS, third-party certifications, or product technical data.

B. Evaluation Reports: For weather barrier and flexible flashing, from ICC-ES.

C. Manufacturer’s Instructions: For installation of each product specified.

D. Qualification Data: For Installer

E. Sample Warranty: For manufacturer's warranty.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is certified by weather barrier system manufacturer to install manufacturer's product.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not store near heat source or open flame.

1.07 WARRANTY

A. Manufacturer’s Product Warranty: To repair or replace weather barrier product that fails in materials within specified warranty period.

1. Warranty Period: 10 years from date of purchase.

B. Manufacturer’s Product and Labor Warranty: Manufacturer agrees to repair or replace weather barrier that fails in materials within specified warranty period, including removal and replacement of affected construction up to manufacturer’s limits.

1. Warranty Period: 10 years from date of purchase.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain weather barrier assembly components, including weather barrier flashing from same manufacturer as weather barrier or manufacturer approved by weather barrier manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. General Performance: Installed weather barrier and accessories shall withstand specified wind pressures, liquid water penetration, and water vapor pressures, without failure due to defective manufacture of products.

B. High-Performance Installations:

1. For installation with one of the following building envelope performance or structural characteristics:
    a. Exceeding 65 mph equivalent structural load.
    b. Exceeding 15 mph equivalent wind-driven rainwater infiltration.
    c. Buildings with 60 feet or more total height above grade plane, as defined in the International Building Code.
    d. Construction with gypsum or cement-based exterior sheathing.
    e. Non-wood based primary structure such as: stel, light gage steel, masonry or concrete.

2.03 WEATHER BARRIER

A. Commercial Building Wrap: ASTM E 2357 passed, ABAA (Air Barrier Association of America) evaluated air barrier assembly, and assembly water resistance per ASTM E 331; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E 84; UV stabilized for nine-month exposure; and acceptable to authorities having jurisdiction.
    1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek CommercialWrap or a comparable product by one of the following:
        a. Approved equal.
    2. System Description, Single-Layer Weather Barrier: Single-layer weather barrier, including flashing and sealing of penetrations and seams.

B. Conformable Weather Barrier Flashing: Composite flashing material composed of micro-creped, polyethylene laminate with a 100 percent butyl-based adhesive layer; AAMA 711 Class A (no primer), Level 3 thermal exposure, 176 deg F for 7 days.
    1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; FlexWrap™ NF or comparable product by one of the following.
        a. Approved equal.

C. Strip Flashing: Composite flashing material composed of spunbonded polyethylene laminate with 100 percent butyl-based, dual-sided, adhesive layer; AAMA 711, Class A (no primer), Level 3 thermal exposure, 176 deg F for 7 days.
    1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; StraightFlash or comparable product by one of the following:
        a. Approved equal.

2.04 FLUID-APPLIED FLASHING

A. Fluid-Applied Flashing: Trowel or brush applied, non-water soluble, single component,

silyl terminated polyether technology (STPE), vapor permeable, flashing material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek® Fluid Applied Flashing & Joint Compound+ or comparable product by one of the following:

    a. Approved equal.

2.05 WEATHER BARRIER ACCESSORIES

A. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by weather barrier manufacturer for sealing joints and penetrations in commercial building wrap.

1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek® Tape.

B. Closed-Cell Polyurethane Foam Insulation: Low pressure, low expansion, single component polyurethane foam, with maximum flame-spread and smoke-developed indexes of 15 and 25, respectively, per ASTM E 84.

1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; DuPont™ Window & Door Foam.

C. Fasteners with Self-Gasketing Washers: Commercial building wrap manufacturer's recommended pneumatically or hand-applied fasteners with 1-inch diameter, high-density polyethylene cap washers with UV inhibitors.

1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek® Wrap Caps.

D. Primer for Flashings: Synthetic rubber-based product; spray applied. Strengthen adhesive bond at low temperature applications between weather products such as self-adhered flashing products, commercial building wraps, and common building sheathing materials.

1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company, DuPont™ Adhesive Primer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements.

B. Verify that substrate and surface conditions are in accordance with commercial weather barrier manufacturer recommendations prior to installation.

1. Verify that rough sill framing for doors and windows is sloped downwards towards the exterior and is level across width of the opening.

C. Verify that surfaces to receive weather barrier flashing are clean, dry, and free of frost.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Direct water onto an acceptable weather barrier drainage plane with an unobstructed path to exterior of wall.

1. Provide a drainage path for water intrusion through window and door attachment system that collects at window and door sills and directs water to the exterior or weather barrier.

3.03 COMMERCIAL BUILDING WRAP INSTALLATION

A. General: Comply with weather barrier manufacturer's written instructions and warranty requirements.

B. Cover exposed exterior surface of sheathing with weather barrier securely fastened to framing immediately after sheathing is installed.

1. Maintain continuity of air and water barrier assemblies.

2. Start weather barrier installation at a building corner, leaving 12 inches of weather barrier extended beyond corner to overlap.

3. Install weather barrier horizontally starting at lower portion of wall surface.

4. Provide minimum 6 inches overlap at horizontal- and vertical-wrap seams in a shingle manner to maintain continuous downward drainage plane and air and water barrier.

C. Seams: Seal seams with building wrap tape per manufacturer's recommended installation instructions.

1. Shiplap horizontal seams in weather barrier to facilitate proper drainage.

D. Fasteners: Use weather barrier manufacturer’s recommended fasteners to secure weather barrier and install fasteners according weather barrier manufacturer’s installation guidelines.

1. Do not use temporary fasteners to permanently attach weather barrier.

2. Do not place fasteners with gasketing washers where weather barrier flashing will be installed.

3. Install fasteners with gasketing washers through flashing where recommended by manufacturer.

E. Openings: Completely cover openings with weather barrier, then cut weather barrier membrane to openings according to weather barrier manufacturer's installation guidelines.

1. Provide head and jamb flaps and seam overlaps to maintain continuous drainage.

2. Repair damage to weather barrier using method recommended by weather barrier manufacturer.

3. Install flashing according to weather barrier manufacturer's installation guidelines.

3.04 WEATHER BARRIER FLASHING INSTALLATION

A. Installation: Remove wrinkles and bubbles, reposition weather barrier as necessary to produce a uniform, smooth surface.

1. Ensure that ambient and substrate surface temperatures are acceptable in accordance with manufacturer instructions and recommendations.
2. Wipe surfaces to remove moisture, dirt, grease and other debris that could interfere with adhesion.
3. Apply weather barrier manufacturer’s recommended primer over concrete, masonry, and glass-mat gypsum wall sheathing substrates to receive weather barrier flashing.
4. Lap weather barrier flashing a minimum of 2 inches onto weather barrier.
5. Apply pressure over entire surface using roller or firm hand pressure.

B. Rough

1. Apply 6-inch wide conformable weather barrier flashing at door and window sills.
2. Ensure that sill flashing does not slope to the interior.
3. Install backer rod in joint between frame of opening product and flashed rough opening on the interior.
4. Apply sealant or closed-cell polyurethane foam insulation around entire opening/fenestration product to create air seal around interior perimeter of window openings in accordance with weather barrier manufacturer’s instructions.
5. Around door and window openings, apply butyl-based flashing to flaps of weather barrier.
6. Use strip flashing with wrap cap screws to secure head flap of the windows.

C. Penetrations: Apply weather barrier manufacturer's recommended weather barrier flashing patches behind fastening plates, such as brick-tie base plates, metal-flashing clips, and metal channels.

1. Seal weather barrier around each penetration with weather barrier manufacturer's recommended self-adhered flashing product or sealant. Integrate products with flanges into the weather barrier.

D. Terminations: Provide minimum 2 inches overlap using strip flashing on adjoining roof and base of wall systems to maintain continuous downward drainage plane.

1. Secure Secure weather barrier with fasteners and weather-barrier flashing.

3.05 FLUID-APPLIED FLASHING INSTALLATION

A. General: Before installing fluid-applied flashing, do the following:

1. Ensure drainage path is not blocked or disrupted. Do not install on walls that do not feature a continuous path for moisture drainage. Blocked or disrupted paths for drainage can result in excess moisture buildup in wall cavity. Do not install below grade.

2. Remove surface dust, dirt, and loose mortar.
3. Verify that surface is free of grease and other contaminants and that surface is smooth.
4. Fill joints in concrete masonry units, and voids in cast-in-place concrete with trowel-applied fluid-applied flashing to ensure surface is flush and smooth.
5. Allow masonry mortar and cast-in-place concrete a minimum of 24 hours to cure before installing fluid-applied flashing.

B. Fluid-Applied Flashing Installation: Using a trowel or brush, apply fluid-applied flashing around perimeter of window and door openings to a minimum thickness of 25 mils
1. Extend flashing a minimum of 2 inches onto exterior face of adjacent surface.
2. Inspect for gaps and pinholes in fluid-applied flashing and apply additional coats until no gaps and pinholes appear.
3. Joint Applications: Using a trowel or a brush, fill cracks and voids up to 1/4 inch in width.
a. For joints and cracks between 1/4 and 1/2 inch wide, cover first with mesh tape.
b. For joints and cracks between 1/2 and 1 inch wide, cover first with butyl-based strip flashing.
c. Apply a bead, then trowel smooth.
d. Seam coverage should be a minimum of 2 inches wide and 15 to 20 mils thick.
e. Inspect for gaps and pinholes in fluid-applied flashing and apply additional coats until no gaps and pinholes appear.

3.06 DRAINAGE MATERIAL INSTALLATION

A. Install drainage material with grooves or channels running vertically in compliance with manufacturer's written instructions.

3.07 CLEANING

A. Immediately remove release paper and scrap from work area and dispose of material in accordance with disposal requirements.

3.08 PROTECTION

A. Protect installed weather barrier from the following:
1. Damage from cladding, structure, or a component of the structure (e.g., window, door, or wall system).
2. Contamination from building site chemicals, premature deterioration of building materials, or nonstandard use or application of products.
3. Foreign objects or agents, including the use of materials incompatible with weather barrier products.

4. UV exposure in excess of products' stated limits.

END OF SECTION 07 25 00

SECTION 07 46 00
STEEL SIDING

PART 1 - GENERAL

1.01 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Preformed and prefinished metal wall panels including related trim, flashings, closures, etc.

C. Related Sections:

1. Section 07 90 00 - Joint Sealants

1.02 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

1.03 SUBMITTALS

A. Submit under provisions of Divisions 01 Section “General Requirements” and “Special Procedures”.

B. Product Data: Manufacturer’s specifications, product data and installation instructions.

C. Shop Drawings: Shop and erection drawings for metal panels, trim, flashings, closures, sub-girts, fastenings, sealant and accessories. Show metal gages, dimensions and finishes. Indicate relationships and connections to adjacent materials.

D. Samples: Full profile width X 12 inches long for approval of each metal panel color, finish and profile.

E. Warranty: Submit required warranties.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer’s Qualifications: Minimum of ten (10) years of successful experience in fabricating metal systems in this type and size.
2. Erector’s Qualifications: Erector acceptable to panel manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, and store panels and trim in a manner to preclude damage or staining of any nature.

B. Remove panels and trim which are cracked, bent, chipped, scratched, stained or otherwise unsuitable for installation and replace with new.

1.06 WARRANTY

A. Warrant organic metal finish for a period of twenty (20) years from date of installation against chipping, cracking, checking, peeling, blistering and color change within the limitations stated in panel manufacturer's standard warranty

B. Subcontractor’s Warranty: Warrant panel system, including flashings, sealants, fasteners, and accessories against defective materials and/or workmanship, to remain watertight and weatherproof for 2 years following Notice of Substantial Completion in accordance with the requirements of Division 01 Section “General Requirements”.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Metal Exterior Siding:

1. 7/8” Corrugated: Bridger Steel, Belgrade, MT
    a. 22 ga.
    b. Truten A606
    c. 37” panel coverage
    d. Anti-siphon groove
2. Approved Equal

B. Metal Roofing: Not applicable

C. Metal Soffit: Not applicable

2.02 ACCESSORIES

A. Trim, Closures and Flashings: Of same manufacture, material, gage and finish as wall panels. See drawings for trim details.

B. Fasteners: As per manufacturer's recommendations for conditions of use, stainless steel or hot dip galvanized. Fasteners shall be designed to be concealed where possible.

C. Sealants and Sealant Tapes: Non-sagging, non-bleeding type as per approved manufacturer's recommendations. Factory applied sidelap sealant is required. Field applied sidelap sealant is not permitted.

D. Profile Closures: Neoprene or polyethylene foam, die-cut or formed to panel configuration.

E. Factory fabricate components ready for field assembly, in accordance with manufacturer's specifications and recommendations and reviewed shop drawings for the particular installations and conditions indicated.

F. Fabricate wall panels in single lengths, top to bottom, as per field measurements. Transverse joints are not permitted.

G. Fabricate trim and flashings in longest practical lengths.

PART 3 - EXECUTION

3.01 CONDITION OF SURFACES

A. Prior to commencing work, examine surfaces and framing to receive wall panels and accessories and report in writing any conditions that would prevent the proper installation of the system. Starting work implies acceptance of surfaces as satisfactory.

3.02 COORDINATION

A. Coordinate installation of wall panels and accessories with installation of work of other trades whose work adjoins with the work of this Section.

3.03 INSTALLATION

A. Install wall panels, flashings, closures, trim and accessories as per Drawing requirements, reviewed shop drawings and manufacturer's specifications, instructions and recommendations, and so as to provide a watertight installation.

B. Erect components using manufacturer's own crews or approved and licensed erector.

C. Remove any strippable protective coating on the panels, trim and flashings prior to installation. In any case, do not allow strippable coating to remain in extreme heat, cold, or in direct sunlight or other UV source.

D. Install work true, square and plumb, field cuts, bending and fitting neatly and accurately done without damage to surfaces.

E. Fit adjacent panels together so that joints are uniform, tight and in full contact.

F. Unless shown or specified otherwise, conceal fasteners. Where exposed fasteners are required for formed metal trim, they shall be uniformly spaced and aligned. Heads of exposed fasteners shall match adjacent panel and trim faces.

G. Provide sealants as per manufacturer's directions and recommendations and so as to provide a watertight installation.

H. Protect dissimilar metals from galvanic corrosion.

3.04 CLEANING

A. Clean exposed surfaces free of dirt, dust and construction soil. Touch up abrasions in factory applied coatings. Where extent of damage will not permit inconspicuous touch-

up and repair, remove damaged items from the site and replace with new.

3.05 PROTECTION

A. Protect work until entire installation is fully completed.

END OF SECTION 07 46 00

SECTION 07 53 00
ELASTOMERIC MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Elastomeric roofing membrane, adhered conventional application.

B. Insulation, flat and tapered.

C. Flashings.

D. Roofing stack boots.

1.02 RELATED REQUIREMENTS

A. Section: Roof drains.

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2012.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2008

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2013

D. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers- Tension; 2006a.

E. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).

F. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2012).

G. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2013.

H. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2013.

I. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011.

J. FM DS 1-28 - Wind Design; Factory Mutual Research Corporation; 2007.

K. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.

L. UL (RMSD) - Roofing Materials and Systems Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

C. Shop Drawings: Provide Tapered Insulation shop drawings indicating degree of slope and layout of sloping boards and fill boards on roof surface. Ensure positive drainage to roof drains.

D. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer’s Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum ten years of experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products in weather protected environment, clear of ground and moisture.

C. Protect foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 90 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a two year period after Date of Substantial Completion.

C. Provide twenty (20) year manufacturer's material and labor warranty to cover failure to

prevent penetration of water.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. TPO Membrane and Roofing Materials:

1. GAF, www.gaf.com
2. Firestone Building Products, LLC: www.firestonebpco.com.
3. Carlisle SynTec: www.carlisle-syntec.com.
4. GenFlex Roofing Systems, LLC: www.genflex.com.
5. Versico Incorporated; www.versico.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING

A. Elastomeric (TPO) Membrane Roofing: One ply membrane, fully adhered.

B. Roofing Assembly Requirements:

1. Solar Reflectance Index (SRI): 0.80, minimum, calculated in accordance with ASTM E1980 based on initial data.
    a. Field applied coating may not be used to achieve specified SRI.
2. Roof Covering External Fire-Resistance Classification: UL Class A.
3. Factory Mutual Classification: Class I and windstorm resistance of I-90, in accordance with FM DS 1-28.
4. Roof Assembly Thermal Requirements: Above deck continuous R-Value of 30, as shown on the drawings.

C. Acceptable Insulation Types - Constant Thickness Application: Any of the types specified.

1. Polyisocyanurate board in layers necessary for roof thermal requirements.

D. Acceptable Insulation Types - Tapered Application: Any of the types specified.

1. Tapered extruded polyiso board covered with uniform thickness glass fiber or composite board.

2.03 THERMOPLASTIC POLOLEFIN (TPO) MEMBRANE

A. Sure-Weld Membrane (by Carlisle):

1. Color: White.
2. Membrane Thickness: 60 mil nominal.
    a. Thickness over Scrim: 0.020 inches (0.508mm).
    b. Breaking Strength (ASTM D 751): 250 lbf/in (1.1 kN/m) minimum.

c. Tear Resistance (ASTM D 751): 55 lbf/in (245 N/m) minimum.

d. Elongation (ASTM D 751): 25 percent.

2.04 DECK SHEATING AND COVER BOARDS

A. HD Cover Board: Closed-cell polyisocyanurate core with coated fiberglass facer, ASTM C1177/C1177M, fire resistant type, 1/2 inch thick.

2.05 INSULATION

A. Closed-cell Polyisocyanurate Foam Board Insulation: ASTM C 1289, Type II, Class 1, with cellulosic glass fiber facer; with the following characteristics:

1. 2 layers at 2 ½" thick each. 5" Total Thickness. Fully Adhered

2. Tapered Board: Slope as indicated; minimum thickness 1 in; fabricate of fewest layers possible.

3. Compressive Strength per ASTM D 1621: 20 psi.

4. Water Absorption per ASTM C209: l e s s t h a n 0.3 percent, volume.

2.06 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane;

B. Cover Board Joint Tape: Paper type, 6 inch wide, self adhering.

C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

E. Membrane Adhesive: As recommended by membrane manufacturer.

F. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

G. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

H. Insulation Adhesive: As recommended by insulation manufacturer.

I. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.

J. Walkway Pads: Suitable for maintenance traffic.

1. Composition: Roofing membrane manufacturer's standard.

2. Size: minimum 18 x 18 inch.

3. Surface Color: White

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 MEMBRANE APPLICATION

A. Position Sure-Weld membrane over the acceptable substrate. Fold membrane sheet back lengthwise so half the underside of the membrane is exposed.

B. Apply approved Bonding Adhesive in accordance with the manufacturer's published instructions, to the exposed underside of the membrane and the corresponding substrate area. Do not apply Bonding Adhesive along the splice edge of the membrane to be hot air welded over the adjoining sheet. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

1. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded section of the membrane sheet immediately after rolling the membrane into the adhesive with a soft bristle push broom to achieve maximum contact.

2. Fold back the unbonded half of the sheet lengthwise and repeat the bonding procedures.

C. Position adjoining sheets to allow a minimum overlap of 2 inches.

D. APEEL Protective Film should be removed from within areas that are to be heat-welded together. In areas that do not require heat welding, the APEEL Protective Film can be left in place for up to 90 days.

E. Hot-air weld the Sure-Weld membrane sheets using the Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's hot air welding procedures. Carlisle recommends a test weld sample be made from a piece of scrap TPO to eliminate the need to remove a section from a completed seam. At all splice intersections, roll the seam with a silicone roller to ensure a continuous hot air welded seam.

F. Continue to install adjoining membrane sheets in the same manner, overlapping edges a minimum of 2 inches and complete the bonding procedures as stated previously.

G. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

H. Shingle joints on sloped substrate in direction of drainage.

I. Fully Adhered Application: Apply adhesive to substrate at rate of recommended by manufacturer. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

J. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

K. At intersections with vertical surfaces:

1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.

2. Fully here flexible flashing over membrane and up to nailing strips.

L. Around roof penetrations, seal flanges and flashings with flexible flashing

M. Coordinate installation of roof drains and related mechanical system flashings.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field quality control and inspection.

3.04 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.05 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07 53 00

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, copings, and other items indicated in Schedule.

B. Reglets and accessories.

1.02 RELATED SECTIONS

A. 07 46 00 – Steel Siding

B. 07 53 00 – Elastomeric roofing

C. 07 90 00 – Joint Sealants

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

B. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

C. Shop Drawings:

1. Identification of material, thickness, and finish for each item.

2. Profiles and dimensions for each item.

D. 4”x4” Color sample of each metal flashing type for verification.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with seven years of experience..

1.06 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

1.07 WARRANTY

A. Warrant installed system to be free of leaks and free from defects in materials and workmanship for 2 years from date of Substantial Completion of project.

B. Warrant factory applied fluorocarbon finish to be free of cracks, splits, crazing, chipping, peeling, and color fading for 10 years from date of Substantial Completion of Project

PART 2 - PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653, with G90 zinc coating; minimum 0.02 inch thick base metal, shop pre-coated with PVDF coating.

1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA
2605; multiple coat, thermally cured fluoropolymer finish system.

2. Color: To match approved sample

a. All locations adjacent to or in contact with Metal Wall Panel: Use same color as Metal Wall Panel.

b. All locations adjacent to or in contact with Coping: Use same color as Coping

2.02 ACCESSORIES

A. Fasteners: fasteners of a compatible metal to avoid electrolytic reaction and per manufacturers
recommendations.

B. Primer: Type per manufacturer.

C. Protective Backing Paint: Zinc molybdate alkyd.

D. Sealant: Type as specified in Section 07 9005.

E. Plastic Cement: ASTM D4586, Type I.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

C. Roof Edge Membrane:

1. Coordinate with roofing manufacturer's requirements.

D. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. General:

1. Install metal work in accordance with SMACNA.

2. Install units plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.

3. Apply asphalt mastic on metal surfaces of units in contact with cementitious materials and dissimilar metals.

4. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

5. Miter, lap seam and close corner joints with solder. Seal seams and joints watertight.

6. Install expansion joints at frequency recommended by SMACNA. Do not fasten seams such that movement is restricted.

7. Coordinate with installation of roofing system and roof accessories.

B. Flashing

1. Insert flashings into reglets to form tight fit. Secure in place with wedges at maximum 12 inches on center. Seal flashings into reglets with sealant.

2. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations approved by Architect.

C. Termination Bar

1. Install termination bar at top edge of roofing membrane. Install sealant behind

roofing membrane at line of termination. Attach bar with appropriate fasteners using predrilled holes.

D. Counterflashing:

1. Fabricate counterflashings as 2 piece assemblies to permit installation of counterflashing after base flashings are in place.
2. Install continuous preformed butyl sealant tape behind fastener line of surface mounted reglets in accordance with manufacturer's written instructions. Apply silicone weather seal at top edge. Prevent contact between different sealing materials.
3. Overlap composition base flashing 4 inches minimum.
4. Install bottom edge tight against base flashing.
5. Lap seam vertical joints 3 inches minimum and apply sealant.

E. Coping

1. Space seams: 8’-0" apart maximum.
2. Lock exterior edges over continuous galvanized cleats secured to nailer.
3. Slope towards inside of parapet, 1/2 inch minimum, unless indicated otherwise.
4. Fasten interior edges to nailer with HWH screw and washer at 12 inch centers.
5. Provide integral drainage system at seams to prevent water infiltration.
6. Miter corners

F. Apply plastic cement compound between metal flashings and felt flashings.

3.04 SCHEDULE

A. Copings: 22 ga.

B. Joint Covers: 22 ga

C. Flat Trim: 20 ga

D. Counterflashings at Roofing Terminations (over roofing base flashings): 20 ga

E. Counterflashings at Curb-Mounted Roof Items, including skylights and roof hatches: 20 ga

F. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports: 24 ga

3.05 CLEANING

A. Upon completion of each area of soldering, carefully remove flux and other residue from surfaces. Neutralize acid flux by washing with washing soda solution, and then flushing clear water rinse. Use special care to neutralize and clean crevices

END OF SECTION 07 62 00

SECTION 07 65 00
FLEXIBLE FLASHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Provides flashing systems, moisture-retardant membranes, including sealing joints and protrusions through membranes, with accessories as required for complete installation.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's literature for each type of membrane.

B. Samples: Submit samples of each type of material. Quality Assurance/Control Submittals: Submit either test reports or manufacturer's certificates indicating materials comply with specified requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Fortifiber Building Systems Group, 1-800-773-4777.

B. Substitutions: Comply with provisions of Division 1.

2.02 MATERIALS

A. Flexible Flashings: Fortifiber/ FortiFlash self-adhesive, self-sealing SBS modified asphalt waterproof membrane laminated to high density, cross-laminated polyethylene film reinforcement

1. Types:

a. Waterproof: Fortifiber / FortiFlash 25 mil and 40 mil Waterproof Flashing.

2. Reference Standards: ICC Acceptance Criteria 148 (waterproof).

3. Water Vapor Permeance: <.08 perms 25-Mil, <.05 perms 40-Mil (waterproof); ASTM F 1249.

4. Water Resistance: 200 hours (waterproof); ASTM D-779

PART 3 - EXECUTION

3.01 PREPARATION

A. Ensure items which pass through membrane are properly and rigidly installed, substrate is free of projections and irregularities which may be detrimental to proper installation of membrane.

3.02 INSTALLATION

A. Apply membrane in accordance with manufacturer's recommendations, laid smooth without folds or bunches of material.

1. Seam Overlap: As recommended by building paper manufacturer for specific building paper material and application indicated.
2. Sealing: Seal items projecting through vapor retarders and vapor barriers.

B. Inspect and repair building paper prior to application of finish material over building paper; tape tears, perforations and similar damage.

END OF SECTION 07 65 00

SECTION 07 90 00
JOINT SEALANTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section includes the work necessary to furnish and install, complete, sealant and backing for all structure and building joints.

1.02 GENERAL REQUIREMENTS

A. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

B. Performance: Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Section 01300, SUBMITTALS in Division 1, GENERAL REQUIREMENTS.

B. Submit the following:

1. Product data: Submit manufacturer's literature, specifications, surface preparation and application instructions for joint sealant materials.

2. Samples: For each material proposed submit sample of color intended, when required to match joint substrate or range of colors for selection.

3. Sealant schedule: Submit sealant schedule indicating joint size and special conditions as well as, manufacturer, type and color of proposed product for each application.

4. Certificates of compliance: proposed materials meet reference standards and specification requirements.

5. Contract closeout submittals: special guarantee.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealants to the jobsite in sealed containers, each bearing manufacturer's name and product designation.

B. Store and protect sealant products from damage, deterioration, and contamination in accordance with manufacturer's written recommendations.

1.05 QUALITY ASSURANCE

A. Installer qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this project and whose work has resulted in joint sealant installations with a record of successful in-

service performance.

1.06 ENVIRONMENTAL CONDITIONS

A. Ambient Temperature: Between 40 and 80 degrees F when sealant is applied.

1.07 SPECIAL GUARANTEE

A. Product: Furnish manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction or, at the option of Owner, removal and replacement of work specified in this section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective work shall be as specified in the General Conditions.

B. Conditions: No adhesive or cohesive failure of sealant.

C. Sealed joints: watertight and weathertight with normal usage.

PART 2 - PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Conditions.

2.02 MASTIC JOINT FILLER

A. The mastic joint filler shall be a ½-inch, pre-molded, non-extruded, resilient type mastic joint filler conforming to ASTM D 1751.

2.03 SEALANT MATERIALS

A. Type 1 - Silicone, Non-sag, Not Immersible: Silicone base, single-component, chemical curing; meeting the requirements of Federal Specification TT-S-001543, non-sag type, Class A; capable of withstanding movement up to 50 percent of joint width; Shore "A" hardness of 50 maximum; non--staining. Use No. 790 manufactured by Dow Corning Corporation; "Silpruf" manufactured by General Electric; or equal.

B. Type 2 - Multi-Part Polyurethane, Self-Leveling, Immersible: Polyurethane base, multi-component, chemical curing; meeting the requirements of Federal Specifications TT-S-00227, self-leveling Type I, Class A; capable of being continuously immersed in water, withstand movement of up to 25 percent of joint width; uniform, homogeneous, and free from lumps, skins, and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding. Use Sonolastic Paving Joint Sealant manufactured by Sonneborn; Urexspan NR-200 manufactured by Pecora Corp.; Iso-Flex 880GB manufactured by H.S. Peterson Co.; Vulkem 245 manufactured by Mameco International; or equal.

C. Type 3 - Multi-Part Polyurethane, Non-sag, Immersible: Polyurethane base, multi-component, chemical curing; meeting the requirements of Federal specifications TT-S-00227, non-sag Type II, Class A; capable of being continuously immersed in water,

withstand movement of up to 25 percent of joint width; uniform homogeneous, and free from lumps, skins, and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding. Use Iso-Flex 881 manufactured by H.S. Peterson Co.; Vulkem 922 manufactured by Mameco International; PRC 270 manufactured by Product Research Corp.; Sonolastic NP-II manufactured by Sonneborn; or equal.

D. Type 4 - Multi-Part Polyurethane, Non-sag, Not Immersible: Polyurethane base, multi-component, chemical curing; meeting the requirements of Federal specifications TT-S-00227, non-sag Type II, Class A and ASTM C 920, Type M, Grade NS, Class 25; withstand movement of up to 25 percent of joint width; uniform, homogeneous, and free from lumps, skins, and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding; color as selected. Use Sonolastic NP-II manufactured by Sonneborn; Dynatrol II manufactured by Pecora Corp.; Dymeric manufactured by Tremco; Isoflex 2000 manufactured by H.S. Peterson Co.; Vulkem 227 manufactured by Mameco International; or equal.

E. Type 5 - One-Part Polyurethane, Immersible: Polyurethane base, single-component, chemical curing; conforming to Federal specification TT-S-00230; capable of being continuously immersed in water, withstand movement of up to 25 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding. For non-sag Type II, Class A, use Sonolastic NP-I manufactured by Sonneborn; Sikaflexla No. 430 manufactured by Sika Chemical Corp.; Vulkem 116 manufactured by Mameco International; or equal. For self-leveling Type I, Class A, use Sonolastic SL-1 manufactured by Sonneborn; Vulkem 45 manufactured by Mameco International; Sikaflex 12SL manufactured by Sika Chemical Corp.; or equal.

F. Type 6 - One-Part Polyurethane, Not Immersible: Polyurethane base, single-component, chemical curing; meeting the requirements of Federal specification TT-S-00230, non-sag Type II, Class A; withstand movement of up to 25 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding. Use Dynatrol I manufactured by Pecora Corp.; Dymonic manufactured by Tremco; Sonolastic NP-I manufactured by Sonneborn; or equal.

G. Type 7 - Multi-Part Polysulfide, Immersible: Polysulfide base, two-component, chemical curing; meeting the requirements of Federal Specification TT-S-00227, Type I self-leveling, Type II non-sagging, Class A, uniform, homogeneous and free from lumps, skins, and coarse particles when mixed; capable of being continuously immersed in water, withstand movement up to 25 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; non-staining and nonbleeding. Use CM-60, two-part manufactured by W.R. Meadows; Sonolastic Two manufactured by Sonneborn; or equal.

H. Type 8 - One-Part Polysulfide, Non-sag, Not Immersible: Polysulfide base, single-component, chemical curing; meeting the requirements of Federal Specification TT-S-00230, Type II non-sag, Class A; capable of withstanding movement up to 20 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; non-staining and nonbleeding. Use CM-60, one-part manufactured by W.R. Meadows; Sonolastic One

manufactured by Sonneborn; Sikaflex 440 manufactured by Sika Chemical Corp.; PRC 7000 manufactured by Product Research Corp.; or equal.

I. Type 9 - One-Part Acrylic Terpolymer, Non-sag: Acrylic base, single-component, solvent curing; meeting the requirements of Federal specification TT-S-00230, Type I non-sag, Class B; capable of withstanding movement up to 7.5 percent of joint width; Shore "A" hardness of maximum 55; non-staining and nonbleeding. Use 60+ Unicrylic manufactured by Pecora Chemical Corp.; Mono manufactured by Tremco; or equal.

J. Type 10 - Sanitary Sealant: Silicone sealant similar to Type 1, above, formulated to resist mold growth and repeated exposure to high humidity while retaining adhesion, flexibility, and color. Use Dow Corning Bathtub Caulk 786; General Electric Sanitary Sealant; or equal.

K. Type 11 - Fire-Resistant Penetration Seal: Medium fire-resistant foam that retains stability at high temperatures. Use 3-6548 Silicone RTV Fire Stop Sealant or Foam manufactured by Dow Corning Corporation; Fire Barrier Caulk CP25 and Putty 303 manufactured by 3M Corp.; General Electric Pensil 851; or equal.

2.04 BACKUP MATERIAL

A. Non-gassing, extruded, closed-cell round polyethylene foam rod compatible with sealant used. Size as shown or as recommended by manufacturers for all joints greater than 3/16-inch wide. Use "Minicel" as manufactured by Haveg Industries, Inc.; "Ethafoam SB" manufactured by Dow Corning; "Sonofoam" manufactured by Sonneborn; HBR manufactured by Hercules, Inc.; or equal.

2.05 BOND BREAKER

A. Pressure sensitive tape recommended by sealant manufacturer to suit application.

2.06 JOINT CLEANER

A. Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

2.07 PRIMER

A. Non-staining type recommended by sealant manufacturer to suit application.

2.08 SEALANT COLOR

A. Unless specifically noted, sealant color shall generally match or complement the color of the principal material adjoining the area of application or as selected by Architect.

2.09 TAPE SEALANT

A. Closed cell polyvinyl chloride (PVC) foam, in black color, coated on both sides with a modified acrylic pressure-sensitive adhesive, in 3/4-inch width by length as required by sufficient thickness, as recommended by manufacturer, for particular application, meeting the following requirements:

1. Tensile Strength (ASTM D 412, Die C): 80 psi

2. Elongation (ASTM D 412, Die C): 125 percent
3. Compression Set (ASTM D 1056): 30 percent max
4. Compression Deflection (ASTM D 1056) at 25 percent Deflection: 2.5 psi
5. Low Temperature Flexibility, 5 hours at -40 degrees F: No cracking
6. Heat Resistance/Maximum Shrinkage, 70 hours at 212 degrees F: 1.5 percent
7. Staining (ASTM D 925) on Most Substrates: None
8. Water Absorption by Weight at 30 percent Compression: 24 percent
9. Density per Cubic Foot (ASTM D 3574) 10 pounds
10. Thermal Conductivity (k factor): 0.24

PART 3 - EXECUTION

3.01 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by the sealant manufacturer.

B. Install joint sealants in accordance with ASTM C962.

C. Sealants shall be self-leveling (S/L) for horizontal and sloping joints with a maximum slope of 1 percent. Non-sag sealants (N/S) shall be used for steeper sloped joints, vertical joints, and overhead joints. Immersible sealant may be used for non-immersible applications.

D. The one-part polysulfide (Type 8) and polyurethane (Types 5 and 6) and the acrylic (Type 9) sealants can be used in joints to maximum 1-inch width. Multi-part polyurethane (Types 2, 3, and 4) and polysulfide (Type 7) and silicone sealants can be used in joints to 2-inch maximum width. For joints wider than 2-inch, consult manufacturer for proper product application. Follow sealant manufacturer's recommendations.

E. Sealants used in water holding structures must be approved for use in domestic wastewater applications.

3.02 PREPARATION

A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.

B. All surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.

1. Mask adjacent surfaces where necessary to maintain neat edge.
2. Starting of work will be construed as acceptance of all sub-surfaces.

C. Verify that joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

E. Use joint filler to achieve required joint depths, to allow sealants to perform properly.

F. Use bond breaker where recommended by sealant manufacturer.

3.03 MASTIC JOINT FILLER

A. Preformed joint filler shall be installed in accordance with manufacturer's specifications.

3.04 CAULKING AND SEALANT INSTALLATION

A. Install backup material as recommended by sealant manufacturer. Where possible, provide full length sections without splices.

B. Seal all joints around window, door, and louver frames; expansion joints; and elsewhere as indicated.

C. Apply all materials following manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.

D. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.

E. Locate tape sealant where indicated on Drawings and install in strict accordance with manufacturer's instructions.

F. Drive caulking compound into the grooves with a caulking gun with sufficient pressure to force out air and to fill grooves solidly using a nozzle of proper size to fit width of grooves. Exposed surface of compound shall be tooled free of wrinkles and uniformly smooth. Leave all adjoining surfaces free of caulking material. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

3.05 CLEANING

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace any damaged surfaces resulting from joint sealing or cleaning activities.

3.06 APPLICATION SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of this project.

Joint Location	Sealant Type(s)
1. Expansion/Contraction and Control Joints at:	
Concrete Walls	1, 3, 4, 5, 6, 7
Concrete Floor Slabs	2,5
Masonry and Precast Walls	1, 3, 4, 5, 6, 7

Joint Location	Sealant Type(s)
2. Material Joints at:	
Metal Door, Window, and Louver Frames (Exterior)	1, 5, 6, 8
Metal Door, Window, and Louver Frames (Interior)	1, 5, 6, 8, 9
Wall Penetrations (Exterior)	1, 5, 6, 8
Wall Penetrations (Interior)	1, 5, 6, 8
Floor Penetrations	5, 6, 7
Ceiling/Roof Penetrations	1, 3, 4, 5, 6, 7
Sheet Metal Flashings	1, 3, 5, 7
3. Other Joints:	
Threshold Sealant Bed	5
Immersed Concrete (Vertical and Sloped)	3, 5
Immersed Concrete (Horizontal)	2, 5
Openings Around Pipes, Conduits, and Ducts Through Fire Rated Construction	11
Concrete Form Snap-Tie Holes	4,6
Between Counter Tops and Backsplashes	10
Around Plumbing Fixtures	10

END OF SECTION 07 90 00

DIVISION 8

OPENINGS

SECTION 08 11 00
STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section includes steel doors and frames.

1.02 GENERAL REQUIREMENTS

A. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 30 00, SUBMITTALS in Division 1, GENERAL REQUIREMENTS.

B. Submit the following:

1. Product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles and finishes.

2. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

3. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those indicated.

4. Manufacturer’s certification that products meet or exceed specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames, cartoned or packaged, to prevent damage and deterioration.

1. Properly identify each item.

2. Provide cardboard, separators, banding, spreaders, and paper wrappings to protect units from damage during and after installation.

3. Replace damage units with new, undamaged units.

B. Store doors upright, in protected dry area, at least 1-inch off ground or floor and at least 1/4-inch between individual pieces.

1. Follow special storage and handling requirements of manufacturer.

2. Protect exposed finish surfaces of prefinished items with masking tape.

1.05 QUALITY ASSURANCE

A. Comply with ANSI/SDI 100.

PART 2 - PRODUCTS

2.01 GENERAL

A. All steel doors and frames shall be the products of one manufacturer.

2.02 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld Building Products, Inc.
2. Ceco Door Products.
3. Curries Co.
4. Fenestra Corp.
5. Kewanee Corp.
6. Republic Builders Products.
7. Approved equivalent.

2.03 DOOR AND FRAME MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569 (ASTM A 569M).

B. Cold-Rolled Steel Sheets: ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality.

C. Galvanized Steel Sheets: ASTM A 526 (ASTM A 526M), commercial quality, or ASTM A 642 (ASTM A 642M), drawing quality, with A 60 or G 60 (Z 180 or ZF 180) coating designation, mill phosphatized.

2.04 DOORS AND FRAMES

A. General Requirements for All Doors and Frames:

1. Accessibility: Comply with ANSI A117.1.
2. Door Texture: Smooth faces.
3. Hardware Preparation: In accordance with DHI A115 Series, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
4. Finish: Factory primed, for field finishing.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.05 STEEL DOORS

A. Grade: NAAMM HMMA 861, physical performance Level A.

B. Core: Polyurethane.

C. Top Closures for Doors: Flush with top of faces and edges, all seams welded and ground smooth.

D. Galvanizing: All components hot-dipped zinc-iron alloy-coated (Galvannealed), A60/ZF180.

E. Glazing Stops:

1. Minimum 0.0359-inch thick steel.

2. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass and other panels in doors.

3. Provide screw-applied, removable, glazing beads on inside of glass and other panels in doors.

F. Texture: Smooth faces.

G. Insulating Value: U-value of .067, when tested in accordance with ASTM C 236.

H. Weatherstripping: Separate, see Section 08 71 00, FINISH HARDWARE.

I. Finish: Factory primed, for field finishing.

2.06 STEEL FRAMES

A. Comply with the requirements of grade specified for corresponding door.

B. Finish: Factory primed, for field finishing.

C. Provide mortar guard boxes for hardware cut-outs in frames to be grouted.

D. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

E. Fully welded, with mitered corners.

F. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed), A60/ZF180.

G. Finish: Factory primed, for field finishing.

2.07 ACCESSORY MATERIALS

A. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.

B. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

C. Head Reinforcing: Where installed in masonry, leave vertical mullions in frames open at top for grouting.

D. Jamb Anchors: Furnish jamb anchors as required to secure frames to adjacent construction, formed of not less than 18-gauge galvanized steel.

E. In-Place Concrete or Masonry Bolts: Anchor frame jambs with minimum 3/8-inch concealed bolts into expansion shields or inserts at 6 inches from top and bottom and 26 inches on center, unless otherwise shown. Reinforce frames at anchor locations. Except for fire-rated openings, apply removable stop to cover anchor bolts unless otherwise indicated.

F. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of not less than 14-gauge galvanized steel sheet, as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with 2 holes to receive fasteners, welded to bottom of jambs and mullions.

G. Head Anchors: Provide 2 anchors at head of frames exceeding 42 inches wide for frames mounted in steel stud walls.

H. Head Strut Supports: Provide 3/8-inch by 2-inch vertical steel struts extending form top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members in compliance with UL 63.

I. Structural Reinforcing Members: Provide as part of frame assembly, where indicated at mullions, transoms, or other locations that are to be built into frame.

J. Head Reinforcing: For frames over 4’-0” wide in masonry wall openings, provide continuous steel channel or angle stiffener, not less than 12 gauge for full width of opening, welded to back of frame at head.

K. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.

2.08 FINISH MATERIALS

A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.

B. Factory Finish: Complying with ANSI A 250.3, manufacturer's standard coating of color as selected.

C. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

2.09 HARDWARE

A. Hardware for doors and frames shall be as specified in Section 08 71 00, FINISH HARDWARE.

2.10 GLAZING

A. Glazing for doors shall be as specified in Section 08 81 00, Glass and Glazing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

3.02 PREPARATION

A. Coat inside of frames with bituminous coating to a thickness of 1/16 inch.

3.03 INSTALLATION

A. General: Install steel doors, frames, and accessories according to shop drawings, manufacturer's data, and as specified.

B. Grout all frames solid.

C. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.

1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.

2. Install at least 1 floor anchor and 3 anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb.

D. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.

E. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

F. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

3.04 FIELD PAINTING

A. Where prime coat has been damaged, sand smooth and touch up with same primer as applied at shop.

1. Remove rust before painting.

2. Touch Up: Not obvious.

3. Perform immediately after door and frame installation.

B. Final paint coat shall be as specified in Section 09 90 00, PAINTING. Color shall be as indicated on the Drawings, or as selected by the Owner and Engineer from the Contractor provided shop drawings.

3.05 PROTECTION

A. Protect installed doors and frames against damage from other construction work.

END OF SECTION 08 11 00

SECTION 08 33 36
OVERHEAD COILING SERVICE DOORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Overhead coiling service doors.

1.02 RELATED SECTIONS

A. Section 05 50 00 - Metal Fabrications: Support framing and framed opening.

B. Section 08 71 00 - Door Hardware: Product Requirements for cylinder core and keys.

C. Section 09 90 00 - Painting: Field applied finish.

D. Section 16 13 00 - Raceway and Boxes: Conduit from electric circuit to door operator and from door operator to control station.

E. Section 16 15 00 - Wiring Connections: Power to disconnect.

1.03 REFERENCES

A. ANSI/DASMA 108 - American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.

B. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.

C. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.

D. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

E. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

G. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

H. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

J. NEMA MG 1 - Motors and Generators.

1.04 DESIGN / PERFORMANCE REQUIREMENTS

A. Overhead coiling service doors:

1. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) without damage to door or assembly components in conformance with ASTM E 330.
2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.

B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.05 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Details of construction and fabrication.
4. Installation instructions.

C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.

B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weathertight location.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 COORDINATION

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.10 WARRANTY

A. Warranty: Manufacturer’s limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.

B. Warranty: Manufacturer’s limited door system warranty for 2 years for all parts and components.

C. Powder coat Finish

1. Powdercoating: Applied to curtain, guides, bottom bar, headplates: Manufacturer’s limited Premium Finish warranty for 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 ADVANCED PERFORMANCE ROLLING SERVICE DOORS

A. RapidSlat Model 626 Stormtite Insulated Doors by Overhead Door Corporation.
1. Curtain: Interlocking roll-formed metal slats as specified with endlocks attached to each end of alternate slats to prevent lateral movement.
a. Flat Profile insulated type F-265i with 24 gauge back covering steel or stainless steel; .024 inch (.06 mm) aluminum, for doors up to 20 feet wide fabricated of:
i. 20 gauge stainless steel.
b. Insulation: Slat cavity shall be filled with CFC-free, foamed-in-place, polyurethane insulation.
i. R-Value: 7.7, U-Value: 0.13.

ii. Sound Rating: STC-21.

c. Slat Finish:

i. PowderGuard Max powder coat.

- Color as selected by Architect.

2. Bottom Bar: Two metal angles, minimum thickness 3/16 inch, bolted back to back to reinforce curtain in the guides.
   a. Material:
      i. Stainless steel with brushed finish.
3. Guides: Three Structural steel angles provided with high usage guide wear strip to minimize wear and reduce sound.
   a. Material:
      i. Steel.
      ii. High usage guide wear strips.
4. Brackets:
   a. Galvanized steel to support counterbalance, curtain and hood.
5. Finish; Bottom Bar, Guides, Headplate and Brackets:
   a. Finish: PowderGuard Zinc base coat, gray with PowderGuard Premium powder coat color as selected by the Architect.
6. Motor: Direct drive, integrated gear motor/brake assembly sized for openings. Provide with a manual hand chain for operation during power outages. Operator and drive assembly is factory pre-assembled and provided with all wiring harnesses needed direct from the factory.
   a. Opening Speed: Up to 24 inches per second.
   b. Closing Speed: 12 inches per second.
   c. Electrical Characteristics: 220V AC, single phase per motor/drive.
   d. Right hand mount.
7. Control Panel: Provide electronic Variable Frequency drive controller with microprocessor self-diagnostics. LCD readout indicates door action, alarm conditions, and fault conditions. Timer to close programming options and non-resettable cycle counter are included. Enclosure is NEMA 4X rated. Control system is UL508A certified. Junction box is IP67 rated.
8. Door Roll: Directly driven, springless roll shall be steel tube with integral shafts, keyed on the Drive End and supported by self-aligning greaseable sealed bearings. Door shall not require any counterbalance device.
9. Hood: Protecting drive motor, barrel, chain, and sprocket from dirt and debris and extending between the support brackets. Fabricated of:
   a. Material:
      i. Stainless steel with brushed finish.
10. Safety Devices: Provide door with following safety devices:
    a. Photoelectric sensors that cast an invisible beam across the door opening and reverses the downward motion of the door when an object enters the path of the beam.
    b. Wireless, monitored safety edge reverses downward motion upon impact.
    c. Built-in (to motor assembly) brake mechanism eliminates uncontrolled curtain travel independent of other safeties.
11. Actuators:

a. One Open/Close/Stop push button station incorporated into Control Panel.

12. Windload Design:
    a. Standard windload shall be 20 PSF.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify opening sizes, tolerances and conditions are acceptable.

B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Division 26. Complete wiring from disconnect to unit components.

F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00.

G. Install perimeter trim and closures.

H. Instruct Owner’s personnel in proper operating procedures and maintenance schedule.

3.04 ADJUSTING

A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.

B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

3.06 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION 08 33 36

SECTION 08 34 83
FLOOR HATCHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This section includes floor hatches, frames, lids, latches, lifting devices, locks, etc.

B. Related Requirements:

1. Section 03 60 000 – “Grout and Repair Mortar”.
2. Section 07 11 00 – “Dampproofing”.
3. Section 07 13 00 – “Sheet Waterproofing”.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, dimensions materials, bearing strength or maximum weight, individual components and profiles, finishes and features.

B. Product Schedule: For all floor hatches including:

i. Influent Splitter Box Access;
ii. Side Stream Lift Station Access;
iii. Grit Chamber Access;
iv. UV Channel (if applicable).

1.04 CLOSEOUT SUBMITTALS

A. Record Documents: For all installed floor hatches, list of location, any departures from the Action Submittal.

1.05 QUALITY ASSURANCE

A. Door Inspector Qualifications: Inspector for field quality control inspections of door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Rated Floor hatches: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency according to NFPA 288.

2.02 ALUMINUM FLOOR HATCHES

A. Gutter Channel Frame Aluminum Floor Hatch:

1. Frame: Mill finish aluminum, gutter profile, with integral drainage coupling and perimeter gasket.
2. Door: Single leaf; 1/4-inch-thick (6.4-mm-thick), diamond-pattern mill-finish aluminum plate.
3. Loading Capacity: 300 lb/ft2 (14.4-kN/sq. m) pedestrian live load.
4. Options: Odor gasket
5. Hardware:
    a. Material and Finish: Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
    b. Hinges: Type 316 stainless steel with tamper proof fasteners and stainless steel pins.
    c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
    d. Latch: Stainless steel slam latch.
    e. Lock: Type 316 stainless steel slam lock with removable key or a recessed padlock hasp with cover.

B. Angle Frame Aluminum Floor hatch:

1. Frame: Mill finish aluminum, angle profile.
2. Door: single or double leaf; 1/4-inch-thick (6.4-mm-thick), diamond-pattern mill-finish aluminum plate.
3. Loading Capacity: 300 lb/ft2 (14.4-kN/sq. m) pedestrian live load.
4. Options: Odor gasket.
5. Hardware:
    a. Material and Finish: Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
    b. Hinges: Heavy-duty butt hinges with stainless steel pins.
    c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.

d. Latch: Stainless steel slam latch.

e. Lock: Recessed padlock hasp with cover.

C. Recessed Cover Aluminum Floor hatch:

1. Frame: Mill finish aluminum, angle profile.

2. Door: Single or Double leaf; 1/4-inch-thick (6.4-mm-thick) aluminum plate with 1-inch-deep (25.4-mm-deep) recess for application of finish materials.

3. Loading Capacity: 150 lb/ft2 (7.2-kN/sq. m) pedestrian live load.

4. Options: Odor gasket.

5. Hardware:

a. Material and Finish: Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.

b. Hinges: Heavy-duty butt hinges with stainless steel pins.

c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.

d. Latch: Stainless steel slam latch.

e. Lock: Recessed padlock hasp with cover.

2.03 STEEL FLOOR HATCHES

A. Gutter Channel Frame Steel Floor hatch:

1. Frame: Prime-painted, Hot-dip galvanized steel, gutter profile, with integral drainage coupling and perimeter gasket.

2. Door: Single or Double leaf per drawings; manufacturer's standard thickness 1/4-inch-thick (6.4-mm-thick) steel plate.

3. Loading Capacity: 300 lb/ft2 (14.4-kN/sq. m) pedestrian live load.

4. OptionsOdor gasket.

5. Hardware:

a. Material and Finish: Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.

b. Hinges: Heavy-duty butt hinges with stainless steel pins.

c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.

d. Latch: Stainless steel slam latch.

e. Lock: Latch with removable handle.

B. Angle Frame Steel Floor hatch:

1. Frame: Prime-painted Hot-dip galvanized steel, angle profile.
2. Door: Single or double leaf per the project drawings; 3/16- or 1/4-inch-thick (4.8-mm- or 6.4-mm-thick)] steel plate.
3. Loading Capacity: 300 lb/ft2 (14.4-kN/sq. m) pedestrian live load.
4. Options: Odor gasket.
5. Hardware:
   a. Material and Finish: Manufacturer's standard including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
   b. Hinges: Heavy-duty butt hinges with stainless steel pins.
   c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
   d. Latch: Stainless steel slam latch.
   e. Lock: Latch with removable handle

2.04 STAINLESS STEEL FLOOR HATCHES

A. Gutter Channel Frame Stainless Steel Floor hatch:

1. Frame: Type 304 or Type 316 (per project drawings) stainless steel, gutter profile, with integral drainage coupling and perimeter gasket.
2. Door: Single or double leaf per the project drawings; 1/4-inch-thick (6.4-mm-thick)] stainless steel plate.
3. Loading Capacity: 300 lb/ft2 (14.4-kN/sq. m) pedestrian live load.
4. Options: Odor gasket.
5. Hardware:
   a. Material and Finish: Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
   b. Hinges: Heavy-duty butt hinges with stainless steel pins.
   c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
   d. Latch: Stainless steel slam latch.
   e. Lock: Latch with removable handle.

2.05 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

E. Rolled-Stainless Steel Floor Plate: ASTM A793, manufacturer's standard finish.

F. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666. Remove tool and die marks and stretch lines, or blend into finish.

G. Stainless Steel Flat Bars: ASTM A666. Remove tool and die marks and stretch lines, or blend into finish.

H. Aluminum Extrusions: ASTM B221 Alloy 6063-T6.

I. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

J. Aluminum Sheet: ASTM B209 alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

K. Frame Anchors: Same material as door face.

L. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.06 FABRICATION

A. General: Provide floor hatches manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure floor hatches to types of supports indicated.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.

2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that comes in contact with concrete.

2.07 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

E. Prime Painted Steel: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

F. Stainless Steel Finish: Bright, cold-rolled, unpolished ASTM A480/A480M No. 2B finish.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing floor hatches.

B. Apply intumescent fireproofing to underside of floor hatch cover to minimum thickness required by intumescent fireproofing manufacturer for fire rating indicated.

3.03 FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.04 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 34 83

SECTION 08 43 13
ALUMINUM FRAMED STOREFRONT

PART 1 - GENERAL

1.01 SUMMARY

A. Related Documents: Conditions of the Contract, Division 1 - General Requirements, and Drawings apply to Work of this Section.

B. Section Includes:

1. Entrances and Storefront Systems complete with reinforcing, fasteners, anchors, and attachment devices.
2. Aluminum doors
3. Accessories necessary to complete work.

C. Related Sections:

1. Section 08 80 00 - Glazing
2. Section 08 71 00 - Door Hardware

1.02 REFERENCES

A. Aluminum Association (AA):

1.	DAF-45	Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association (AAMA):

1.	503.1	Test Method for Condensation Resistance of Windows, Doors and Glazed Wall Systems.
2.	605.2-92	Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
3.	607.1	Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
4.	608.1	Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.
5.	701.2	Specifications for Pile Weatherstripping.
6.	Manual #10 Care and Handling of Architectural	Aluminum From Shop to Site.
7.	SFM-1	Aluminum Storefront and Entrance Manual.

C. American National Standards Institute (ANSI):

1.	A117.1	Safety Standards for the Handicapped.

D. American Society for Testing and Materials (ASTM):

1.	A36	Structural Steel.
2.	B209	Aluminum and Aluminum - Alloy Sheet and Plate.
3.	B221	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
4.	B308	Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
5.	C509	Cellular Elastomeric Pre-formed Gasket and Sealing Material.
6.	C864	Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spacers.
7.	E283	Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
8.	E330	Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
9.	E331	Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

E. Federal Specifications (FS):

1.	TT-P-645A	Primer, Paint, Zinc Chromate, Alkyd Type.

F. Steel Structures Painting Council (SSPC):

1.	Paint 12	Cold-Applied Asphalt Mastic (Extra Thick Film).

1.03 SYSTEM REQUIREMENTS

A. Design Requirements:

1. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage or moisture disposal.
2. Requirements shown by details are intended to establish basic dimension of units, sight lines and profiles of members.
3. Provide concealed fastening.
4. Provide entrance and storefront systems, including necessary modifications, to meet specified requirements and maintaining visual design concepts.
5. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.

6. Anchors, fasteners and braces shall be structurally stressed not more than 50% of allowable stress when maximum loads are applied.
7. Provide for expansion and contraction without detriment to appearance or performance.
8. Assemblies shall be free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.
9. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

B. Performance Requirements:

1. Air infiltration: Air leakage through fixed light areas of storefront shall not exceed 0.06 cfm per square foot (0.0003 m3/sm2) of surface area when tested in accordance with ASTM E283 at differential static pressure of 6.24 psf (300 Pa).
2. Water infiltration: No uncontrolled water penetration when tested in accordance with ASTM E 331 at test pressure of 8.0 psf (384 Pa).

ASTM E 331 at test pressure of [8.0] [10.0] psf ([380] [480] Pa).

C. Thermal Requirements:

1. Framing systems shall accommodate expansion and contraction movement due to surface temperature differentials of 180 degrees Fahrenheit (82 degrees Celsius) without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance, or other detrimental effects.
2. Ensure doors function normally within limits of specified temperature range.

D. Testing Requirements: Provide components that have been previously tested by an independent testing laboratory.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

B. Product Data:

1. Submit manufacturer's descriptive literature and product specifications.
2. Include information for factory finishes, hardware, accessories and other required components.
3. Include color charts for finish indicating manufacturer's standard colors available for selection.

C. Shop Drawings:

1. Submit shop drawings covering fabrication, installation and finish of specified systems.
2. Include following:

a. Fully dimensioned plans and elevations with detail coordination keys.

b. Locations of exposed fasteners and joints.

3. Provide detailed drawings of:

a. Composite members.

b. Joint connections for framing systems and for entrance doors.

c. Anchorage.

d. System reinforcements.

e. Expansion and contraction provisions.

f. Hardware, including locations, mounting heights, reinforcements and special installation provisions.

g. Glazing methods and accessories.

h. Internal sealant requirements as recommended by sealant manufacturer.

4. Schedule of finishes.

D. Samples:

1. Submit samples indicating quality of finish, in required colors, on alloys used for work, in sizes as standard with manufacturer.

2. Where normal texture or color variations are expected, include additional samples illustrating range of variation.

E. Test Reports:

1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of re-testing. Include other supportive data as necessary.

F. Certificates:

1. Submit manufacturer's certification stating that systems are in compliance with specified requirements.

G. Qualification Data:

1. Submit installer qualifications verifying years of experience.

2. Include list of projects having similar scope of work identified by Brand name, location, date, references, contact, and phone number.

H. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility:

1. To ensure quality of appearance and performance, obtain materials for each system from either a single manufacturer or from manufacturer approved by each system

manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 60 00.

B. Protect finished surfaces as necessary to prevent damage.

C. Do not use adhesive papers or sprayed coatings that become firmly bonded when exposed to sun.

D. Do not leave coating residue on any surfaces.

E. Replace damaged units.

1.07 WARRANTY

A. Provide warranties in accordance with Section 01 77 00.

B. Provide written manufacturer's warranty, executed by company official, warranting against defects in materials and products for 2 years from date of Substantial Completion.

C. Provide written installer's warranty, warranting work to be watertight, free from defective materials, defective workmanship, glass breakage due to defective design, and agreeing to replace components that fail within 2 years from ship date.

1. Warranty shall cover following:

a. Complete watertight and airtight system installation within specified tolerances.

b. Completed installation will remain free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.

c. System is structurally sound and free from distortion.

d. Glass and glazing gaskets will not break or "pop" from frames due to design wind, expansion or contraction movement.

e. Glazing sealants and gaskets will remain free from abnormal deterioration or dislocation due to sunlight, weather or oxidation.

D. Provide a written thermal integrity warranty for 2 years from ship date against thermal barrier system failure resulting from the following:

1. Longitudinal and transverse thermal barrier shrinkage.

2. Thermal barrier cracking.

3. Structural failure of the thermal barrier material.

4. Loss of adhesion or loss of prescribed edge pressure on glazing material resulting in excessive air and water infiltration.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Subject to compliance with requirements indicated, provide products by one of the

following:

1. U.S. Aluminum
   2450 E. Vernon Ave Los Angeles, California 90058-1802
   Toll Free Phone: (800) 262-5151 Phone: (323) 268-4230
   Toll Free Fax: (866) 262-3299
   Email: usalum@crlaurence.com
   www.usalum.com

B. Substitutions: Submit under provisions of Section 01 60 00, a minimum of 10 days prior to bid date.

C. Acceptable Storefront Framing Systems:

1. Framing System: Series 400

   All Storefront Systems must be provided with E.P.D.M. Top Load Gasketing.

   Center Glazed Systems feature screw race joinery and panel type installation.

SERIES	FACE WIDTH	DEPTH	GLAZING INFILLS	GLAZING METHOD
400	1-3/4" (44.5)	4" (101.6)	1/4" (6) or 3/8" (10)	Exterior/Interior

   Center Glazed "Stack" Systems feature continuous head and sill channels allowing vertical and horizontal inserts to be stacked into the channels.

SERIES	FACE WIDTH	HEAD/SILL DEPTH	GLAZING INFILLS	GLAZING METHOD
400-S	1-3/4" (44.5)	4-1/4" (108)	1/4" (6) or 3/8" (10)	Exterior/Interior

2.02 FRAMING MATERIALS AND ACCESSORIES

A. Aluminum:

1. ASTM B221, alloy 6063-T6 for extrusions; ASTM B209, alloy 5005-H34 for sheets; or other alloys and temper recommended by manufacturer appropriate for specified finish.

B. Internal Reinforcing:

1. ASTM A36 for carbon steel; or ASTM B308 for structural aluminum.
2. Shapes and sizes to suit installation.
3. Shop coat steel components after fabrication with alkyd type zinc chromate primer complying with FS TT-P-645.]

C. Anchorage Devices:

1. Manufacturer's standard formed or fabricated steel or aluminum assemblies of

shapes, plates, bars or tubes.

D. Fasteners:

1. Aluminum, non-magnetic stainless steel or other materials warranted by manufacturer to be non-corrosive and compatible with components being fastened.
2. Do not use exposed fasteners, except where unavoidable for application of hardware.
3. For exposed locations, provide countersunk Phillips head screws with finish matching items fastened.
4. For concealed locations, provide manufacturer's standard fasteners.
5. Provide nuts, washers of design having means to prevent disengagement; deforming of fastener threads is unacceptable.

E. Expansion Anchor Devices: Lead-shield or toothed-steel, drilled-in, expansion bolt anchors.

F. Protective Coatings: Cold-applied asphalt mastic complying with SSPC-Paint 12, compounded for 30 mil (0.77 mm) thickness for each coat; or alkyd type zinc chromate primer complying with FS TT-P-645.

G. Glazing Gaskets:

1. Compression type design, replaceable, molded or extruded, of neoprene or ethylene propylene diene monomer (EPDM).
2. Conform to ASTM C509 or C864.
3. Profile and hardness as required to maintain uniform pressure for watertight seal.
4. Provide in manufacturer's standard black color.

H. Internal Sealants: Types recommended by sealant manufacturer.

I. Anti-Walk" Edge Blocking: "W" shaped EPDM blocks for use in keeping glazing material stationary under vibration or seismic loading.

J. Baffles (at weep holes): Type as recommended by system manufacturer and shown in published installation instructions.

K. End Dams: Type as recommended by System manufacturer and shown in the published Installation instructions.

2.03 FABRICATION

A. Coordination of Fabrication:

1. Check actual frame or door openings required in construction work by accurate field measurements before fabrication.
2. Fabricate units to withstand loads that will be applied when system is in place.

B. General:

1. Conceal fasteners wherever possible.
2. Reinforce work as necessary for performance requirements and for support to structure.
3. Separate dissimilar metals and aluminum in contact with concrete utilizing protective coating or pre-formed separators that will prevent contact and corrosion.
4. Comply with Section 08 81 00 for glazing requirements.

C. Aluminum Framing:

1. Supply size of members, shape, and profile designed to provide for glazing from [exterior] [interior].
2. Fabricate frame assemblies with joints straight and tight fitting.
3. Reinforce internally with structural members as necessary to support design loads.
4. Maintain accurate relation of planes and angles, with hairline fit of contacting members.
5. Seal horizontals and direct moisture accumulation to exterior.
6. Provide flashings and other materials used internally or externally that are corrosive resistant, non-staining, non-bleeding and compatible with adjoining materials.
7. Provide manufacturer's extrusions and accessories to accommodate expansion and contraction due to temperature changes without being detrimental to appearance or performance.
8. Make provisions in framing for minimum edge clearance, nominal edge cover and nominal pocket width for thickness and type of glazing or infill used in accordance with recommendations of manufacturer and FGMA Glazing Manual.
9. Provide tight fitting, injection molded, water deflectors at all intermediate horizontals.

D. Welding:

1. Comply with recommendations of the American Welding Society.
2. Use recommended electrodes and methods to avoid distortion and discoloration.
3. Grind exposed welds smooth and flush with adjacent surfaces; restore mechanical finish.

E. Flashings: Form from sheet aluminum with same finish as extruded sections. Apply finish after fabrication. Material thickness as required to suit condition without deflection or "oil-canning".

2.04 FINISH

A. Clear Anodized:

1. Conforming to AA-M12C22A31 and AAMA 607.1.

2. Architectural Class II, etched, medium matte, clear anodic coating, 0.4 mil (0.010 mm) minimum thickness.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions and proceed with Work in accordance with Section 01 40 00.

B. Verify dimensions, tolerances and method of attachment with other Work.

3.02 INSTALLATION

A. Erection Tolerances:

1. Limit variations from plumb and level:

a. 1/8 inch (3 mm) in 10 feet (3 M) vertically.

b. 1/8 inch (3 mm) in 20 feet (6 M) horizontally.

2. Limit variations from theoretical locations: 1/4 inch (6 mm) for any member at any location.

3. Limit offsets in theoretical end-to-end and edge-to-edge alignment: 1/16 inch (2 mm) from flush surfaces not more than 2 inches (51 mm) apart or out-of-flush by more than 1/4 inch (6 mm).

B. Install doors and hardware in accordance with manufacturer's printed instructions.

C. Set units plumb, level and true to line, without warp or rack of frame.

D. Anchor securely in place, allowing for required movement, including expansion and contraction.

E. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with bituminous paint or pre-formed separators to prevent contact and corrosion.

F. Seal perimeter members as shown on manufacturer’s installation instructions or as required for unique job conditions. Set other members with internal sealants and baffles as called for in manufacturer’s installation instructions. Use sealants as recommended by sealant manufacturer.

G. Coordinate installation of perimeter sealant and backing materials between assemblies and adjacent construction in accordance with requirements of Section 07920.

H. Glazing: Refer to requirements of Section 08 81 00. Utilize "anti-walk" edge blocking on all vertical edges of glazing.

3.03 ADJUSTING

A. Test door operating functions. Adjust closing and latching speeds and other hardware in accordance with manufacturer's instructions to ensure smooth operation.

3.04 CLEANING

A. Clean surfaces in compliance with manufacturer's recommendations; remove excess mastic, mastic smears, foreign materials and other unsightly marks.

B. Clean metal surfaces exercising care to avoid damage.

END OF SECTION 08 43 13

SECTION 08 45 00
TRANSLUCENT WALL & ROOF ASSEMBLIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Flat, factory pre-fabricated, thermally broken, structural, insulated sandwich panels of translucent skins separated with an aluminum grid wall system and associated aluminum flashings.

1.02 REFERENCED STANDARDS

A. AAMA 2604 – Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2005.

B. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2005.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, panel configuration, internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.

D. Installer Certificate, signed by installer, certifying compliance with Project qualification requirements.

E. Installation Data: Special installation requirements.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 10 years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Puncture wrappings at ends for ventilation. Store panels on the long edge; several inches above ground per manufacturer’s storage and handling instructions.

1.06 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and after installation of sealants.

1.07 WARRANTY

A. Provide manufacturer's and Installer's standard written warranty agreeing to repair or replace panel system work, which fails in materials or workmanship within one year of Substantial Completion, and the following written extended warranties:

1. Fiver year covering Materials and Workmanship.
2. Ten year limited warranty covering separation of faces from grid core, and/or abnormal color change of the exterior face.
3. 20 year limited warranty against reinforcing fiberbloom.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Sandwich Panel Wall/Roof System Manufacturers:

1. Kalwall; Product 2 3/4" Insulated Translucent Panel Wall System and S-lines Skylight System: www.kalwall.com
2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Panels: Bonded to both sides of thermally broken composite of aluminum and fiberglass grid of indicated pattern; exposed surfaces of exterior sheet chemically and permanently treated to protect against surface erosion and extreme weather conditions; exposed surface of interior sheets fire retardant to a flame rating of 50 maximum and smoke rating of 250 maximum:

1. Exterior Face Sheets: Crystal, smooth, 0.070 inches thick.
2. Interior Face Sheets: Crystal, smooth, 0.045 inches thick.
3. Grid core: I-beam thermal break: Minimum 1" thermoset fiberglass composite.
4. Panel thickness: 2-3/4 inches.
5. Light Transmission: 15%.
6. Panel U-factor: 0.14, NFRC certified.

2.03 SEALANT MATERIALS

A. Perimeter Sealant: As recommended by certified installer for this installation.

2.04 FABRICATION

A. Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Arrange fasteners and attachments to ensure concealment from view.

D. Reinforce framing members for external imposed loads.

2.05 FINISHES

A. Finish Coatings: Conform to AAMA 2604 and AAMA 2605.

B. Exterior Exposed Aluminum Surfaces: To match existing window finish on building.

1. Exterior anodized clear color, to 0.0007 inch thickness.

C. Interior Exposed Aluminum Surfaces: To match existing window finish on building.

1. Exterior anodized clear color, to 0.0007 inch thickness.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work

B. Verify wall openings and adjoining air barrier and vapor retarder materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install translucent panel wall system and skylight system in accordance with manufacturer instructions and approved shop drawings. Install cellular panels with cells vertical.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Panel System Members and Adjacent Construction: Maximum of 1/2 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. Provide the services of the manufacturer's field representative to observe installation and make report.

B. Water Test: Installer to test skylights according to procedures in AAMA 501.2.

C. Repair or replace work that does not pass testing or that is damaged by testing and retest

work.

3.05 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

D. Clean wall and skylight systems at interior and exterior.

3.06 PROTECTION

A. Protect finished work from damage.

END OF SECTION 08 45 00

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Mechanical door hardware for:

a. Swinging doors.

2. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

3. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
3. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
4. Division 26 sections for connections to electrical power system and for low-voltage wiring.
5. Division 28 sections for coordination with other components of electronic access control system.

1.03 REFERENCES

A. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

B. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.

B. Action Submittals:

1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
    a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
3. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
    a. Door Index; include door number, heading number, and Architects hardware set number.
    b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
    c. Quantity, type, style, function, size, and finish of each hardware item.

d. Name and manufacturer of each item.

e. Fastenings and other pertinent information.

f. Location of each hardware set cross-referenced to indications on Drawings.

g. Explanation of all abbreviations, symbols, and codes contained in schedule.

h. Mounting locations for hardware.

i. Door and frame sizes and materials.

j. Name and phone number for local manufacturer's representative for each product.

k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.

    i. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

4. Key Schedule:

    a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.

    b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.

    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.

    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.

    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.

        i. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

    f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.

5. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product data for electrified door hardware:
    a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
    a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    b. Catalog pages for each product.
    c. Factory order acknowledgement numbers (for warranty and service)
    d. Name, address, and phone number of local representative for each manufacturer.
    e. Parts list for each product.
    f. Final approved hardware schedule, edited to reflect conditions as-installed.
    g. Final keying schedule
    h. Copies of floor plans with keying nomenclature
    i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

A. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
    a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
    1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
    2. Can provide installation and technical data to Architect and other related subcontractors.
    3. Can inspect and verify components are in working order upon completion of installation.
    4. Capable of producing wiring diagrams.
    5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.

E. Keying Conference
    1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
        a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
        b. Preliminary key system schematic diagram.
        c. Requirements for key control system.
        d. Requirements for access control.
        e. Address for delivery of keys.

F. Pre-installation Conference
    1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    2. Inspect and discuss preparatory work performed by other trades.
    3. Inspect and discuss electrical roughing-in for electrified door hardware.

4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

G. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer's original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:

1. Promptly replace products damaged during shipping.
2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

F. Deliver keys to Owner by registered mail or overnight package service.

1.07 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate

provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.08 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.

a. Closers:

i. Mechanical: 25 years.

b. Locksets:

i. Mechanical: 10 years.

c. Continuous Hinges: Lifetime warranty.

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

B. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.

2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

A. Manufacturers and Products:
1. Scheduled Manufacturer and Product: Ives 5BB series.
2. Acceptable Manufacturers and Products: Hager BB series, Stanley FBB Series.

B. Requirements:
1. Provide hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:

a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high

b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.

6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.

7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

a. Steel Hinges: Steel pins

b. Non-Ferrous Hinges: Stainless steel pins

c. Out-Swinging Exterior Doors: Non-removable pins

d. Out-Swinging Interior Lockable Doors: Non-removable pins

e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with

2.04 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:

a. Scheduled Manufacturer: Ives.

b. Acceptable Manufacturers: Select, Stanley.

2. Requirements:

a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.

b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.

c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.

d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.

e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.

f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.

g. Install hinges with fasteners supplied by manufacturer.

h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Falcon MA series.

2. Acceptable Manufacturers and Products: Substitutions by Architect approval

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3 hour fire doors.

2. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.

3. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.

4. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.

5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

6. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
    a. Lever Design: Falcon Dane

2.07 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:
    1. Scheduled Manufacturer and Product: Falcon T series.
    2. Acceptable Manufacturers and Products: Substitutions by Architect approval

B. Requirements:
    1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
    2. Cylinders: Refer to “KEYING” article, herein.
    3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
    4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
    5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
    6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
    7. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
        a. Lever Design: Falcon Dane

2.08 AUXILIARY LOCKS

A. Aluminum Door Deadbolt - Narrow Style:
    1. Manufacturers and Products:
        a. Scheduled Manufacturer and Product: Adams Rite MS1850 Series.
        b. Acceptable Manufacturers and Products: No Substitute.
    2. Requirements:
        a. Provide narrow style aluminum door deadbolts as specified.
        b. Cylinders: Refer to “KEYING” article, herein.
        c. Provide deadbolts with necessary backset with full 1-13/32 inches (36 mm) throw deadbolt.
        d. Provide manufacturer’s standard strikes unless extended lip strikes are necessary to protect trim.

2.09 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer: Match existing key system as directed by Owner.

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.10 KEYING

A. Provide cylinders/cores keyed into Owner's existing factory registered keying system.

B. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

a. Master Keying system as directed by the Owner.

2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.

3. Provide keys with the following features:

a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)

4. Identification:

a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Do not provide blind code marks with actual key cuts.

b. Identification stamping provisions must be approved by the Architect and Owner.

c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.

d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.

e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

2.11 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4050 series.

2. Acceptable Manufacturers and Products: Substitutions by Architect approval

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2 inch (38 mm) diameter with 11/16 inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.12 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
2. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
3. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.

2.13 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
    a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.14 DOOR STOPS

A. Manufacturers:
1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Provide door stops at each door leaf:
1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:
1. Scheduled Manufacturer: Zero International.
2. Acceptable Manufacturers: National Guard, Reese.

B. Requirements:
1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Size of thresholds:
    a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
    b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
4. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.16 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.17 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing door and frame for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
    a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
    1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
    2. Custom Steel Doors and Frames: HMMA 831.
    3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

I. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

J. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

K. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

L. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

M. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

N. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.

1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer's Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

A. Hardware items are referenced in the following hardware. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

HARDWARE GROUP NO. 01

FOR USE ON MARK/DOOR #(S):

102B 201A 202A 301A 302A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4 NRP	630	IVE
1	EA	SECURITY LOCK W/ DB	MA431L DG	626	FAL
2	EA	MORTISE CYLINDER	MATCH EXISTING KEY SYSTEM	626	
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4050 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429A @ HEAD & JAMBS	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A - OR AS REQUIRED BY SILL DETAIL	A	ZER

HARDWARE GROUP NO. 02

FOR USE ON MARK/DOOR #(S):

203A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4 NRP	630	IVE
2	EA	MANUAL FLUSH BOLT	FB358/FB458 - AS REQUIRED	626	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQUIRED	626	IVE
1	EA	SECURITY LOCK W/ DB	MA431L DG	626	FAL
2	EA	MORTISE CYLINDER	MATCH EXISTING KEY SYSTEM	626	
2	EA	SURFACE CLOSER (W/ SPRING STOP)	4050 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429A @ HEAD & JAMBS	A	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	OVERLAPPING ASTRAGAL	44STST	STST	ZER
1	EA	THRESHOLD	655A - OR AS REQUIRED BY SILL DETAIL	A	ZER

HARDWARE GROUP NO. 03

FOR USE ON MARK/DOOR #(S):

105A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	T101 DAN	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 04

FOR USE ON MARK/DOOR #(S):

108A 204A 303A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	T301S DAN	626	FAL
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 05

FOR USE ON MARK/DOOR #(S):

103A 106A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRY / OFFICE LOCK	T511 DAN (CYLINDER PREP AS REQUIRED)	626	FAL
1	SET	CYLINDER(S)	MATCH EXISTING KEY SYSTEM	626	
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 06

FOR USE ON MARK/DOOR #(S):

104B 203D

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	T561 DAN (CYLINDER PREP AS REQUIRED)	626	FAL
1	SET	CYLINDER(S)	MATCH EXISTING KEY SYSTEM	626	

1	EA	SURFACE CLOSER (W/ SPRING STOP & HOLD OPEN)	4050 SHCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 07
FOR USE ON MARK/DOOR #(S):
201B
EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	T581 DAN (CYLINDER PREP AS REQUIRED)	626	FAL
1	SET	CYLINDER(S)	MATCH EXISTING KEY SYSTEM	626	
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4050 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. AL-01
FOR USE ON MARK/DOOR #(S):
104A
EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	MORTISE DEADBOLT	MS1850S	626	ADA
1	EA	EXIT INDICATOR	4089	119	ADA
2	EA	MORTISE CYLINDER	MATCH EXISTING KEY SYSTEM	626	
1	EA	PUSH/PULL BAR	9190HD-10"-NO	630	IVE
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4050 SCUSH	689	LCN
1	SET	CLOSER BRACKET(S)	AS REQUIRED TO INSTALL CLOSER	689	LCN
1	SET	SEALS	BY ALUM DOOR/FRAME MANUFACTURER		
1	EA	DOOR SWEEP	BY ALUM DOOR/FRAME MANUFACTURER		
1	EA	THRESHOLD	655A - OR AS REQUIRED BY SILL DETAIL	A	ZER

HARDWARE GROUP NO. EX-01
FOR USE ON MARK/DOOR #(S):

101A
EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	EXTERIOR HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQUIRED BY EXISTING CONDITIONS)	630	IVE
1	EA	STOREROOM LOCK	T581 DAN (CYLINDER PREP AS REQUIRED)	626	FAL
1	SET	CYLINDER(S)	MATCH EXISTING KEY SYSTEM	626	
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4050 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429A @ HEAD & JAMBS	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A - OR AS REQUIRED BY SILL DETAIL	A	ZER

At existing doors and frames, general contractor and hardware supplier to field verify existing conditions to ensure the compatibility of new hardware with existing preps prior to order of new materials. General contractor to provide necessary fillers, reinforcements and fasteners, compatible with existing materials as required for mounting new opening hardware and to cover existing frame preparations.

HARDWARE GROUP NO. EX-02
FOR USE ON MARK/DOOR #(S):
101C
EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQUIRED BY EXISTING CONDITIONS)	652	IVE
1	EA	CLASSROOM LOCK	T561 DAN (CYLINDER PREP AS REQUIRED)	626	FAL
1	SET	CYLINDER(S)	MATCH EXISTING KEY SYSTEM	626	
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S @ HEAD AND JAMBS	BK	ZER

At existing doors and frames, general contractor and hardware supplier to field verify existing conditions to ensure the compatibility of new hardware with existing preps prior to order of new materials. General contractor to provide necessary fillers, reinforcements and fasteners,

compatible with existing materials as required for mounting new opening hardware and to cover existing frame preparations.

HARDWARE GROUP NO. EX-03
FOR USE ON MARK/DOOR #(S):
107A
EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQUIRED BY EXISTING CONDITIONS)	652	IVE
1	EA	CLASSROOM LOCK	T561 DAN (CYLINDER PREP AS REQUIRED)	626	FAL
1	SET	CYLINDER(S)	MATCH EXISTING KEY SYSTEM	626	
1	EA	SURFACE CLOSER (W/ SPRING STOP & HOLD OPEN)	4050 SHCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

At existing doors and frames, general contractor and hardware supplier to field verify existing conditions to ensure the compatibility of new hardware with existing preps prior to order of new materials. General contractor to provide necessary fillers, reinforcements and fasteners, compatible with existing materials as required for mounting new opening hardware and to cover existing frame preparations.

HARDWARE GROUP NO. OH-01
FOR USE ON MARK/DOOR #(S):
101B 102A 202B 203B 203C 301B
302B

All hardware provided by overhead door manufacturer.

END OF SECTION 08 71 00

SECTION 08 81 00
GLASS GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMETNS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Door light, sidelight and borrowed lite glazing

2. Glazing for Aluminum windows.

1.03 DEFINITIONS

A. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use due to causes other than glass breakage and improper practices for maintaining, and cleaning insulating glass. Evidence of failure is the obstruction of vision by dust, moisture, or film on the interior surfaces of glass. Improper practices for maintaining and cleaning glass do not comply with the manufacturer's directions.

1.04 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Product data for each glass product and glazing material indicated.

C. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements.

D. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.

E. Compatibility test report from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.

F. Product test reports for each type of glazing sealant and gasket indicated, evidencing compliance with requirements specified.

G. Maintenance data for glass and other glazing materials to include in Operating and Maintenance Manual specified in Division 1.

1.05 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. FGMA Publications: "FGMA Glazing Manual".

2. SIGMA Publications: TM-3000 "Vertical Glazing Guidelines".

B. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.

1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

C. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component lite of units with appropriate certification label of inspecting and testing agency indicated below:

1. Insulating Glass Certification Council (IGCC).

2. Associated Laboratories, Inc. (ALI).

3. National Certified Testing Laboratories (NCTL).

D. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in-service performance.

E. Single-Source Responsibility: Obtain glass and Glazing Accessories from one source.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1. Where insulating glass units will be exposed to substantial altitude changes, comply with insulating glass fabricator's recommendations for venting and sealing to avoid hermetic seal ruptures.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.08 WARRANTY

A. Manufacturer’s Warranty on Insulating Glass: Submit written warranty signed by manufacturer of insulating glass agreeing to furnish replacements for insulating glass units that deteriorate as defined in "Definitions" article, f.o.b. point of manufacture,

freight allowed Project site, within specified warranty period indicated below. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer's published instructions.

1. Warranty Period: Manufacturer's standard but not less than 10 years after date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated in schedules at the end of Part 3.

2.02 HEAT TREATED FLOAT GLASS

A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind and condition as indicated in schedules at the end of Part 3.

B. Tempered Float Glass: ASTM C 1048; Kind FT (fully tempered), Type I (transparent glass, flat); Quality q3 (glazing select); class, kind and condition as indicated in schedules at the end of Part 3.

1. Tong marks: Provide tempered glass produced by manufacturer's process which eliminates tong marks.

2.03 INSULATING GLASS PRODUCTS

A. Sealed Insulating Glass Units: Preassembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E 774 and with other requirements indicated below:

1. Provide heat-treated, float glass full tempered where designated on drawings or required by code.

2. Performance characteristics designated for insulating glass are nominal in values based on manufacturer’s published test data for units with lites 6 mm thick and nominal 1/2 inch dehydrated space between lites, unless otherwise indicated.

3. U-values are expressed as Btu/hr x sq. ft. x deg F (W/sq. m x K)

4. Overall Thickness: 1 inch.

5. Uncoated Indoor Lite: If not specified in schedules; Class 1 (clear) float glass, Type II (patterned and wired glass, flat). Kind FT (fully tempered) where required by code, Condition A (uncoated).

2.04 PRIMARY FLOAT GLASS PRODUCTS

A. Float Glass: Heat strengthened annealed glass.

1. Thickness: 1/4 inch.

2. Install into hollow metal frames and interio metal door half lites. Comply with

safety glazing requirements.

2.05 ELASTIMERIC GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2. Suitability: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation.

3. Colors: Provide color of exposed joint sealants as selected by Architect.

B. Elastomeric Glazing Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with ASTM C 920 requirements

C. Acrylic Sealant: FS TT-S-00230, Type II, Class A; single component; cured Shore A hardness of 15- 25; color as selected

D. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding, non-sagging type, Shore A Hardness Range 20 to 35

E. Silicone Sealant: FS TT-S-01543, Class A; single component; solvent curing; capable of water immersion without loss of properties; cured Shore A hardness of 15-25; color as selected.

2.06 GLAZING TAPES

A. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air and vapor seal.

2.07 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side-walking).

2.08 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.

2. Presence and functioning of weep system.

3. Minimum required face or edge clearances.

4. Effective sealing between joints of glass-framing members.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.03 GLAZING, GENERAL

A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass from edge damage during handling and installation as follows:

1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.

2. Remove damaged glass from Project site and legally dispose of off site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install elastomeric setting blocks in sill rabbets, sized and located to comply with

referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:

1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.04 PROTECTION AND CLEANING

A. Protect exterior glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way.

E. Wash glass on both faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.05 GLAZING SCHEDULE

A. 1/4” (6mm) Clear Tempered Float Glass – At interior H.M. windows, Interior and Exterior Metal Door lites

1. Products: Provide one of the following:

a. AFG Industries Inc.

b. Guardian Industries Corporation.

c. Viracon, Inc.

B. 1” Insulated Glass Units, Low E Coating – At New Storefront and Door and at exterior metal door half lites.

1. Quality: Double glazed, hermetically sealed around perimeter with continuous metal spacer filled with moisture absorbing desiccant per ASTM E774, adhered to glass lights with:

a. Primary Seal: Polyisobutylene.

b. Secondary Seal: Silicone two-part.

2. Total thickness: 1 inch.

a. Outer Light:

i. Quality: Glazing select, float, complying with ASTM C1036.

ii. Type: Annealed; Heat-strengthened, complying with ASTM C1048, Kind HS, heat strengthened where required by heat load.

iii. Thickness: 1/4 inch.

iv. Color: Clear.

v. Low E Coating: No. 2, inner surface.

b. Inner Light:

i. Quality: Glazing select, float.

ii. Type: Annealed; Heat-strengthened, complying with ASTM C1048, Kind HS, heat strengthened where required by heat load.

iii. Thickness: 1/4 inch.

iv. Color: Clear.

c. Air Space: 1/2 inch dehydrated air space.

3. Acceptable Manufacturers:

a. Cardinal IG, Minnetonka, MN.

b. Ford Glass, Allen Park, MI.

c. Guardian Industries Corporation, Carleton, MI.

d. Viracon, Owatonna, MN.

4. Provide fully tempered glass at safety locations as required by code.

END OF SECTION 08 81 00

DIVISION 9

FINISHES, PAINT & COATINGS

SECTION 09 06 00
SCHEDULES FOR FINISHES

PART 1 - GENERAL

1.01 SUBMITTALS

A. Submittal requirements are specified in appropriate product sections.

PART 2 - PRODUCTS

2.01 GENERAL

A. Products and materials referred to in this section are specified in appropriate product sections.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Requirements for incorporation of scheduled products into the Work are specified in appropriate product sections.

B. Architectural painting and coating schedules are depicted on the Drawings.

C. In the event schedules for painting and coating systems conflict, the requirements for High Performance Painting and Coating shall govern.

D. Paint exposed surface whether or not painting system is designated in “schedules”, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If coating system is not designated, the Engineer will select from coating systems available.

3.02 SUPPLEMENTS

A. The supplements listed below, are a part of this Specification.

1. High Performance Coating System Schedule: A tabulation of coating systems for equipment and areas as depicted on the Drawings.

High Performance Painting & Coating Schedule

Building	Space	Material or Surface	Coating System	Specification
Main Lift Station	Pump Gallery	Walls and Ceiling		See Architectural
		Metals, concrete embedded	System 6	09 90 02
		Ferrous metals, all interior	System 4	09 90 02
		Equipment	System 4	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Piping	System 4	09 90 02
	Upper Level	Walls and Ceiling		See Architectural
		Ferrous metals, all interior	System 2	09 90 02
		Metals, concrete embedded	System 6	09 90 02
Sidestream Lift Station	All Spaces	Ferrous Metals	System 4	09 90 02
		Process Piping	System 4	09 90 02
		Precast Concrete, Immersion and High H_2S Exposure	System 11	09 90 02
Grit Channel & Building	All Spaces	Walls		See Architectural
		Ceiling		See Architectural
		Floors		See Architectural
		Cast-in-Place Concrete, Immersion and High H_2S Exposure	System 11	09 90 02
		Concrete Pedestals & Mounting	System 13	09 90 02
		Ferrous Metals	System 4	09 90 02
		Metals, Concrete embedded	System 6	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Piping	System 4	09 90 02
		Galvanized, Copper, Nonferrous Alloys	System 7	09 90 02
Reactor Basins	All Spaces	Ferrous Metals	System 4	09 90 02
		Metals, Concrete embedded	System 6	09 90 02
		Aluminum & Dissimilar Metals	System 14	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Piping	System 4	09 90 02
		Galvanized, Copper, Nonferrous Alloys	System 7	09 90 02

Building	Space	Material or Surface	Coating System	Specification
Main Process Building	All Spaces	Walls		See Architectural
		Ceiling		See Architectural
		Floor		See Architectural
		Interior Ferrous Metals, Non-immersion	System 2	09 90 02
		Ferrous Metals, Immersion	System 3	09 90 02
		Metals, Concrete embedded & Encased	System 6	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Piping	System 2	09 90 02
		Non-Ferrous Metals & Piping	System 7	09 90 02
		Aluminum & Dissimilar Metals	System 14	09 90 02
SBB & WLC	All Spaces	Ferrous Metals	System 4	09 90 02
UV Room	All Spaces	Walls		See Architectural
		Ceiling		See Architectural
		Floors		See Architectural
		Ferrous Metals	System 4	09 90 02
		Metals, Concrete embedded	System 6	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Pipe	System 4	09 90 02
Biosolids Blower Building	All Spaces	Walls		Existing
		Ceiling		Existing
		Ferrous Metals	System 2	09 90 02
		Process Pipe	System 2	09 90 02
		Floors		Existing
Admin. Building	All Spaces	Walls		See Architectural
		Ceiling		See Architectural
		Floors		See Architectural

END OF SECTION 09 06 00

SECTION 09 20 00
PLASTER AND GYPSUM BOARD

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section covers the work necessary to furnish and install gypsum board assemblies, complete.

1.02 GENERAL REQUIREMENTS

A. Sound Transmission Characteristics: For assemblies indicated to have STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing agency.

1.03 RELATED SECTIONS

A. Section 07 20 00, Building Insulation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Subject

1. Georgia-Pacific Corp.
2. Gold Bond Building Products Div., National Gypsum Co.
3. United States Gypsum Co.
4. Or equal.

B. Gypsum Board: Provide gypsum board of types indicated, in maximum lengths available, to minimize end joints:

1. Gypsum Wallboard: ASTM C 36, thickness as indicated.
    a. Type: Type X where required for fire-resistive rated assemblies.
2. Water-Resistant Gypsum Backing Board: ASTM C 630, thickness as indicated at toilets and sinks.
    a. Type: Type X for fire-resistive-rated assemblies.

C. Accessories for Interior Installation: Corner beads, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:

1. Material: Formed metal, plastic, or metal combined with paper, with metal complying with the following requirement:
    a. Sheet steel coated with zinc by hot-dip or electrolytic processes, or with aluminum or rolled zinc.

2. Shapes indicated below by reference to Figure 1 designations in ASTM C 1047:
    a. Cornerbead on outside corners, unless otherwise indicated.
    b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim unless otherwise indicated.
    c. L-trim and J-trim at windows, doors, and at panels that abut other materials.

D. Gypsum Board Joint Treatment Materials: ASTM C 475 and ASTM C 840, and as follows:
1. Joint Tape: Paper reinforcing tape, unless otherwise indicated.
    a. Use open-weave glass-fiber tape where recommended by gypsum board manufacturer with setting-type joint compound.
2. Setting-Type Joint Compound: Factory-packaged, job-mixed chemical-hardening powder products formulated for uses indicated.
    a. For topping compound, use sandable formulation.
    b. Use in wet areas.
3. Drying-Type Joint Compounds: Factory-packaged, vinyl-based products complying with the following requirements:
    a. Ready-Mixed Formulation: Factory premixed.
    b. Taping compound formulated for embedding tape and first coat over fasteners and flanges of corner beads and edge trim.
    c. Topping compound formulated for fill (second) and finish (third) coats.
4. Miscellaneous Materials: As follows, recommended by gypsum board manufacturer:
    a. Steel drill screws complying with ASTM C 1002 for fastening gypsum board to steel members.
    b. Exposed and Concealed Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.
    c. Sound Attenuation Blankets: ASTM C 665, Type I, unfaced mineral-fiber blanket insulation.

PART 3 - EXECUTION

3.01 GENERAL

A. Install and finish gypsum board to comply with ASTM C 840 and as follows:
1. Install gypsum board panels horizontally in longest panels possible.
2. Isolate gypsum board construction from abutting structural and masonry work. Provide edge trim and acoustical sealant as recommended by manufacturer.
3. Install sound attenuation blankets where indicated, without gaps, and support, where

necessary, to prevent movement or dislocation.

4. Install water-resistant backing board where indicated, and adjacent to all plumbing and fixtures.
5. Screw gypsum board to metal supports.
6. Do not bridge building expansion joints. Leave a space of the width indicated between boards, and trim both edges for installation of sealant or gasket.
7. Install control joints in gypsum board panels at spacings recommended by manufacturer.

B. Finishing Gypsum Board Assemblies:

1. Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects, and elsewhere, as required, to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated.
2. Levels of Gypsum Board Finish: Provide the levels of finish per Room Finish Schedule in accordance with GA-214.

END OF SECTION 09 20 00

SECTION 09 65 00
RESILIENT FLOORING AND ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet flooring.

B. Resilient base.

C. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 REFERENCE STANDARDS

A. ASTM F1482 – Standard Guide to Wood Underlayment Products available for Use under resilient flooring.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

C. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2012.

D. ASTM F1700 – Standard Specification for Solid Vinyl Tile.

E. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

F. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov; 2002.

G. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant; Federal Specifications and Standards; Revision E, 1994.

H. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plan.

D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

E. Verification Samples: Submit two samples in manufacturer’s standard sample size illustrating color and pattern for each resilient flooring product specified.

F. Concrete Testing Standard: Submit a copy of ASTM F710.

G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Flooring Material: Quantity equivalent of 5% of each type and color.

3. Extra Wall Base: 15 linear feet of each type and color.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer’s delivery and storage requirements.

B. Protect roll materials from damage by storing on end.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Comply with manufacturer's written requirements under which products can be installed.

2. Store flooring materials in spaces where they will be installed for at least 48 hours before beginning installation at a temperature of 65 degrees F to achieve temperature stability.

3. Do not install products until they are at same air and subfloor temperature as space where they are to be installed.

4. Maintain minimum temperature of 65 degrees F and maximum relative humidity of 65 percent for minimum of 24 hour prior to installation. Maintain temperature for 72 hours after installation.

B. Substrate Conditions: Do not install resilient flooring over concrete slabs until they are sufficiently dry to achieve bond with adhesive as determined by manufacturer's bond and moisture tests.

1. Do not begin the installation over concrete substrates that do not meet the following moisture vapor emission rate (MVER) requirements.

a. Moisture: Conduct Relative Humidity testing and results must be below 90% (ASTM F-2170) for 24 hours.

b. Alkalinity: pH testing should be performed with results ranging between 7.0 and 10.0 (ASTM F-710). Take corrective measures if the results exceed these limits. Flooring manufacturer to recognize the relative humidity (RH) test as the qualifying standard.

2. Flooring Contractor to perform moisture testing and provide results to General Contractor, Owner and Architect.

PART 2 - PRODUCTS

2.01 SHEET FLOORING

A. Resilient Sheet Vinyl: Color and pattern throughout entire thickness, with backing, and:

1. Minimum Requirements: Comply with ASTM F1303, Type II, with Class A fibrous backing.
2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
3. Wear Layer Thickness: 0.055 inch minimum.
4. Total Thickness: 0.080 inch minimum.
5. Sheet Width: 72 inch minimum.
6. Static Load Resistance: 125 psi minimum.
7. Heat welded seams.
8. Manufacturers:
    a. Mannington Mills, Inc.: Basis of Design Product:
    b. Armstrong Flooring.
    c. Johnsonite
    d. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 RESILIENT BASE

A. Resilient Base (RB-1): ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:

1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
2. Height: 4 inch.
3. Thickness: 0.125 inch thick.
4. Finish: Satin.
5. Length: Roll.
6. Color: selected by architect
7. Accessories: Pre-molded external corners and end stops.
8. Manufacturers:
    a. Burke Flooring; www.burkemercer.com.
    b. Johnsonite, Inc; www.johnsonite.com.
    c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

A. Leveling, Patching and Underlayment Compounds:

1. Cementitious types required by resilient flooring manufacturer; gypsum based compounds not allowed.
2. Capable of being extended to a feather-edge.
3. Capable of sustaining loads without indentation
4. Vapor retarder underlayment: Underlayment compound having a moisture permeance no greater than 1 perm.

B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.

1. Materials required by resilient product manufacturer for particular product and substrate moisture content and condition.
2. Removable adhesive with antimicrobial additive; approved by resilient product manufacturer.
3. Provide products havin lower Volatile organic compound content where possible or 3 g/L, maximum.

C. Moldings, Reducers and Transition Edge Strips: Homogeneous rubber composition type.

1. Product: Must be ADA-Compliant.
2. Colors: Selected by Architect from manufacturer's full range of colors.
3. Manufacturers:
   a. Johnsonite, Inc; www.johnsonite.com.
   b. Roppe Corp; www.roppe.com.
   c. Flexco Floors; http://www.flexcofloors.com/
   d. Substitutions: See Section 01 60 00 - Product Requirements.
4. Carpet to Resilient Flooring Reducer Strip:
   a. Model: Johnsonite Transition SLT-XX-C.
5. Carpet to Concrete Flooring Reducer Strip
   a. Model: Johnsonite Transition CTA-XX-J.
6. Resilient to Concrete or existing Wood Flooring Reducer Strip
   a. Model: Johnsonite Reducer SSR-XX-B.

D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds,

surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.

1. Test in accordance with ASTM F710.

2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify wood sub-floor surfaces comply with manufacturer’s installation requirements.

3.02 PREPARATION

A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

D. Prohibit traffic until filler is cured.

E. Clean substrate.

F. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints tightly.

E. Set flooring in place, press with heavy roller to attain full adhesion.

F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

1. Resilient Strips: Attach to substrate using adhesive.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

I. Install flooring in recessed floor access covers, maintaining floor pattern.

3.04 RESILIENT SHEET FLOORING

A. Install sheeting flooring with heat welded seams per manufacturer’s instructions.

B. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns carefully at seams.

C. Seams are prohibited in main traffic routes set up in the space. Confirm with Architect.

D. Lay flooring with tightly butted seams, without any seam sealer.

E. Extend sheet flooring under casework and built-in units to wall surfaces.

3.05 RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces. Verify bonding 72 hours after installation and re-bond if necessary.

D. Scribe and fit to door frames and other interruptions.

3.06 RESILIENT STAIR COVERINGS

A. Install stair coverings in one piece for full width and depth of tread.

B. Install stringers configured tightly to stair profile.

C. Adhere over entire surface. Fit accurately and securely.

D. Re-adjust after installation, as needed, to ensure material is installed accurately and securely.

3.07 REDUCER AND TRANSITION STRIPS

A. Provide reducer and transition strips at all unprotected edges, exposed eddes and where flooring and carpet terminates.

B. Center strip under door where flooring terminates at door openings, extend under door thresholds, or per Architect’s recommendations.

C. Install in longest lengths practicable with minimal joints, fit tightly.

D. Adhere over entire surface. Fit accurately and securely.

3.08 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage. Repair or replace any damaged adjacent surfaces to new condition.

B. Clean in accordance with manufacturer's instructions each flooring material installed.

3.09 PROTECTION

A. Prohibit traffic on resilient flooring for 72 hours after installation.

B. Protect newly installed flooring materials from subsequent trades until turn over to the Owner.

END OF SECTION 09 65 00

SECTION 09 6800
CARPETING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Modular Carpet.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

B. Secton 09 65 00 – Resilient Flooring and Accessories

1.03 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

B. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2009.

C. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color and type selected.

D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Carpet Tiles and Carpet Base: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum five years experience.

B. Installer Qualifications: Company specializing in installing carpet with minimum five years experience.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.07 WARRANTY

A. Manufacturer's Lifetime warranty on edge ravel, delamination, tuft bind and dimensional stability, stain, static, abrasive wear, colorfastness to light and atmospheric conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Interface, Inc. www.interfaceinc.com.
2. Patcraft: www.patcraft.com.
3. Shaw Contract Group: www.shawcontractgroup.com.

2.02 MATERIALS

A. Carpet Type CPT (Carpet Tile) per room finish schedule:

1. Approved Products: per architect
2. Installation Pattern: per architect
3. Primary Backing: per architect

2.03 ACCESSORIES

A. Reducer and Transition Strips: per 09 65 00

B. Patching compound:

1. Pre-mixed latex recommended by carpet manufacturer.
2. Gypsum based products not allowed.
3. Compatible with adhesive and curing and sealing compound on concrete
4. Apply manufacturer's C-56 adhesive primer.

C. Adhesives:

1. General: Water based adhesive approved by carpet manufacturer.
2. Acceptable to carpet tile manufacturer, compatible with materials being adhered:
   a. Interface TacTiles

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that sub-floor surfaces are dust-free and free of substances that could impair

bonding of adhesive materials to sub-floor surfaces.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.

1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

D. Verify that concrete sub-floor surfaces are dry enough and ready for flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by carpet tile manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Remove existing flooring materials and adhesives where exist.

B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

E. Wet mop and let dry before installing carpet tile.

3.03 INSTALLATION

A. Carpet Tile:

1. Starting installation constitutes acceptance of sub-floor conditions.

2. Install carpet tile in accordance with manufacturer's instructions and CRI Carpet Installation Standard.

3. Blend carpet from different cartons to ensure minimal variation in color match.

4. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

5. Visible gaps will not be accepted, and contractor is responsible for reinstallation without any visible gaps from tilt to tile or tile to adjacent surfaces.

6. Lay carpet tiles in pattern and pile direction as noted on the drawings.

7. Fully adhere carpet tile to substrate.

8. Trim carpet tile neatly at walls and around interruptions with no visible gaps.

9. Roll in carpet w/ 75# roller.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

3.05 PROTECTION

A. Protect finished work in accordance with Section 01 7000.

B. Comply with CRI 104, Section 15: "Protection of Indoor Installation."

C. Maintain protection satisfactory to manufacturer and installer to ensure carpet not damaged at time of Substantial Completion.

END OF SECTION 09 68 00

SECTION 09 77 00
FIBERGLASS REINFORCED PLASTIC PANEL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Glass fiber reinforced plastic panels.

B. Trim.

1.02 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010.

B. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor; 2013a.

C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

D. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2012.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.

F. FDA Food Code - Chapter 6, Physical Facilities; current edition with Supplements, if any.

G. FM 4880 - Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems; 2010.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Samples: Submit two samples 6 inch in size illustrating material and surface design of panels.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Glass Fiber Reinforced Plastic Panels:

1. Marlite: www.marlite.com.
2. Crane Composites, Inc. www.cranecomposites.com.
3. Panolam FRP, www.panolam.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels at all bathrooms (inside and outside) and custodial, and kitchen where indicated on plans

1. Panel Size: 4 by 8 feet
2. Panel Thickness: 3 / 32 inch.
3. Surface Design: subway tile
4. Color: White.
5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS

A. Panels: Glass fiber reinforced plastic, complying with ASTM D5319.

1. Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 450, maximum; when whole system is tested in accordance with ASTM E84.
2. Class 1 fire rated as tested in accordance with FM Approval Standard 4880.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Scratch Resistance: Barcol hardness score of not less than 35, when tested in accordance with ASTM D2583.
5. Impact Strength: Not less than 6 ft-lb/in, when tested in accordance with ASTM D256.
6. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.

B. Trims: Extruded aluminum, color coordinating with panel, shapes as required for conditions.

C. Adhesive: Type recommended by panel manufacturer.

D. Sealant: Type recommended by panel manufacturer; clear.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades or drill bits, or cut with snips.

C. Apply adhesive to the back side of the panel using trowel recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturer's recommended gap for panel field and corner joints.

F. Place trim on panel before fastening edges, if required.

G. Fill channels in trim with sealant before attaching to panel.

H. Install trim with adhesive and screws or nails as required.

I. Seal gaps at floor, ceiling, and between panels with specified sealant to prevent moisture intrusion.

J. Remove excess sealant as paneling is installed.

END OF SECTION 09 77 00

SECTION 09 90 00
PAINTING AND COATING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes surface preparation and field application and finishing of exposed interior and exterior items and surfaces.

B. Related Divisions:

1. Division 3 – Concrete and Grout
2. Division 4 - Masonry
3. Division 5 - Metals
4. Division 6 – Woods, Plastics, Composites
5. Division 7 – Thermal & Moisture Protection
6. Division 11 – Equipment
7. Division 40 – Process Interconnections

1.02 REFERENCES

A. American Society for Testing and Materials:

1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

B. Painting and Decorating Contractors of America:

1. PDCA - Architectural Painting Specification Manual.

C. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.

1.03 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on finishing products.

C. Manufacturer's Installation Instructions: Submit special surface preparation procedures and substrate conditions requiring special attention.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair

of painted and coated surfaces.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing work of this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45°F and maximum of 90°F, in ventilated area, and as required by manufacturer's instructions.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

B. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.

C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish and oil based Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candle measured mid-height at substrate surface in order to assure proper visual quality assurance.

1.09 SEQUENCING

A. Section 01 11 00 - Summary: Work sequence.

B. Sequence application to the following:

1. Do not apply finish coats until paintable sealant is applied.

2. Back prime wood trim before installation of trim.

1.10 WARRANTY

A. Furnish five year manufacturer warranty for paints and coatings.

1.11 EXTRA MATERIALS

A. Supply 1 gallon of each color, type, and surface texture; store where directed.

B. Label each container with color, type, texture and room locations in addition to manufacturer's label.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide Products (Paint, Primer, Sealers and Block Fillers) as manufactured by:

1. Sherwin Williams (SW)
2. Benjamin Moore & Co.;
3. PPG Industries;
4. Tnemec Company, Inc;
5. Glidden Professional.
6. Columbia Paints.

B. Listing of products by manufacturer’s trade name is not intended to exclude equivalent products by other manufacturers identified above. For products not specifically named, submit substitution request in accordance with Section 01 60 00.

2.02 FILLERS AND SEALERS

A. Interior Block Filler:

1. Benjamin Moore and Company: Super Craft Block Filler No. 285
2. PPG Industries, Inc.: Speedhide Acrylic Latex Masonry Block Filler, 6-7.
3. Sherwin-Williams: Interior/Exterior Block Filler No. B25W25.
4. Tnemec Company, Inc.: Latex Masonry Filler No. 54-560.

B. Single Component Masonry Conditioner:

1. Benjamin Moore: Acrylic Masonry Sealer (066)
2. PPG Industries, Inc.: Masonry Surface Sealer No. 6-8.
3. Sherwin-Williams: Loxon Masonry Conditioner A24

C. Paste Wood Filler:

1. Benjamin Moore and Company: Benwood Wood Filler #238
2. Sherwin-Williams: Sherwood Wood Filler.

D. Sanding Sealer (Vinyl Toluene Copolymer):

1. Benjamin Moore and Company: IWF Sanding Sealer Clear No. 413.
2. PPG Industries, Inc.: Speedhide Alkyd Sanding Sealer, 6-10.
3. Sherwin-Williams: Wood ClassicsClassics Fast Dry Sanding Sealer.

E. Stain Sealer:

1. Benjamin Moore and Company: Moore's Stain Blocking Primer No 202.
2. Sherwin-Williams: Preprite Problock Latex & Alkyd Primer/Sealer

2.03 PRIME COATINGS

A. Exterior Alkali Resistant Primer:

1. Benjamin Moore and Company: Super Spec Exterior Latex Primer No. 169
2. PPG Industries, Inc.: Alkali Resistant Primer No. 6-3.
3. Sherwin-Williams: Loxon Exterior Masonry Primer A24 Series

B. Interior Alkyd Enamel Undercoater:

1. Benjamin Moore and Company: Super Spec Alkyd Enamel Undercoater C245
2. PPG Industries, Inc.: Speedhide Quick Drying Enamel Undercoater, 6-6.
3. Sherwin-Williams: Wall and Wood Primer B49WZ2.

C. Alkyd-Phenolic Primer:

1. Benjamin Moore: M07 Universal Metal Primer
2. PPG Industries, Inc.: Multiprime Universal Primer No. 97-682.
3. Sherwin-Williams: Ken Kromik Universal B50NZ Series.
4. Tnemec Company, Inc.: Series 37 Chem-Prime.

D. Etching Metal Primer:

1. PPG Industries, Inc.: Polyclutch Wash Primer No. 97-687.
2. Sherwin-Williams: DTM Wash Primer B71Y1.
3. Tnemec Company, Inc.: Tneme-Grip No. 32-1210.

E. Ethyl Silicate Zinc Primer:

1. Benjamin Moore: M01/M02 Inorganic Zinc Primer
2. PPG Industries, Inc.: Metalhide 1001 Inorganic Zinc Rich Primer, 97-673/97-674.
3. Sherwin-Williams: Zinc Clad II HS Ethyl Silicate B69BVZ3.
4. Tnemec Company, Inc.: Tneme-Zinc No. N90E92.

F. Acrylic Latex Ferrous Metal Primer:

1. Benjamin Moore: Acrylic Metal Primer M04
2. Sherwin Williams: Pro Cryl Universal Metal Primer B66W310

G. Exterior Alkyd Primer:
1. Benjamin Moore and Company: Super Spec Alkyd Exterior Primer No. 176.
2. PPG Industries, Inc.: Speedhide Exterior Alkyd Wood Primer, 6-9.
3. Sherwin-Williams: A-100 Exterior Wood Primer Y24.
4. Tnemec Company, Inc.: Undercoater No. 36-603.

H. Galvanized Primer:
1. Benjamin Moore: Acrylic Metal Primer M04
2. PPG Industries, Inc.: Galvanized Steel Primer No. 6-209.
3. Sherwin-Williams: Galvite HS B50WZ30.
4. Tnemec Company, Inc.: Galv-Gard Series 22.

I. Latex Primer:Interior
1. Benjamin Moore: Super Spec Primer Sealer & Latex Undercoat No 253.
2. PPG Industries, Inc.: Speedhide Latex Wall Sealer No. 6-2.
3. Sherwin-Williams: PrepRite Primer B28W200
4. Tnemec Company, Inc.: PVA Sealer No. 51-792.

J. Latex Primer Exterior :
1. Benjamin Moore: Super Spec Latex Exterior Primer No. 169
2. Sherwin Williams; A-100 Latex Primer B42W41

K. Long-Oil Alkyd Primer:
1. Benjamin Moore: Moorwhite Penetrating Alkyd Primer No. 100
2. PPG Industries, Inc.: Speedhide Alkyd Red Rust Inhibitive Steel Primer, 6-208.
3. Sherwin-Williams: Kromik Metal Primer E41N1.
4. Tnemec Company, Inc.: Tnemec Primer Series 10.

2.04 WATER REDUCIBLE COATINGS

A. Industrial 100% Acrylic:
1. Benjamin Moore: DTM Acrylic Gloss (M28) or Semi-Gloss (M29)
2. PPG Industries, Inc.: Water Base Inhibitive Primer No. 6-712.
3. Sherwin-Williams: DTM Acrylic.
a. Gloss: B66-100.

b. Semi-Gloss: B66-200.

4. Tnemec Company, Inc.: Tneme-Cryl Series 6 (Flat) and Series 7 (Semi-gloss).

B. Interior Premium Acrylic Latex Enamel:

1. Benjamin Moore and Company:

a. Eggshell: Super Spec Latex Eggshell Enamel (286)

b. Pearl Finish:: Super Sec Latex Pearl Finish (277)

c. Semi-Gloss: Super Spec Latex Semi-Gloss Enamel (283)

d. Gloss: Impervex Metal & Wood Enamel no. 309

2. PPG Industries, Inc.:

a. Eggshell: Speedhide Acrylic Latex Enamel, 6-411.

b. Semi-Gloss: Speedhide Acrylic Latex Enamel, 6-510.

3. Sherwin-Williams:

a. Eggshell: ProMar 200 EgShel B20W200.

b. Semi-Gloss: Pro Mar 200 Latex Semi Gloss B31 Series

c. Gloss: Pro Classic Gloss B21

C. Interior Acrylic Vinyl Latex Flat Paint:

1. Benjamin Moore and Company: Super Spec Latex Flat (275)

2. PPG Industries, Inc.: Speedhide Acrylic Latex Flat Wall Paint, 6-70.

3. Sherwin-Williams: ProMar 200 Flat B30W200

D. Water Based Epoxy:

1. Benjamin Moore and Company: Super Spec Acrylic Epoxy Enamel No. 256

2. PPG Industries, Inc.: Pitt-Glaze Water Based Acrylic Epoxy Enamel.

3. Sherwin Williams: Water Based Epoxy B70-200.

2.05 WOOD STAINS AND COATINGS

A. Masking Wiping Stain:

1. Benjamin Moore and Company: Benwood Interior Stain No. 234

2. PPG Industries, Inc.: Rez Interior Stain No. 77-302.

3. Sherwin-Williams: Wood Classics A49-200.

B. Non-Masking Penetrating Stain:

1. Sherwin-Williams: Sherwood S64.

C. Alkyd Polyurethane Varnish:

1. Benjamin Moore and Company: Benwood Polyurethane Finishes No.424 (Flat), 435 (Satin), and 428 (Gloss).
2. PPG Industries, Inc.: Rez Polyurethane Varnish No. 77-9 (Satin), 77-5 (Gloss).
3. Sherwin-Williams: Wood Classics Polyurethane Varnish A67 Series.
4. Minwax® Wipe-On Poly.

D. Semi-Transparent Stain:

1. Benjamin Moore and Company: Benjamin Moore Alkyd Semi-Transparent Stain No. 328
2. PPG Industries, Inc.: Rez Stain Wood Preservative & Water Repellant Stain No. 77-860.
3. Sherwin-Williams: WoodScapes Semi-Transparent Stain A15T5.

E. Spar Varnish:

1. Benjamin Moore and Company: Impervo 440 Spar Varnish.
2. PPG Industries, Inc.: Rez Spar Varnish No. 77-10.
3. Sherwin-Williams: Helmsman /Minwax Spar Varnish.

2.06 ACCESSORY MATERIALS

A. Muriatic acid, mildewcide, TSP (tri-sodium phosphate), acidic-detergent, zinc sulfate, sodium metasilicate, and solvent: Commercially available, non-damaging to surface being cleaned; as specified in PDCA Specification Manual; acceptable to coating manufacturer.

B. Metal Conditioner: Proprietary phosphoric acid based, etching type solution; acceptable to coating manufacturer.

C. Rust Inhibitor: Water containing 0.32 percent of sodium nitrite and 1.28 percent by weight of secondary ammonium phosphate (dibasic); or water containing 0.2 percent by weight of chromic acid or sodium chromate or sodium dichromate or potassium dichromate.

D. Spackling compound, putty, plastic wood filler, liquid de-glosser, latex patching plaster, latex base filler, thinners, and other materials not specifically indicated but required to achieve finishes specified: Pure, of highest commercial quality, compatible with coatings and acceptable to coating manufacturer.

E. Do not use products of different manufacturers in combination.

2.07 CONCRETE FLOOR SEALER (SC)

A. Manufacturers

1. H & C Concrete Sealer Wet – Look Water Based (Basis of Design)
2. Substitutions: Per Section 01 61 00 – Product Requirements.

B. Products

1. 100% Clear Acrylic Sealer
2. Slip Resistant Additive
    a. H & C Shark Grip

C. Installation: Per manufacturer's instructions.

2.08 CONCRETE WALL SEALER

A. Manufacturers:

1. Sika Corporation: Sikagard 62 Epoxy Coating
    a. 2-component, 100% solids, moisture-tolerant epoxy resin
    b. High-build, protective, dampproofing and waterproofing vapor- barrier system
2. Substitutions: Per Section 01 61 00 – Product Requirements.

2.09 BLOCK FILLER

A. Manufacturers

1. Sherwin Williams, Prep Rite.
2. Substitutions: Per Section 01 61 00 – Product Requirements.

2.10 MIXING

A. Use factory prepared colors matching approved samples. Site tinting will not be permitted.

B. Thoroughly mix and stir coatings before use to ensure homogeneous dispersion of ingredients. Prior to application, blend multiple containers of same material and color by pouring from one container to another several times to ensure uniform consistency, color, and smoothness.

C. Mix only in clean mixing pails of material recommended by manufacturer to avoid contamination.

D. Remove film which may form on surface of material in containers and strain material before using. Stir frequently during use to maintain pigments in suspension. Do not stir film into material.

E. Apply coatings of consistency recommended by manufacturer. Thin only within recommended limits using thinners approved by coating manufacturer.

2.11 COLORS AND FINISHES

A. Refer to the Painting & Coating Schedule at the end of this Section and also on the Project Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 70 00 - Execution Requirements: Coordination and project conditions.

B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of substrates using recently calibrated electronic moisture meter. Do not apply coatings if moisture content of surfaces exceeds lesser of percentages listed below or those required by coating manufacturer. If excess moisture content exists and cannot be reduced, obtain written approval of coating manufacturer before application of coatings.

1. Gypsum board and gypsum plaster: 17 percent.

2. Architectural woodwork, trim, cabinets, and casework: 10 percent; measure with resistance-type meter in accordance with ASTM D4442.

3. Common board and dimension lumber: 12 percent; measure with resistance-type meter in accordance with ASTM D4442.

4. Masonry, concrete, CMU, and Portland cement plaster: 17 percent for solvent reduced coatings. Test concrete floors in accordance with ASTM D4263.

5. Canvas and cotton insulation coverings: 12 percent max.

6. Concrete Floors: 8 percent.

3.02 PREPARATION

A. Protect completed construction from damage. Furnish drop cloths, shields, and protective methods to prevent spray, splatter, or droppings from disfiguring other surfaces.

B. Remove surface hardware, mechanical diffusers, escutcheons, registers, electrical plates, light fixture trim, fittings, fastenings and similar items prior to preparing surfaces for finishing. Provide surface-applied protective masking for non-removable items. Carefully store removed items for reinstallation.

C. Remove mildew by scrubbing with mildewcide. Rinse thoroughly with clean water and allow surface to dry completely.

D. Before beginning application of coatings, ensure surfaces are clean, dry, and free of dirt, dust, rust or rust scale, oil, grease, mold, mildew, algae, efflorescence, release agents, or any other foreign material which could adversely affect coating adhesion or finished appearance.

E. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt,

and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

F. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

G. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.03 SURFACE PREPARATION FOR NEW WORK

A. General:

1. Correct minor defects.

2. Remove temporary labels, wrappings, and protective coverings from surfaces to be coated.

3. Seal stains, marks, and other imperfections which may bleed through surface finishes.

B. Aluminum:

1. Clean in accordance with SSPC SP1 "Solvent Cleaning".

2. Apply etching type primer.

C. Concrete:

1. Prior to application of coatings, allow surfaces to cure minimum 60 days.

2. Remove dirt, scale, powder, laitance, and bond breakers by light sandblasting to minimum 1.5 mil profile.

3. Remove oil and grease with solution of TSP; rinse well.

4. Remove stains caused by weathering or corroding metals with solution of sodium metasilicate applied after thoroughly wetting surface with potable water; allow to dry.

5. Fill cracks and voids with compatible filler.

6. Brush-off blast floors to lightly abrade surface without entirely removing surface or exposing underlying aggregate.

D. Gypsum Board:

1. Fill remaining cracks, depressions, holes and other irregularities with spackling compound.

2. Sand rough or high spots left by joint cement or spackling compound without damaging paper face.

3. Remove dust by wiping with damp cloths and vacuuming.

E. Masonry:

1. Prior to application of coatings, allow surfaces to cure minimum 28 days.
2. Remove dirt, scale, loose mortar, efflorescence, and powder by wire brushing or by other approved methods.
3. Remove oil and grease with solution of TSP, rinse, and allow to dry.
4. Remove stains caused by weathering or corroding metals with solution of sodium metasilicate applied after thoroughly wetting surface with potable water; allow to dry.
5. Wash and neutralize surfaces as recommended by coating manufacturer, rinse, and allow to dry.

F. Existing and New Plaster (or stucco) :

1. Allow surfaces to cure and dry completely prior to application of coatings; minimum of 28 days.
2. Remove dirt, efflorescence, scale, loose sand, and powder by wire brushing or by other approved methods.
3. Remove oil and grease with solution of TSP, rinse, and allow to dry.
4. Wash portland cement plaster to receive solvent reducible coatings with zinc sulfate solution, rinse, and allow to dry.
5. Wash gypsum plaster to receive solvent reducible coatings with acidic-detergent, rinse and allow to dry.
6. Fill hairline cracks, small holes and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces.

G. Steel - Uncoated:

1. Remove weld spatter by chipping or grinding.
2. Clean interior and weather protected steel in accordance with SSPC SP2 "Hand Tool Cleaning" and SP3 "Power Tool Cleaning". Clean areas of excessive corrosion or scale in accordance with SSPC SP7 "Brush-Off Blast Cleaning".
3. Clean exterior steel permanently exposed to elements in accordance with SSPC SP6 "Commercial Blast Cleaning".
4. Apply metal conditioner to bare surfaces in accordance with manufacturer's recommendations, paying particular attention to abrasions, welds, bolts, and nuts. Allow to set as recommended by solution manufacturer. Rinse with clean water with rust inhibitor mixed with water or applied immediately following rinse. Allow to dry.
5. Prime coat immediately.

H. Steel - Prime Coated:

1. Remove loose primer and rust to feather-edge at adjacent sound primer by cleaning in accordance with SSPC SP2 "Hand Tool Cleaning" and SP3 "Power Tool Cleaning".

2. Apply metal conditioner to abrasions, welds, bolts, and nuts in accordance with manufacturer's recommendations. Allow to set as recommended by manufacturer. Rinse with clean water with rust inhibitor mixed with water or applied immediately following rinse. Allow to dry.

3. Prime coat bare areas immediately.

I. Steel - Galvanized:

1. Remove white rust by cleaning in accordance with SSPC SP2 "Hand Tool Cleaning" and SP3 "Power Tool Cleaning". Exercise care not to remove galvanizing.

2. Pretreat surfaces to receive solvent reducible coatings immediately.

J. Wood - Opaque Finish:

1. Remove excess residue from knots, pitch streaks, cracks, open joints, and sappy spots. Remove or seal over grade stamp markings.

2. Sand wood surfaces and edges smooth. Remove dust after each sanding.

3. Apply compatible stain sealer to knots, pitch and resinous sapwood before applying prime coat. Do not apply shellac to exterior surfaces, or under latex or urethane finishes.

4. After primer is dry and before second coat, countersink nails and fill nail holes, cracks, open joints and other defects with putty or plastic wood filler.

K. Wood - Transparent Finish:

1. Remove excess residue from knots, pitch streaks, cracks, open joints, and sappy spots. Ensure exposed fasteners are countersunk.

2. Sand wood surfaces and edges smooth. Remove dust after each sanding.

3. After stain is dry and before sanding sealers are applied, fill nail holes, cracks, open joints and other defects with putty or plastic wood filler.

4. Tint fillers to match stain and finish coatings. Work fillers well into and perpendicular to grain before set. Wipe excess from surface.

3.04 SURFACE PREPARATION OF PREVIOUSLY COATED SURFACES

A. General:

1. Remove cracked and deteriorated sealants and calking.

2. Remove chalk deposits and loose, blistered, peeling, scaling, or crazed finish to bare base material or sound substrate by scraping and sanding.

3. Wash surfaces with solution of TSP to remove wax, oil, grease, and other foreign material; rinse, and allow to dry. Exercise caution that TSP solution does not soften existing coating.

4. Abrade glossy surfaces by sanding or wiping with liquid de-glosser.

5. Remove mildew as specified above.

6. Test compatibility of existing coatings by applying new coating to small, inconspicuous area. If new coatings lift or blister existing coatings, request recommendation from Architect.

7. Apply specified primer to surfaces scheduled to receive coatings.

B. Concrete, Masonry, and Portland Cement Plaster:

1. Fill cracks and voids with latex base filler.

2. Apply masonry conditioner to masonry surfaces in accordance with manufacturer's instructions.

3. Apply primer over bare surfaces and filler material.

C. Gypsum Wallboard and Gypsum Plaster:

1. Fill cracks and voids with spackling compound.

2. Apply primer over bare surfaces and newly applied texture coatings.

D. Metal:

1. Remove rust from surfaces to bare metal in accordance with SSPC SP6 "Commercial Blast Cleaning".

2. Exercise care not to remove galvanizing.

3. Complete preparation as specified for new work.

E. Wood:

1. Fill cracks, crevices and nail holes with putty or wood filler.

2. Apply primer over bare surfaces and filler material.

3.05 APPLICATION

A. General Requirements:

1. Coat all surfaces specified, scheduled, illustrated, and otherwise exposed unless specifically noted otherwise.

2. Apply coatings of type, color, and sheen as scheduled.

3. Use application materials, equipment, and techniques as recommended by coating manufacturer and best suited for substrate and type of material being applied.

4. Do not apply finishes to surfaces that are improperly prepared.

5. Number of coats specified are minimum number acceptable.
6. Apply coating systems to total dry film thickness scheduled. Apply material at not less than manufacturer's recommended spreading rate. Do not exceed maximum single coat thickness recommended by coating manufacturer. Do not double-back with spray equipment building up film thickness of two coats in one pass.
7. Ensure that edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent of flat surfaces.
8. Finish edges of coatings adjoining other materials or colors sharp and clean, without overlapping.

B. Prime Coats:

1. Apply initial coat to surfaces as soon as practical after preparation and before subsequent surface deterioration.
2. Backprime exterior woodwork with specified primer.
3. Backprime interior woodwork scheduled to receive transparent finish with gloss varnish reduced 25 percent with mineral spirits.
4. Apply primer to wood and metal sash before field glazing.

C. Intermediate and Top Coats:

1. Allow previously applied coat to dry before next coat is applied.
2. Sand and dust lightly between coats as recommended by coating manufacturer.
3. Apply each coat to achieve uniform finish, color, appearance, and coverage free of brush and roller marks, runs, misses, visible laps or shadows, hazing, bubbles, pin holes, or other defects.
4. If stains, undercoats, or other conditions show through final topcoat, correct defects and apply additional topcoats until coating film is of uniform finish, color, and appearance.

D. Finish Matching:

1. Finish closets same as adjoining rooms, unless otherwise specified.
2. Finish tops, bottoms, and edges of doors same as door faces. Apply sanding sealer to cut-outs. When faces are different colors, finish edges of doors to match space from which they are visible when door is in partly open position.
3. Finish other surfaces not specifically mentioned to match adjoining surfaces.

E. Mechanical and Electrical Items:

1. Refer to Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 - Heating, Ventilating, and Air Conditioning, and Division 26 - Electrical for schedule of color coding and identification banding of equipment, ductwork, piping, and conduit. Color code equipment, piping, conduit and exposed ductwork in accordance with requirements indicated.

2. Prior to finishing mechanical and electrical items, remove louvers, grilles, covers, and access panels and finish separately. Replace when dry.

3. Paint interior surfaces of ducts, and heating cabinets that are visible or reflective behind grilles and registers with one coat of flat black paint.

4. Finish dampers visible behind grilles and registers to match surface finish.

5. Paint both sides and edges of plywood equipment backboards before installing equipment.

6. Do not apply coatings over name plates, tags, or other equipment identification.

F. Reinstall trim, fittings, and other items removed for finishing.

3.06 FIELD QUALITY CONTROL

A. General: Comply with requirements of Section 01 40 00.

B. Periodically test film thickness of each coat with wet film gage to ensure coatings are being applied to proper thickness.

C. Request review of each applied coat by Architect before application of successive coats. Only reviewed coats will be considered in determining number of coats applied.

D. Immediately prior to Substantial Completion, perform detailed inspection of painted surfaces and repair or refinish abraded, stained, or otherwise disfigured surfaces.

E. Testing: Owner reserves right to employ independent testing agency to verify acceptability of substrates and conformance of coating materials to specified requirements; and to test coating quality and dry film thickness.

F. If test results show that material does not comply with specified requirements, remove noncomplying coatings, recoat with acceptable material, and pay costs of additional testing to ensure compliance.

3.07 CLEANING

A. Promptly remove spilled, splashed, or spattered coatings. Clean spots, oil, and other soiling from finished surfaces using cleaning agents and methods which will not damage materials.

B. If completed construction is damaged beyond normal cleaning or repair by painting operations, replace damaged items at no additional cost to Owner.

C. Maintain premises and storage areas free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

D. Collect waste, cloths, and material which may constitute fire hazards and place in closed metal containers; remove from site daily along with empty containers.

3.08 PROTECTION

A. Protect finished work in accordance with Section 01 70 00.

B. Protect work of other trades against damage from coating activities. Correct damage by cleaning, repairing, replacing, and recoating as acceptable to Architect.

C. Provide "Wet Paint" signs and other methods to protect newly coated surfaces. Remove when directed or when no longer needed.

3.09 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

A. Exposed surfaces of lintels, Hollow metal frames units, and miscellaneous exposed steel construction.

3.10 SCHEDULE - EXTERIOR COATING SYSTEMS

A. Metal Surfaces:

1. Non-Ferrous Metals and Zinc-Coated (Galvanized) Steel

a. System Latex Finish:

Sheen: Semi-Gloss.

Prime Coat: Galvanized Primer at 2.0 mils.

Under Coat: Industrial Acrylic at 3.0 mils.

Top Coat: Industrial Acrylic at 3.0 mils.

System DFT: 8.0 mils.

2. Ferrous Metals – Uncoated:

a. System Latex Finish:

Sheen: Semi-Gloss.

Prime Coat: Alkyd-Phenolic Primer at 2.5 mils.

Under Coat: Industrial Acrylic at 2.5 mils.

Top Coat: Industrial Acrylic at 2.5 mils.

System DFT: 7.5 mils.

3. Ferrous Metals - Previously Coated:

a. Coating System Latex Finish:

Sheen: Semi-Gloss.

Prime Coat: Touch-up existing with compatible primer.

Under Coat: Industrial Acrylic at 2.5 mils.

Top Coat: Industrial Acrylic at 2.5 mils.

System DFT: 5.0 mils (excluding existing and touch-up primer).

3.11 SCHEDULE - INTERIOR COATING SYSTEMS

A. Concrete and Masonry Surfaces

1. Concrete Masonry Units:

a. System Latex Finish:

Sheen: Satin.

Prime Coat: Interior Block Filler at 11.0 mils.

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 3.0 mils (excluding primer).

b. System Alkyd Finish:

Sheen: Satin.

Prime Coat: Interior Block Filler at 11.0 mils.

Under Coat: Interior Alkyd Enamel at 1.7 mils.

Top Coat: Interior Alkyd Enamel at 1.7 mils.

System DFT: 3.4 mils (excluding primer).

2. Metal Surfaces:

a. Non-Ferrous Metals and Zinc-Coated (Galvanized) Steel:

i. System Latex Finish:

Sheen: Satin.

Prime Coat: Galvanized Primer at 2.0 mils.

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 5.0 mils

b. Exposed Interior Structural Steel - Uncoated:

i. System Latex Finish:

Sheen: Satin.

Prime Coat: Waterbased Ferrous Metal Primer

Under Coat: Waterbased Polyurethane Acrylic at 1.5 mils.

Top Coat: Polyurethane Clear Coat at 1.5 mils.

System DFT: 5.0 mils.

c. Ferrous Metals - Uncoated:

i. System Latex Finish:

Sheen: Satin.

Prime Coat: Acrylic Latex Ferrous Metal Primer

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 6.0 mils.

d. Ferrous Metals - Previously Coated and intumescent fireproofing:

i. System Latex Finish:

Sheen: Satin.

Prime Coat: Acrylic Latex Ferrous Metal Primer

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 3.0 mils (excluding existing and touch-up primer).

3. Gypsum Surfaces:

a. Gypsum Board:

i. System Flat Latex Finish at ceilings:

Sheen: Flat

Prime Coat: Latex Primer at 1.0 mils.

Under Coat: Interior Latex Flat Paint at 1.4 mils.

Top Coat: Interior Latex Flat Paint at 1.4 mils.

System DFT: 3.8 mils.

ii. System Latex Finish at Walls:

Sheen: Eggshell.

Prime Coat: Latex Primer at 1.0 mils.

Under Coat: Interior Latex Enamel at 1.4 mils.

Top Coat: Interior Latex Enamel at 1.4 mils.

System DFT: 3.8 mils.

iii. System Water Based Epoxy at Toilet Rooms:

Sheen: Satin.

Prime Coat: Latex Primer at 1.0 mils.

Under Coat: Water Based Epoxy at 2.5 mils.

Top Coat: Water Based Epoxy 2.5 mils.

System DFT: 6 mils.

4. Wood Surfaces:

a. Painted Wood Panels and Trim:

i. System Opaque Latex Paint Finish:

Sheen: Semi-Gloss.

Prime Coat: Alkyd Enamel Undercoater at 2.0 mils.

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 5.0 mils.

3.12 PAINT COLORS

A. Exterior Surfaces: Selected by Architect - Verify.

B. Interior Surfaces: Selected by Architect - Verify.

END OF SECTION 09 90 00

SECTION 09 90 02
HIGH PERFORMANCE PAINTING AND COATING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for providing high performance painting and coating. Includes preparation, cleaning, protection, application and materials for areas that require high performance painting and coating systems, including, but not limited to,

B. Related Sections Include:

1. Division 1.
2. Division 3 – Concrete.
3. Division 5 – Metals.
4. Section 09 06 00 – Schedule for Finishes.
5. Section 09 90 00 – Painting and Coating.
6. Division 40 – Process Integration.
7. Division 41 – Material Processing and Handling.
8. Division 43 – Process Gas and Liquid Handling Equipment.
9. Division 46 – Water and Wastewater Process Equipment.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
2. ANSI/ASTM D16 – Standard Terminology for Paint, Related Coatings, Materials, and Applications.
3. Environmental Protection Agency (EPA).
4. Occupational Safety and Health Act (OSHA).
5. Current Joint Standards for the Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers International (NACE).
6. Ten States Standards – 54.5 Piping Code.

1.03 DEFINITIONS

A. Conform to ANSI/ATSM D16 for interpretation of terms used in this Section.

1.04 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00. Indicate each material and cross-referenced specified coating, finish system, and application. Identify each material by manufacturer’s catalog number and general classification.

B. Provide Product data on all Products including manufacturer’s technical information, label analysis, and instructions for handling, mixing, storing, and applying each coating material. Submit manufacturer's application instructions under provisions of Section 01 33 00.

C. Provide a paint system data sheet for each coating system, including all components for providing a complete system. Components include surface preparation, primer, intermediate coats, and finish coats.

D. Provide paint manufacturers certification that proposed coating systems meet specified performance requirements.

E. Submit five (5) full color sample sheets illustrating available colors for each scheduled surface finish Product. During the shop drawing review process, Engineer and Owner will select color choices for surfaces to be coated. Submit samples under provisions of Section 01 33 00.

F. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible for each instance.

G. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details

1.05 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing quality paints and finish products with minimum ten (10) years experience.

B. Applicator: Minimum 10 years' experience in application of specified products.

C. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.

2. Perform surface preparation and painting in accordance with recommendations of the following:

a. Paint manufacturer's instructions.

b. SSPC PA 3, Guide to Safety in Paint Applications.

c. Federal, state, and local agencies having jurisdiction.

D. Maintain examples of SSPC visual standards on Site.

E. Provide wet and dry paint thickness measurement instrument on Site.

F. Specification language for High Performance Coating Systems is based on Sherwin Williams and Tnemec.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivered materials shall be stockpiled and stored at locations approved by the OWNER until required for installation. Materials shall be transported, delivered, stored and handled in accordance with manufacturer's instructions and the requirements of Section 01 61 00.

B. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

C. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

D. Take precautionary measures to prevent fire hazards and spontaneous combustion. Removal all paint waste from site daily and dispose of properly.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable Montana Department of Public Health and Human Services, Montana Department of Environmental Quality, Environmental Protection Agency, Occupational Health and Safety Administration, Ten States Standards, Uniform Building Code, and Uniform Fire Codes and Standards.

B. All Products that may come into contact with water intended for use in a Public Water System shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.08 THREE YEAR PERFORMANCE GUARANTEE

A. The quality of both materials and workmanship for the installed coating materials (as defined in this specification) will be the sole responsibility of the Contractor. It is hereby guaranteed that should the coating material delaminate, chip, peel, blister, crack or otherwise fail due to improper surface preparation, improper mixing and application or curing of coating materials or protection of the coating work during cure by the Contractor or due to lack of material quality on the part of the material manufacturer, the Contractor shall repair or replace the damaged or failing coating to Owner’s satisfaction at no cost to Owner and at Owner’s convenience. Should the existing substrate below the coating fail causing such coating failure, except if related to inadequate surface preparation or coating quality causing substrate corrosion, the Contractor shall not be held liable.

B. It is further understood by the Contractor that any incompatibility with or error in formulation of the coating materials used on this project, which results in a coating failure, will be a financial matter strictly between the Coating System Manufacturer and the Contractor. The business responsibility and financial accountability for such a material related failure to Owner would remain solely with the Contractor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Mechanical Protective Coating Systems: All paint materials selected for coating systems for each type of system shall be the product of one manufacturer.

Acceptable manufacturers are:

1. Tnemec
2. Sherwin-Williams (SW) Industrial Coating.

B. Coating systems of all manufacturers must be in accordance with the Contract Documents. Being named as a manufacturer does not eliminate their responsibility of providing coating systems in compliance with the following specification section. Any deviations without sufficient evidence proving equal or superior quality shall be rejected without further review or comment.

C. Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

D. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions and obtain approval from Engineer before bidding in accordance with Division 01.

2.02 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.

2.04 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Mix only components specified and furnished by paint manufacturer.
5. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.

B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment Specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.

2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

1. Ductile Iron Pipe:

a. Use SSPC standards as a guide for desired prepared surface.

b. Follow recommendations of pipe and coating manufacturers for means and methods to achieve SSPC-equivalent surface.

c. The surface preparation and application of the primer and finish coats shall be performed by pipe manufacturer.

d. For high performance (epoxy) coatings, follow additional recommendations of pipe and coating manufacturers.

e. Prior to blast cleaning, grind smooth surface imperfections, including, but not limited to delaminating metal or oxide layers.

f. For conventional (alkyd) coatings, clean asphalt varnish supplied on pipe and apply one full coat of a tar stop before two full coats of the color coats specified.

2.06 SPARES

A. Furnish small quantity kits (minimum one gallon per product per color) for touchup painting and for painting other small areas.

PART 3 - EXECUTION

3.01 GENERAL

A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.

C. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.

2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

D. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

A. Factory Finished Items:

1. Review other Section in which primers are provided to ensure compatibility of the total system for various substrates

2. Schedule inspection with Engineer before repairing damaged factory finished items delivered to Site.

3. Test shop applied primer and finishes for compatibility with subsequent coating and covering materials.

4. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

A. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.

2. Refer to coating systems for degree of abrasive blasting required.

3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

B. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:

a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.

b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.

c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, sing power-assisted hand tools.

d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.

e. SP 6, Commercial Blast Cleaning: Removal of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter of at least 66⅔% of a sample unit area at least 3"x3" (9 in^2). Light shadows, slight streaks, or minor discolorations caused by stains of rust, mill scale, or previously applied coating in less than 33⅓% of the unit area is acceptable.

f. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, mill scale or previously applied coatings.

2. The words "solvent cleaning", "hand tool cleaning", "wire brushing", and "blast cleaning" or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC specification.

3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.
4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
    a. Prepare such that there is:
        i. No undercutting or reverse ridges on weld bead.
        ii. No weld spatter on or adjacent to weld or any area to be painted.
        iii. No sharp peaks or ridges along weld bead.
    b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
    a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
    b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
    c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
    a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
    b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
    c. Use only dry blast cleaning methods.
    d. Do not reuse abrasive, except for designed recyclable systems.
    e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.

10. Post-Blast Cleaning and Other Cleaning Requirements:

    a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.

    b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

C. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.

2. Remove oil and grease by wiping or scrubbing surface with suitable solvent, rag, and brush. Use clean solvent and clean rag for final wiping to avoid contaminating surface.

3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.

D. Concrete Surface Preparation:

1. Do not begin until 30 days after concrete has been placed.

2. Meet requirements of SSPC SP 13.

3. Voids and other defects that are at or near the surface shall be exposed during surface preparation.

4. Brush-off blast clean to remove loose concrete and laitance, and provide a tooth for binding. Upon approval by Engineer, surface may be cleaned by acid etching method. Approval is subject to producing desired profile as listed in section 3.07 below based on the required coating system. If not specifying, surface profile to the equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces shall not be allowed. Coordinate blast clean with buffing requirements provided in Division 03 – Concrete.

5. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.

6. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.

7. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

E. Plastic and FRP Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.

2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

F. Masonry Surface Preparation:

1. Complete and cure masonry construction for 14 days or more before starting surface preparation work.

2. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods.

3. Clean masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:

a. Nonmetallic fiber brushes and commercial muriatic acid followed by rinsing with clean water.

b. Brush-off blasting.

c. Water blasting.

4. Do not damage masonry mortar joints or adjacent surfaces.

5. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.

6. Masonry Surfaces to be Painted: Uniform texture and free of surface imperfections that would impair intended finished appearance.

7. Masonry Surfaces to be Clear Coated: Free of discolorations and uniform in texture after cleaning.

G. Gypsum Board Surface Preparation: Typically, new gypsum board surfaces need no special preparation before painting.

1. Surface Finish: Dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.

2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.

3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.

4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.

5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Acid Etching:

1. After precleaning, spread the following solution by brush or plastic sprinkling can: One part commercial muriatic acid reduced by two parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.
2. Application:
    a. Rate: Approximately 2 gallons per 100 square feet.
    b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained. c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
    c. After bubbling subsides (10 minutes), hose down remaining slurry with high pressure clean water.
    d. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.
    e. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.
3. Ensure surface is completely dry before application of coating.
4. Apply acid etching to obtain a “grit sandpaper” surface profile. If not, repeat treatment.

C. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. In general, all new and modified existing structures and items, whether specifically mentioned or not, shall be painted, unless otherwise noted. Do not paint exterior concrete surfaces, unless specifically indicated.
    a. Interior concrete walls, floors, and ceilings within the WRRF.
    b. Interior concrete block masonry within the WRRF and modified concrete block masonry.

c. All new doors and frames and window frames (if required) within the expanded WRRF.

d. Exterior, interior, and submerged ferrous metals.

e. Miscellaneous other metals.

f. Paint shop-primed equipment and fixtures.

g. Unfinished louvers, grilles, covers, and access panels on mechanical and electrical components; paint separately.

h. Prime and paint all surfaces located behind, underneath, or otherwise previously obstructed by items that have been removed or demolished.

i. Prime and paint all surfaces of new process pipes (non-insulated and insulated), electrical conduit, valves, fittings, meters, boxes, hangers, brackets, collars, and supports, except where items are prefinished.

j. Paint discharge heads and base plates of all new or modified pumps.

k. Prime and paint all new unburied exterior steel, ductile, galvanized, or PVC piping.

l. Replace identification markings on mechanical or electrical equipment when painted accidentally.

m. Paint exposed conduit and electrical equipment occurring in finished areas.

n. Paint both sides and edges of plywood backboards for electrical equipment before installing equipment.

o. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

p. All surfaces not specifically excluded

2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.

3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.

4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.

5. Apply a stripe coat of an approved coating system via brush or roller to all weld seams, edges, angles, and mechanical connections. Stripe coat shall be applied after primer coat and be of a different color than the primer coat.

6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
7. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
8. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
9. Keep paint materials sealed when not in use.
10. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Galvanized Metal, Copper, and Nonferrous Metal Alloys:

1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.
2. Prepare surface and apply primer in accordance with Protective Coating System specification.
3. Apply intermediate and finish coats of the coating system appropriate for the exposure.

C. Porous Surfaces, Such As Concrete and Masonry:

1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.
2. Prime Coat: May be thinned to provide maximum penetration and adhesion.
    a. Type and Amount of Thinning: Determined by paint manufacturer and dependent on surface density and type of coating.
3. Surface Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of coating.

D. Film Thickness and Coverage:

1. Number of Coats:
    a. Minimum required without regard to coating thickness.
    b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
    a. Follow coating manufacturer's recommendations.
    b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.

3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
    a. Perform with properly calibrated instruments.
    b. Recoat and repair as necessary for compliance with Specification.
    c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 HIGH PERFORMANCE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Refer to Section 09 06 00, Schedules for Finishes for specific surfaces to be coated in accordance with the following Systems 1 thru 14. Additional requirements are included in the Piping Schedule.

B. In the event of discrepancies or omissions in the following, defer to Section 09 06 00 and request clarification from Engineer before starting work in question.

C. System No. 1: Ferrous Metals, Exterior Exposure, Non immersion

System Type	Surface Preparation	Primer Coat 3.0 to 5.0 DFT	Intermediate Coat,	Topcoat, 2.0 to 3.0 DFT
Polyamidoamine	SSPC SP6	Tnemec Series N69, SW Macropoxy 646	NA	Tnemec Series 1075, SW Macropoxy 646

1. Use two coat coating system for maintenance coating of structural steel. For non-immersed, non-corrosive environments.
2. Use on new exposed metal surfaces, located outside of structures, including structural steel, metal decking, guard posts, hollow metal doors and frames, piping, equipment, and miscellaneous metal.

D. System No. 2: Ferrous Metals, Interior Exposure, Non-Immersion

System Type	Surface Preparation	Primer Coat, 3.0 to 5.0 DFT	Intermediate Coat	Topcoat, 3.0 to 5.0 DFT

Polyamidoamine	SSPC SP10	Tnemec Series N69, SW Duraplate 235 MPE	NA	Tnemec Series N69, SW Duraplate 235 MPE

1. For interior two coat coating system for coating of carbon steel and other ferrous metals. For non-immersed, mildly corrosive splash/spill and wet environments.
2. For exposed metal surfaces located inside of structures, exposed to weather or in a highly humid atmosphere, such as pipe galleries, and for the specific surfaces:
    a. Exterior surfaces of process pipes. All pipes scheduled to be insulated must be painted prior to providing insulation.
    b. Exterior surface of valves.
    c. Exterior surface of equipment not shop finished, per manufacturer's instructions.
    d. Pipe supports, excluding stainless and galvanized steel.

E. System No. 3: Ferrous Metals, Immersion

System Type	Surface Preparation	Primer Coat, 3.0 to 5.0 DFT	Intermediate Coat	Topcoat, 3.0 to 5.0 DFT
Polyamidoamine	SSPC SP10	Tnemec Series N69, SW Duraplate 235 MPE	NA	Tnemec Series N69, SW Duraplate 235 MPE

1. Verify with manufacturer a compatible field tie-in coat for shop primed items where applicable.
2. Use on immersed metal surfaces, metal surfaces above maximum liquid surface that are a part of immersed equipment, concrete embedded surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, structural steel, and interior surfaces of steel piping noted in the Piping Schedule.
    a. Submerged, partially submerged and splash area equipment not shop finished.

F. System No. 4: Ferrous Metals, Immersion and/or H2S Exposure

System Type	Surface Preparation	Primer Coat	Intermediate Coat	Topcoat

Moisture Cured Polyurethane	SSPC SP10	Tnemec Series 1 Omnithane (2.5 to 3.5 mils DFT), Or SW Equivalent	Tnemec Series 446 (8.0 to 10.0 mils DFT), Or SW Equivalent	Tnemec Series 446 (8.0 to 10.0 mils DFT), Or SW Equivalent
Reinforced Amine Epoxy	SSPC SP 10	SW Corothane 1-GalvaPac(3.0 to 4.0 mils DFT), Or Tnemec Equivalent	SW Sher-Glass FF (8.0 to 20.0 mils DFT), Or Tnemec Equivalent	SW Sher- Glass FF (8.0 to 20.0 mils DFT), Or Tnemec Equivalent

1. Use on immersed metal surface, metal surfaces above maximum liquid surface that are a part of immersed equipment, concrete embedded surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, and interior surfaces of steel piping noted in the Piping Schedule in areas with potential H2S exposure. These areas include:

    a. Surfaces as defined in the Project Drawings.

G. System No. 5: Metals, Buried and/or Below Grade

System Type	Surface Preparation	Primer Coat, 3.0 to 5.0 mils DFT	Intermediate Coat	Topcoat, 16.0 to 20.0 mil DFT
Coal tar epoxy	SSPC SP10	Tnemec Series N69 (optional), SW Macropoxy 646 (optional)	NA	Tnemec Series 46H- 413, SW Hi-Mil Sher-Tar Epoxy

1. For steel pipe and fittings, follow AWWA C209 and AWWA C214 with double outer wrap.
2. For buried, below grade portions of metal items, except buried stainless steel, and the follow specific surfaces:

    a. Fasteners and accessories for buried piping

    b. Buried Valves

H. System No. 6: Metals, Concrete Embedded and Encased

System Type	Surface Preparation	Primer Coat	Intermediate Coat, 8.0 to 10.0 mils DFT	Topcoat, 8.0 to 10.0 mils DFT

Coal tar epoxy	SSPC SP6	NA	Tnemec Series 46H-413, SW Hi-Mil Sher-Tar Epoxy	Tnemec Series 46H-413, SW Hi-Mil Sher-Tar Epoxy

1. For concrete embedded and encased surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles.

I. System No. 7: Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning:

System Type	Surface Preparation	Primer Coat, 3.0 to 5.0 mils DFT	Intermediate Coat	Topcoat, 3.0 to 5.0 mils DFT
Epoxy Polyamide	Abrasive brush blast to create a 1.5 mil profile	Tnemec Series N69, SW Macropoxy 646	NA	Tnemec Series N69, SW Macropoxy 646

1. Verify with manufacturer compatibility as a field tie-in coat.
2. Use on the following items or areas:
    a. Galvanized surfaces requiring painting.
    b. After application of System No. 7, apply System No. 1 topcoat for exterior, System No. 3 topcoat for interior.

J. System No. 8: PVC, CPVC and FRP, Exposed

System Type	Surface Preparation	Primer Coat, 2.0 to 4.0 mils DFT	Intermediate Coat	Topcoat, 2.0 to 4.0 mils DFT
Polyamidoamine	Scarify	Tnemec Series N69, SW Macropoxy 646	NA	Tnemec Series N69, SW Macropoxy 646

1. For use on exposed PVC, CPVC, and FRP.

K. System No. 9: Insulated Pipe, Exposed:

System Type	Surface Preparation	Primer Coat, 2.0 to 3.0 mils DFT	Intermediate Coat	Topcoat, 2.0 to 3.0 mils DFT
Acrylic	Clean and Dry	Tnemec Series 6, SW DTM primer/finish	NA	Tnemec Series 6, SW DTM primer/finish

1. For use on insulation of insulated pipes.
2. Coat pipes with appropriate coating system before insulating.

L. System No. 10: Concrete, Precast and Poured in Place, Immersion, Light H2S

Vapor:

System Type	Surface Preparation	Primer Coat 3.0 to 5.0 mils DFT	Intermediate Coat	Topcoat, 3.0 to 5.0 mils DFT
Polyamidoamine	SSPC SP13, ICRI CSP2-3	Tnemec Series N69, SW Duraplate 235 MPE	NA	Tnemec Series N69, SW Duraplate 235 MPE

1. Prep surface in accordance with concrete surface preparation.
2. For use on walls and ceilings in areas with light to moderate H2S exposure.
3. Scheduled for:
    a. Biosolids metering and wasting structures: entire interior wall and floor;
    b. New manholes on Drain to Main Lift Station: entire interior wall and floor;
    c. Biosolids Blower Building: blower room floor;

M. System No. 11: Concrete, Precast and Poured in Place, Immersion, High H2S

System Type	Surface Preparation	Primer Coat	Intermediate Coat	Topcoat
Fiber reinforced MP Epoxy	SSPC SP13, ICRI CSP4-6	Tnemec Series 218 MortarClad (60 to 65 mils DFT), SW Core- Cote FRE (60 to 120 mils DFT)	NA	Tnemec Series 436 (50 to 80 mils DFT), SW Core- Cote SC (15 to 20 mils DFT)

1. Prep surface in accordance with concrete surface preparation.
2. For use on walls and ceilings in areas with moderate to heavy H2S exposure.
3. Schedule for:
    a. Influent channel: entire interior wall and floor;
    b. Grit channel and chute: entire wall, floor and underside;
    c. Grit chamber: top of wall to one foot below minimum water surface elevation and underside of cover slab;
    d. Interior of feedwell: top of wall to one foot below minimum water surface elevation and ceilings.
    e. Grit building sewer manholes (GBMH-1 and GBMH-2): entire interior wall and floor;

f. Reactor basins: top of wall to one foot below minimum water surface elevation and underside of and underside of walkways/gutters;

g. Sludge Buffer Basins: entire interior wall and floor;

h. Water Level Correction Basin: entire interior wall and floor;

i. Effluent gutters: entire interior wall and floor;

j. Side Stream Lift Station: entire interior wall and floor;

k. UV channel: entire interior wall and floor;

l. NPW basin: top of wall to one foot below minimum water surface elevation and underside of cover slab.

m. Biosolids Basin Level Control Structure: entire interior walls and floor;

N. System No. 12: Concrete, Precast and Poured in Place, Immersion

System Type	Surface Preparation	Primer Coat 3.0 to 5.0 mils DFT	Intermediate Coat	Topcoat, 3.0 to 5.0 mils DFT
Polyamidoamine	SSPC SP13 ICRI CSP2-4	Tnemec Series N69, SW Duraplate 235 MPE	NA	Tnemec Series N69, SW Duraplate 235 MPE

1. Prep surface in accordance with concrete surface preparation.

2. For use on floors, walls and ceilings in areas with no to minimal H2S exposure.

3. Scheduled for:

   a. Surfaces as specified in the Project Drawings:

   b. Grit Building: floor of chemical feed room;

   c. Main Process Building: floor of UV room;

   d. Main Process Building: floor of pump room;

   e. Outfall Manholes

O. System No. 13, Concrete Secondary Containment, Chemical Resistant Paint

System Type	Surface Preparation	Primer Coat, Per Mnfr recommendation	Intermediate Coat Per Mnfr recommendation	Topcoat Per Mnfr recommendation
Epoxy	SSPC SP13 ICRI CSP5	Tnemec Series 218, SW Corobond 300 resurfacer	Tnemec Series 104, SW Sherglass FF	Tnemec Series 104 SW Sherglass FF

1. Prep surface in accordance with concrete surface preparation.
2. For use on floors and walls in secondary containment basins.
3. Scheduled for:
    a. Main Lift Station floor;
    b. Blower Building floor;
    c. All secondary containment basins.

P. System No. 14 Aluminum and Dissimilar Metal Insulation:

System Type	Surface Preparation	Primer Coat	Intermediate Coat	Topcoat
Bituminous	Abrasive blast to provide a 3.0 mil angular anchor profile	NA	NA	Tnemec Series 46H- 413, SW Hi-Mil Sher-Tar Epoxy

1. Use on aluminum surfaces embedded or in contact with concrete and for dissimilar metal insulation.

3.08 COLORS

A. Provide as designated herein and shown in Piping Schedule or as selected by Engineer.

B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

C. Equipment Colors:

1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
2. Paint non-submerged portions of equipment the same color as the piping it serves, except as itemized below:
    a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
    b. Fire Protection Equipment and Apparatus: OSHA Red.
    c. Radiation Hazards: OSHA Purple.
    d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

D. Pipe Identification Painting:

1. Color code non-submerged metal piping, except electrical conduit. Paint fittings and valves the same color as pipe, except equipment isolation valves.

2. Pipe Color Coding: In accordance with the “Recommended Standards For Wastewater Facilities” and as specified in Section 40 27 60 – Process Identification.

3. On exposed stainless steel piping, apply color 24 inches in length along pipe axis at connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along piping not greater than 9 feet on center.

4. Pipe Supports: Painted light gray, as approved by Engineer.

3.09 FIELD QUALITY CONTROL

E. Sharp edges, weld spatter, scab marks, and other imperfections shall be ground to a smooth radius or removed and re-blasted before coating application.

F. Testing:

1. Thickness and Continuity Testing:

a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.

b. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

G. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer.

1. Provide additional staging and lighting as requested by Engineer.

H. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.

2. Evidence of runs, bridges, holidays, laps, or other imperfections is cause for rejection.

3. Repair defects in accordance with written recommendations of coating manufacturer.

I. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.

2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.

3. Apply finish coats, including touchup and damage-repair coats in a manner

that will present a uniform texture and color-matched appearance.

3.10 MANUFACTURER'S SERVICES

J. In accordance with Section 01 40 00, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:

1. On first day of application of any coating system.
2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
3. As required to resolve field problems attributable to or associated with manufacturer's product.
4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.11 CLEANUP

K. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

L. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

END OF SECTION 09 90 02

DIVISION 10

MISC SPECIALITIES

SECTION 10 11 01
VISUAL DISPLAY BOARDS

PART 1 - GENERAL

1.01 SYSTEM DESCRIPTION

A. Fixed Dry Erase Magnetic Glass Markerboards

1.02 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

B. Product Data:

1. Submit manufacturer's descriptive literature and product specifications for each product.

2. Include information for factory finishes, accessories, and other required components.

C. Submit following Submittals:

1. Shop Drawings: Provide shop drawings for each type of VSD required.

2. Product Data: Provide technical data for materials specified including MSDS.

3. Samples: Provide Samples to illustrate finish and texture.

4. Manufacturer’s Instructions: Provide Manufacturer’s installation and cleaning instructions.

D. Closeout Submittals:

1. Warranty: Submit a warranty, stating that under normal usage and maintenance, and when installed in accordance with manufacturer’s instructions and recommendations, Claridge glass markerboard writing surfaces are guaranteed for ten (10) years. Guarantee covers replacement of defective boards but does not include cost of removal or reinstallation.

1.03 QUALITY ASSURANCE

A. Operation and Maintenance Data: Submit manufacturer's printed, recommended regular cleaning instructions, stain removal instructions, and surface break-in instructions for markerboards.

B. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.

1.04 HANDLING

A. Comply with requirements of Section 01 60 00.

1.05 SEQUENCING

A. Ensure finishes, including painting, are completed and accepted prior to installation of work of this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Acceptable Manufacturers:

1. Basis of Design: Claridge Products and Equipment, Inc., www.claridgeproducts.com.

2. Or equal product with prior approval by Architect per Section 01 60 00 Product Requirements.

2.02 MATERIALS

A. Glass Markerboards
   1. Glass: ¼ -inch thick, tempered, low-iron, extra clear, safety writing glass with polished edges
   2. Glass Markerboard writing surface: Smooth finish intended for use with dry-erase markers
   3. Sizes:
      a. one unit at 4’ x 4’ (near entry)
      b. two units at 4’ x 8’ (Conference Room, Lab)
   4. Back-Coated Color: Brilliant White.
   5. Backing: Provide steel backing permanently adhered to the back of the glass for magnetic function.

B. Mounting Methods
   1. Invisimount (Z-bar hanger clips) – no visible mounting hardware; concealed hanger mounted to back of board. Full-length, minus 3”, concealed z-bar hanger for the wall. Furnished with 3M Dual Lock™ fasteners to hold bottom of board firmly in place. Z-bar mounting method to pass 500 lb. load test without failure. Designate MGMI (magnetic) or PGBI (non-magnetic)

C. Accessories

D. Provide Optional Marker Caddy and Magnetic Eraser (Magnetic Glass Markerboards only)

PART 3 – EXECUTION

3.01 PROJECT CONDITIONS

A. Interior moisture and temperature should approximate normal occupied conditions.

B. Verify that wall surfaces are true and plumb and are prepared and ready to receive boards.

3.02 INSTALLATION

A. Deliver factory built units completely assembled and of dimensions shown in details and in accordance with manufacturer’s shop drawings as approved by the architect.

B. Follow manufacturer’s instructions for storage and handling of units before installation.

C. Do not install on damp walls or in damp and humid weather without heat in the building.

D. Install level and plumb, keeping perimeter trim straight in accordance with

manufacturer’s recommendations.

3.03 ADJUST AND CLEAN

A. Verify that all accessories are installed as required for each unit.

B. At completion of work, clean surfaces and trim in accordance with manufacturer’s recommendations, leaving all materials ready for use.

END SECTION 10 11 01

SECTION 10 14 00
SIGNS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section covers the work necessary to furnish and install all informational and warning signs and their mounting requirements in the: existing Screen Building; Grit Building; AGS Reactor Basins; Main Process Building; Administration Building; Biosolids Blower Building, and; general treatment plant site. Signs include custom-fabricated informational and warning signs, and illuminated “Exit” signs. Note that signs listed for mounting on chemical bulk tank is to be provided and installed by tankage manufacturer and may be painted or adhesive on tank rather than rigid metal signs – see chemical tank Specifications.

B. Pipe identification lettering and color-coding are not covered by this section; instead see Section 40 27 60 – Process Identification and Division 09 - Coatings.

1.02 SUBMITTALS

A. In addition to the requirements of Section 01 33 00 – Submittal Procedures and 01 40 00 – Quality Requirements, the following documentation shall also be provided for signs, and accompany other required submittals:

1. Scaled drawings and specifications covering materials, mounting fixtures, and locations shall be submitted for each sign in accordance with project submittal requirements.

2. Product samples consisting of a 3" x 3" coupon of sign sheeting complete with proposed lettering shall be provided for each sign style and material to be used.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered to the site clearly labeled with the manufacturer's name, product identification, and lot number where appropriate.

B. Materials shall be protected from damage during transit, handling, storage and installation.

C. Fabricated sign panels shall be delivered with protective poly sheeting adhered to the lettered surface to protect from scratching. Any scratched or otherwise damaged signs shall be replaced by the Contractor.

PART 2 - MATERIALS

2.01 INTERIOR/EXTERIOR INFORMATIONAL & WARNING SIGNS

A. Signs shall be provided with a stainless steel fasteners or adhesives suitable for the substrate at the mounting location. Adhesives shall be removable without permanent damage to the substrate.

B. The sign manufacturer shall verify all sign graphics before fabrications. Signs with typographical or format errors shall not be installed, and replaced.

C. Sign Panels

1. Sign panels shall be composite panels with aluminum face and back, and thermoplastic core. Aluminum faces shall be coated with factory-baked polyester paint. Panels shall be Alucobond Architectural Dibond®, Omega Panel Products Laminators Omega-Bond™, or equal.

2. Panel background color shall be as indicated in the Sign Schedule herein.

3. Sign panels shall be cut to the dimensions shown in the Sign Schedule herein. All panel corners shall be cut to a smooth ¼" radius. Mounting holes shall be neatly drilled and symmetrical with panel geometry. Panel edges, corners, and mounting holes shall be de-burred and smooth.

D. Sign Panel Lettering

1. Sign lettering shall be "Arial Black" font, all capital letters, in the sizes indicated in the Sign Schedule herein.

2. Sign lettering shall be permanently adhered, vinyl lettering, suitable for the sign panel material. Lettering and lettering adhesive for outdoor signs shall be UV protected and suitable for outdoor use without peeling or cracking.

E. Interior/Exterior Sign Schedule

Sign Text	**No. Reqd**	**Location(s)**	**Panel Size (H x W)**	**Letter Height**	**Color**	
					Letters	**Background**
CAUTION – FALL HAZARD WHEN GRIT CHAMBER HATCH IS OPEN! CONFINED SPACE	1	On handrail west of Grit Basin	12" x 18"	2.5" 1.50"	Yellow black	Black red
PLANT INFLUENT FLOW	1	On east wall of Grit Building near influent flow meter	3" x 6"	0.50"	black	white
OPEN FOR GRIT CHAMBER BYPASS	1	Bypass Slide Gate Frame	4" x 5"	0.50"	black	white
REACTOR BASIN #1 INFLUENT	1	South wall Grit Building above Basin #1 influent pipe	9" x 12"	1.50"	black	white
REACTOR BASIN #2 INFLUENT	1	South wall Grit Building above Basin #2 influent pipe	9" x 12"	1.50"	black	white

REACTOR BASIN #3 INFLUENT	1	South wall Grit Building above Basin #3 influent pipe	9" x 12"	1.50"	black	white
FUTURE REACTOR BASIN #4 INFLUENT	1	South wall Grit Building above Basin #4 influent stub-out	9" x 12"	1.00"	black	white
SIDESTREAM LIFT STATION CONTROL PANEL	1	East wall Grit Building near SideStream Lift Station valve gallery	9" x 12"	1.50"	black	white
WET WELL IS CONFINED SPACE – DO NOT ENTER FALL HAZARD WHEN HATCHES ARE OPEN	1	East exterior wall of Grit Building near SideStream Lift Station access hatch	12" x 18"	1.00"	black	red
INFLUENT SPLITTER BOX DRAIN TO MAIN LIFT STATION	1	South interior wall of Grit Building near drain valve	12" x 18"	1.00"	black	white
GRIT PUMP –STARTS WITHOUT WARNING	1	South interior wall of Grit Building near grit pump	9" x 12"	1.00"	black	white
GRIT WASHING ROOM – VERIFY VENTILATION PRIOR TO ENTRY	1	Exterior of access door to grit washing room	6" x 18"	1.00"	black	white
HOIST CONTROLS	1	Near hoist controls in Grit Washing Room	2" x 5"	0.50"	black	white
GRIT WASHER	1	South interior wall of Grit Building near grit pump	4" x 8"	1.00"	black	white
NON-POTABLE WATER – DO NOT DRINK	4	At each NPW demand point in Grit Building	2" x 9"	0.50"	black	white
ALUM FEED PUMP SYSTEM	1	Back wall of feed pump skid	8" x 12"	1.00"	black	white
ALUM STORAGE TANK	1	North side of alum storage tank	8" x 12"	1.00"	black	white
ALUM STORAGE TANK LEVEL (GALLONS)	1	Southeast side of alum storage tank at reverse float indicator	8" x 12"	1.00"	black	white
ALUM STORAGE TANK FILL	1	On north exterior wall of Grit Building above sump	8" x 12"	1.00"	black	white

RESTROOM – ()	1	Outside surface of restroom door	6" x 12"	1.00"	black	white
CAUTION	2	Interior and exterior of Grit Building near chemical sumps	12" x 18"	2.50"	yellow	black
SUMP MAY CONTAIN SPILLED ALUM – PUMP & HANDLE PROPERLY				1.5"	black	yellow
REACTOR BASIN #1	4	On handrail near each corner of Reactor Basin #1	8" x 18"	2.00"	black	white
REACTOR BASIN #2	4	On handrail near each corner of Reactor Basin #2	8" x 18"	2.00"	black	white
REACTOR BASIN #3	4	On handrail near each corner of Reactor Basin #3	8" x 18"	2.00"	black	white
SCUM CONTROL VALVE	12	On handrail near each scum control telescoping valve	5" x 7"	1.00"	black	white
NON-POTABLE WATER – DO NOT DRINK	4	At each NPW demand point in reactor basin area	2" x 9"	0.50"	black	white
TSS SENSING – BASIN (#1, #2 OR #3)	3	Door of each TSS sensing box for basins #1, #2 and #3	2" x 6"	0.50"	black	white
pH SENSING – BASIN (#1, #2 OR #3)	3	Door of each pH sensing box for basins #1, #2 and #3	2" x 6"	0.50"	black	white
ORP SENSING – BASIN (#1, #2 OR #3)	3	Door of each ORP sensing box for basins #1, #2 and #3	2" x 6"	0.50"	black	white
NITRATE SENSING – BASIN (#1, #2 OR #3)	3	Door of each Nitrate sensing box for basins #1, #2 and #3	2" x 8"	0.50"	black	white
DISSOLVED OXYGEN SENSING – BASIN (#1, #2 OR #3)	3	Door of each DO sensing box for basins #1, #2 and #3	2" x 8"	0.50"	black	white
PROCESS CONTROL SENSING – BASIN (#1, #2 OR #3)	3	Door of each 5-probe sensing box for basins #1, #2 and #3	2" x 8"	0.50"	black	white
FILTRAX PROBE – BASIN (#1, #2 OR #3)	3	Door of each 5-probe sensing box for basins #1, #2 and #3	2" x 8"	0.50"	black	white

LEVEL SENSING – BASIN (#1, #2 OR #3)	3	Door of each level sensing float box for basins #1, #2 and #3	2" x 8"	0.50"	black	white
CAUTION – STAIRS FOR USE BY AUTHORIZED PERSONS ONLY – USE HANDRAIL AT ALL TIMES	3	At exterior entry for all reactor basin access stairs	12" x 18"	2.5" 1.50"	Yellow black	Black red
CAUTION – WALKING SURFACE MAY BE SLIPPERY – USE HANDRAIL AT ALL TIMES	6	On handrail - evenly distributed through reactor basin walkway system	12" x 18"	2.5" 1.50"	Yellow black	Black red
BIOSOLIDS MIXING PUMP #1	1	On pump #1 motor local control box	6" x 12"	1.00"	black	white
BIOSOLIDS MIXING PUMP #2	1	On pump #2 motor local control box	6" x 12"	1.00"	black	white
BIOSOLIDS MIXING SYSTEM PANEL	1	On pump control panel in MPB	2" x 6"	0.50"	black	white
SBB #1 PUMP	2	On each pump for SBB #1 motor housing	4" x 6"	1.00"	black	white
SBB #2 PUMP	2	On each pump for SBB #2 motor housing	4" x 6"	1.00"	black	white
WATER LEVEL CORRECTION PUMP	1	On sludge pump #1 motor housing	8" x 12"	1.00"	black	white
WASTE SLUDGE – BASIN (#1, #2 OR #3)	3	Above sludge wasting valve for basins #1, #2 and #3	6" x 9"	1.00"	black	white
WATER LEVEL CORRECTION – BASIN (#1, #2 OR #3)	3	Above water level correction valve for basins #1, #2 and #3	8" x 12"	1.00"	black	white
BASIN (#1, #2 or #3) SUMP -	3	On 12" suction pipe between tee and valve	2" x 5"	0.50"	black	white
WASTE GRANULES – 10 psi PRESSURE	1	On handrail near sludge waste quick-connect	2" x 9"	0.50"	black	white
UV BYPASS	1	On UV influent box near slide gate	2" x 10"	1.00"	black	white
N.P.W. PUMP FLOW	1	W wall at flowmeter display	2.0" x 4"	0.50"	black	white

N.P.W. PRESSURE CONTROLLER 24 VDC	1	W wall at power supply for NPW	3"x 8"	0.50"	black	white
PLANT EFFLUENT FLOW	1	W wall at flowmeter display	3" x 8"	0.50"	black	white
EFFLUENT AUTOMATIC SAMPLER	1	S wall at sampler	3" x 8"	0.50"	black	white
UV CONTROL PANEL	1	On north wall of UV room near UV control panel	3" x 8"	0.50"	black	white
CEILING FAN CONTROL	2	Near ceiling fan controls in Grit Building and Main Process Building	3" x 6"	0.50"	black	white
VENTILATION CONTROL	3	Near ventilation controls in Grit Building, Main Process Building, UV Room and Electrical Room	3" x 6"	0.50"	black	white
BRIDGE CRANE CONTROLS	1	Near bridge crane controls in Main Process Building	3" x 6"	0.50"	black	white
ELECTRICAL ROOM	1	On east side of door between UV and Electrical Room	4" x 12"	1.00"	black	white
UV ROOM	1	On west side of door between UV and Electrical Room	2" x 10"	1.00"	black	white
RESTROOM – (🚹 | 🚺)	1	Outside surface of Main Process Building restroom door	6" x 12"	1.00"	black	white
NON-POTABLE WATER – DO NOT DRINK	4	At each NPW demand point in Screen Building area	2" x 9"	0.50"	black	white
NON-POTABLE WATER – DO NOT DRINK	4	At each NPW demand point in Main Process Building area	2" x 9"	0.50"	black	white
SLUDGE BUFFER BASIN #1	1	On handrail east of Sludge Buffer Basin #1	12" x 18"	2.00"	black	white

SLUDGE BUFFER BASIN #2	1	On handrail east of Sludge Buffer Basin #2	12" x 18"	2.00"	black	white
WATER LEVEL CORRECTION BASIN	1	On handrail east of Water Level Correction Basin	12" x 18"	2.00"	black	white
BIOSOLIDS BASIN AERATION CONTROLS	1	On front of blower control panel in Biosolids Blower Building	3" x 9"	0.50"	black	white
CONFERENCE ROOM	1	West side of Admin. Bldg Conference room door	4" x 12"	1.00"	black	white
RESTROOM – ()	1	Outside surface of Administration Building restroom door	6" x 12"	1.00"	black	white
CONTROL ROOM	2	South side of Admin. Bldg. Laboratory room door and west side of Control Room west door	4" x 10"	1.00"	black	white
LABORATORY	1	North side of Admin. Bldg. Laboratory room door	2.5" x 12"	1.00"	black	white
WORK ROOM	1	East side of Admin. Bldg. Control Room west door	4" x 6"	1.00"	black	white
OFFICE	1	South side of Admin. Bldg. Office door	2.5" x 8"	1.00"	black	white
CAUTION	1	Outside Main Process Building exterior south wall at east side of overhead door.	18" x 20"	2.50"	yellow	black
WATCH FOR OBSTRUCTIONS WHEN BACKING UP (Backward print to view in mirror)				1.5"	black	yellow
CAUTION	1	Outside Administration Building exterior south wall at west side of overhead door.	18" x 20"	2.50"	yellow	black
WATCH FOR OBSTRUCTIONS WHEN BACKING UP (Backward print to view in mirror)				1.5"	black	yellow
KEEP OUT	14	Every 50' on west side	12" x 16"	2.50"	yellow	black

WASTEWATER TREATMENT FACILTY		of new perimeter fence		1.5"	black	yellow

2.02 EXTERIOR SIGN BLADES

A. All guide signs must meet the requirements of the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).

B. Flat Aluminum Blades shall be:

1. manufactured using a domestic aluminum alloy, Type 6061-T6 or better quality;
2. a minimum thickness of 0.080";
3. treated with an Alodine 1200E or similar anodizing process in order to enhance longevity.

C. Reflective Sheeting shall be:

1. High Intensity Prismatic (HIP) sheeting. Any "Or Equal" vendor materials must be approved by OWNER prior to any manufacturing or installations. Currently approved materials are:
   - 3M #3930, HIP Silver/White
   - 3M #3931, HIP Yellow
   - 3M #3932 HIP Red
   - 3M #4083 HIP Yellow Green
2. Type I Engineering Grade reflective sheeting unless otherwise noted;
3. Type III high-intensity prismatic reflective sheeting on all warning signs: pedestrian/trail crossings; No Motor Vehicles; Stop; etc.
4. Foreground colors, lettering, symbols and designs shall be:
   i. Type I Engineering Grade reflective sheeting cut-out unless otherwise noted;
   ii. Affixed to the sign surface with high-durability, pressure-sensitive adhesive.
5. All ElectroCut (E/C) Film shall use the following approved materials. Any "Or Equal" vendor materials must be approved by OWNER prior to use.
   - 3M #1177C E/C Green
   - 3M #1179C E/C Brown
   - 3M #1172C E/C Red
   - 3M #1178C E/C Black
   - 3M #1175C E/C Blue
6. All warning and informational blades shall be made using the appropriate colors for pedestrian crossing signs; share the road signs, directional arrows (3M #3931 HIP Yellow background) and 3M #1178C Black for lettering and symbols.

2.04 LUMINOUS EXIT SIGNS

A. Exit signs shall be photoluminescent, glow-in-the-dark signs requiring no wiring or batteries. Signs shall be wall-mounted, single-sided, 8" tall by 15" wide. Exit signs shall be UL 944 and C-UL U.S. listed. Signs shall be non-radioactive. Signs construction shall be anodized 0.035" steel and plastic, with pop-out arrows for customized direction indication. Signs shall be furnished with mounting brackets. Body color shall be red.

B. Exit signs shall be Lab Safety Supply #159179R, manufactured by Glo Brite, or equal.

PART 3 - EXECUTION

3.01 MOUNTING

A. Mount all custom-fabricated, lettered signs at 5'-0" A.F.F., unless otherwise noted in Sign Schedule or on the Drawings. Where dual signs are required at same location, place lower sign 4'-0" A.F.F. and place upper sign directly above, separated by 3". If specified sign locations conflict with other wall-mounted items, adjust locations to nearest clear wall space.

B. Mount all signs using either galvanized steel or stainless steel fasteners. Any signs located within 3'-0" of chemical storage tanks or chemical feed pumps must be mounted with stainless steel fasteners and hardware.

C. Mount Exit signs in accordance with manufacturer’s recommendations, and NFPA standards.

D. Mount signs level, and centered on walls or next to identified objects shown in the Sign Schedule and the Drawings.

END OF SECTION 10 14 00

SECTION 10 28 00
TOILET BATH AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Accessories for restroom (grab bars, toilet paper dispenser, mirror, hooks, paper towel dispenser).

1.02 REFERENCE STANDARDS

A. 36 CFR 1191 -Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; current edition; (ADA Standards for Accessible Design).

B. ASTM A123/A123M- Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.

C. ASTM A653/A653M- Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

D. ASTM A666- Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.

E. ASTM C1036- Standard Specification for Flat Glass; 2011e1.

F. ASTM C1503- Standard Specification for Silvered Flat Glass Mirror; 2008.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

A. See Section 01 33 00, SUBMITTALS, for submittal procedures.

B. Manufacturer’s Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Basis of Design: Bradley Corporation: www.bradleycorp.com.
2. American Specialties, Inc: www.americanspecialties.com.
3. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
4. Or approved equal.

B. All items of each type to be made by the same Manufacturer.

2.02 MATERIALS

A. Accessories-General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Mirror Glass: Float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

C. Adhesive: Two component epoxy type, waterproof.

D. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.

2.03 FINISHES

A. Stainless Steel: No. 4 satin brushed finish.

2.04 TOILET ROOM ACCESSORIES

A. Toilet Paper Dispenser: Duel Roll, surface mounted bracket type. (3 total).

1. Product: 5234 manufactured by Bradley.

B. Grab Bars: Stainless steel, safety grip finish.

1. Heavy Duty Grab Bars: 1 each at 42”, 36”, 18” (at 2 toilet rooms = 6 total bars)

2. Push/Pull Point Load: 250 pound-force, minimum.

3. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar. Peened finish.

4. Products:

a. Bradley 812 Series.

C. Mirrors:

1. 24” x 36”. Bradley 781 Series channel frame. (2 total- 1 at each new toilet room.)

2. 18” x 36” Bradely 781 Series channel frame (1 total – old toilet room)

D. Hooks: Bradley 9119-81 (3 total – one each toilet room)

E. Paper Towel and Soap Dispenser by owner.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation. Conduct meeting with architect to verify location of all accessories.

3.02 INSTALLATION

A. Install accessories in accordance with Manufacturers' instructions.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights and Locations: As required by accessibility regulations See ADA Sheet.

3.03 FIELD TESTING

A. After.

END OF SECTION 10 28 00

SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire extinguishers;
2. Extinguisher cabinets;
3. Accessories.

B. Related Requirements:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 01 33 00 - Submittal Procedures: For administrative and procedural requirements for processing of submittals during the construction phase.
3. Section 01 77 00 - Closeout Procedures: For administrative and procedural requirements for completion of the Work.
4. Section 09 90 00 – Painting and Coating: For field painting of cabinets.

1.02 REFERENCES

A. Reference Standards:

1. National Fire Protection Association (NFPA):
   a. NFPA 10-2010, Standard for Portable Fire Extinguishers: For criteria covering installations for Class A, B, C, D, and K hazards as well as the selection, inspection, maintenance, recharging, and testing of portable fire extinguishing equipment.
   b. NFPA 70-2011, National Electrical Code.
2. Underwriters Laboratories, Inc. (UL)
3. United States Code (USC):
   a. Americans with Disabilities Act of 1990, as amended by the ADA Amendments Act of 2008: For restrictions relating to cabinet projections in corridors.

1.03 ACTION SUBMITTALS

A. Submit in accordance with Section 01 33 00

1. Product Data:
   a. Cabinets: Materials description for fire extinguisher cabinets include roughing-

in dimensions, details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, door style and materials.

b. Extinguishers: Materials description for fire extinguishers; include ratings and classifications.

c. Installation instructions for each product specified.

2. Shop Drawings:

a. Small-scale plans showing locations of fire extinguisher cabinets and individual fire extinguishers.

b. Schedules showing each type of cabinet and extinguisher to ensure proper fit and function.

c. Indicate installation procedures and accessories required for a complete installation.

1.04 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.05 QUALITY ASSURANCE

A. Comply with standards referenced in Article 1.02 - REFERENCES.

B. Provide fire extinguishers, cabinets and accessories produced by a single manufacturer.

C. Provide fire extinguishers of type approved by UL, State Fire Marshal's Office, and local regulatory agencies, if any.

D. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle fire protection specialties and related materials using means and methods that will prevent damage, deterioration, or loss.

1. Deliver components in manufacturer's original packaging, properly labeled for identification.

1.07 WARRANTY

A. All Fire Extinguishers carry a five (5) year warranty after date of shipment against defects in materials or workmanship. Manufacturer will replace or repair any product found defective within this period. No other warranty expressed or implied is valid. Manufacturer’s warranty, terms and conditions apply in all cases.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Multi-Purpose Chemical Type: Extinguisher unit containing a fluidized and siliconized

mono ammonium phosphate powder; nonconductive and nontoxic.

1. Construction: Heavy duty steel cylinder with metal valve and siphon tube, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin and upright squeeze grip.
2. Finish: Factory powder-coated; Red.
3. Effectiveness (Rating): Class A, B, and C fires.
4. Model Identification and UL Rating: Cosmic 10E, Multi-Purpose ABC, 10 lb. – 4A-80BC UL Rating

B. Accessories:

1. Mounting Brackets:
2. Standard Brackets: Provide manufacturer's standard steel bracket, designed to secure fire extinguisher to wall or within cabinet, of sizes required for the fire extinguisher specified above.

2.02 EXTINGUISHER CABINETS

A. Cabinet with Steel Trim and Door: Ambassador Series, Model 1013F10.

1. Cabinet Style: Surface Mounted
2. Components:
   a. Tub: Cold-rolled steel.
      i. Finish: Factory-applied powder coat paint finish.
         - Standard Color: White.

B. Door Style:

1. Style F: Full glazing with pull handle
2. Glazing : Clear tempered glass

C. Additional Options:

1. Wall Signs and Cabinet Lettering:
   a. Mounting Direction: [Vertical] [Horizontal].
   b. Type: Decal lettering:
   c. Text: FIRE EXTINGUISHER; vertical
   d. Color(s): black & white
2. Door Hardware:
   a. "Futura" embossed "FIRE" handle: red

2.03 SOURCE QUALITY CONTROL

A. Ship extinguishers to the Project site fully charged.

B. Obtain Fire Extinguishers and Fire Extinguisher Brackets from same manufacturer to ensure compatibility.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine walls and partitions for suitable blocking where surface mounted cabinets will be installed.

1. Notify the Contractor in writing of conditions detrimental to proper and timely completion of the installation.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install cabinets in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

1. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer=s instructions.

B. Wall Signs:

1. Location: Where shown or directed.

2. Apply on walls after field painting is completed and has been accepted.

C. Cabinet Lettering:

1. Location: Face of door framing

2. Apply lettering on field-painted fire protection cabinets after painting is complete and has been accepted.

3.03 FIELD QUALITY CONTROL

A. Ensure that each extinguisher is fully charged, and that inspection of each extinguisher has been performed, as evidenced by the National Association of Fire Equipment Distributors certification tag, just prior to turnover.

3.04 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to

E. factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

F. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 16

SECTION 10 51 13
METAL LOCKERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Heavy-Duty Steel Lockers.

1.02 RELATED SECTIONS

A. Section 06100 – Rough Carpentry: Wood ground and furring for anchoring lockers.

1.03 SUBMITTALS

A. Comply with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's product data and installation instructions.

C. Shop Drawings: Submit manufacturer's shop drawings, indicating construction, materials, dimensions, door frames, doors, handles, locks, ventilation, options, accessories, finish, locker layout, anchoring, and installation details.

D. Samples: Submit manufacturer's standard color samples.

E. Warranty: Submit manufacturer's standard warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Lyon Workspace Products, PO Box 671, Aurora, Illinois 60507. Toll Free (800) 323-0082. Phone (630) 892-8941. Fax (800) 367-6681. Web Site www.lyonworkspace.com. Email: lyon@lyonworkspace.com.

B. Substitution: Comply with provisions of Divisions 1.

2.02 STEEL LOCKERS

A. Model: Standard Steel Locker (Cat. No. 5092).

B. Style: Single tier, 1 wide

C. Locker Size: 18 inches wide by 18 inches deep by 78 inches high.

D. Locker Configuration: One row of 4 lockers. See drawings.

E. Construction: All welded. Pre-assembled, with seams and joints welded.

F. Material:

1. Steel: ASTM A 653, galvannealed steel.
2. Bolts: Zinc plated or other comparable rust-retardant treatment.

G. Body:

1. 16-gauge steel.
2. Flanged to give double thickness of metal at seams, joints, and corners.
3. Back: 18-gauge steel.

H. Door Frame:

1. 16-gauge formed-steel channels.
2. Vertical Members: Additional flange to form continuous door strike.
3. Corners: Lapped and welded into rigid assembly.
4. Bottom Cross Members: Tang at each end that fits through slot in rear flange of upright frame member to prevent twisting out of alignment.
5. Top and Bottom Cross Members: Provide support for front edge of locker top and bottom.

I. Doors:

1. 1-piece, 14-gauge steel.
2. Single, Double, and Triple-Tier Locker Doors: Both vertical edges formed into channel-shaped formation. Top and bottom flanged at 90-degree angle.
3. Multiple-Tier Locker Doors: Hinge side formed into channel-shaped formation with other 3 sides flanged at 90-degree angle.

J. Ventilation:

1. Single-Tier Lockers:
    a. Six 6-inch louvers top and bottom.

K. Hinges:

1. Height: Minimum of 2 inches.
2. Type: 0.050-inch thick steel, 5-knuckle, full-loop hinge forming double thickness on each leaf.
3. Attachment: Set hinges in slot in door and frame and projection welded to frame and securely attached to door.
4. Hinge Pin: Spun over at ends to resist removal.
5. Single-Tier Lockers, 48 Inches and Higher: 3 hinges.

6. Mounting: Right-hand side of door.

L. Locking Device:

1. Single-Point Latch.
2. Doors: Provided with lock hole filler to permit use of built-in key or combination lock.

M. Handles:

1. Single-Point Latching System:
    a. Single, double, triple, and multiple-tier lockers.
    b. 4-1/8 inches wide by 6-1/16 inches high by 1-1/4 inches deep.
    c. Flush-front appearance.
    d. Operators with no moving parts
    e. Pan reinforcements, 18 gauge.

N. Shelves:

1. Single-tier lockers.
2. 1 shelf, approximately 9 inches below top.
3. Single sheet, 16-gauge steel.
4. Flanged on 4 sides.
5. Safety Front Flange: Double flanged with second bend turned 45 degrees.
6. Attachment: Minimum of 2 points through each side flange.

O. Coat Hooks and Rods for Single Tier Lockers:

1. 5/8-inch diameter, galvanized steel coat rod attached with bracket and 2 bolts at each end.
2. 3 single-prong wall hooks.
3. Steel rod stock with ball points for snag-free use.
4. Attachment: 2 bolts.
5. Finish: Zinc-plated or comparable rust-retardant treatment.

P. Free-Standing Lockers:

1. 6-inch legs.
2. Provide front and end closed bases.

2.03 ACCESSORIES

A. Number Plates:

1. Aluminum.

2. Size: 2-3/4 inches wide by 1 inch high.
3. Numbers: Clearly etched numbers a minimum of 3/8 inch high. (number lockers 1 through 4)
4. Attachment: Attach in pre-punched holes near top of doors

B. Locks: Built-in combination.

C. Tops: Flat.

D. Bottoms: Painted galvannealed steel, 16 gauge.

E. Floor Anchoring: Anchor lockers to floor in accordance with manufacturer's instructions.

F. Closures and Fillers:
1. Top closures, closure strips, front expansion fillers, and corner fillers.
2. Fill spaces between 2 lockers or between lockers and walls as required for proper fit.

G. End Panels:
1. End Cover Panels: 14-gauge steel, construction bolt heads exposed at perimeter.
2. End Finishing Panels: 16-gauge steel, no bolt heads exposed.

H. Recess Trim:
1. End and Top Recess Trim for Lockers to be Placed in Wall Recesses: 18-gauge formed steel with 2-3/4-inch wide face. Bolted to locker frames.
2. Top Recess Trim: Approximately 5'-0" lengths with formed splice cap to cover joints and to hold top recess trim in alignment.
3. End Recess Trim: 2-3/4 inches higher than lockers and lap over ends of top recess trim for neat joint at top of corners.

2.04 FINISH

A. General: Factory apply finish in accordance with manufacturer's instructions.

B. Color: Dove Gray

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive lockers. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

A. Install lockers in accordance with manufacturer's instructions at locations indicated on the Drawings.

B. Install lockers plumb, level, square, rigid, with flush installation.

C. Use manufacturer's supplied hardware.

D. Anchoring: Securely anchor lockers to floors and walls as require to prevent tipping.

E. Metal Fillers: Install metal fillers where required using concealed fasteners.

F. Joints: Provide flush hairline joints against adjacent surfaces

G. Number Plates: Attach number plates to face of doors level with 2 aluminum rivets. Attach in sequence, left to right when facing lockers; 1, 2, 3, 4

H. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

I. Remove and replace defective or damaged components that cannot be successfully repaired as determined by Architect.

3.03 ADJUSTING

A. Adjust doors, locks, and operating hardware to function properly and for smooth operation without binding.

3.04 CLEANING

A. Clean surfaces promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that could damage finish.

3.05 PROTECTION

A. Protect installed lockers from damage during construction.

END OF SECTION 10 51 13

DIVISION 12

FURNISHINGS

SECTION 12 32 16
MANUFACTURED PLASTIC LAMINATE CASEWORK

PART 1 - GENERAL

1.01 SUMMARY

A. This section covers the work necessary to furnish and install the following:

1. Plastic laminate casework.
2. Chemical resistant, plastic laminate countertops.
3. Accessory items and components as specified herein.

1.02 CASEWORK DESIGN

A. Door and Drawer Design: Square edged flush overlay design with 1/8" reveals between door to door, door to drawer, drawer to drawer; 1/16" vertical reveal between doors/drawers and cabinet ends.

B. Cabinet end panels exposed to view after installation must have finished ends. All end panels not exposed to view after installation will be as listed under "concealed".

C. Cabinets to be rigid, self-supporting design for use in assembly or as a single stand alone unit if furnished with exposed finished ends. Suspended units are without sub base.

D. Flush Interiors: Surface mounted bottoms and offsets caused by front face frames, which interfere with ease of cleaning, are not acceptable.

E. Joinery: 32mm doweled joinery system glued, clamped and screwed. Dowels are to be hardwood, laterally fluted with chamfered ends and a minimum diameter of 8mm. Spacing of dowels to meet AWI and WI standards. Exposed shoulder pocket screw fasteners are not acceptable.

F. Casework width and depth dimension are to be within plus or minus 1/2" from what is shown on the drawings. Manufacturer’s standards are not acceptable unless able to meet these requirements.

G. See plan and elevation drawings for general scope and design.

1.03 SUBMITTALS

A. Shop Drawings: Provide large scale plans and elevations of casework, cross sections, rough in and anchor placements, tolerances and clearances. Indicate relationship of units to windows, doors, surrounding walls and other building components. Include cabinet dimensions, configurations, construction details, joint details, attachment details, and rough in details as required.

B. Single Source: Casework to be manufactured and furnished by a single laboratory furniture company.

C. Manufacturer’s Qualifications: Modern plant with proper tools, dies, fixtures and skilled production staff to produce high quality laboratory casework and shall meet the following

minimum requirements:

1. Minimum of ten years experience in the manufacturing of plastic laminate laboratory casework.
2. Ten installations of equal or larger size.
3. Must be financially stable.
4. Must be a member of AWI and be QCP certified.

D. Installer Qualifications: Certified by the manufacturer.

1.04 PROJECT CONDITIONS

A. Plastic laminate product shall not be delivered and installed until the following conditions are met:

1. Windows and doors are installed and the building is secure and weather tight.
2. Ceiling, overhead ductwork and lighting are installed.
3. All painting is completed and floor tile is installed.
4. Interior building temperature to be between 65 and 80 degree F, and ambient relative humidity maintained between 25% and 55% prior to delivery, and during and after installation. Frequent and/or excessive changes in temperature and/or humidity levels during casework installation, or once casework is installed, must be avoided to prevent damage to materials.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Schedule delivery so rooms are sufficiently complete that material can be installed immediately following delivery.

B. Casework: Protect finished surfaces from soiling or damage during handling and installation.

C. Work Surfaces: Protect throughout the construction period.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Design, materials, construction and finish of casework as specified represents the minimum acceptable standard of quality for plastic laminate laboratory casework. Specifications are based on product by Fisher Hamilton L.L.C., 1316-18th Street, Two Rivers, WI 54241.

B. Casework furnished by all qualified interested manufacturers will be considered, provided the necessary changes required are submitted in conformance with the requirements of the GENERAL CONDITIONS and Division 1, GENERAL REQUIREMENTS. The Contractor shall bear all costs for necessary changes for a complete and satisfactory installation.

C. Warranty: Provide manufacturer's one-year warranty against defects in materials and

workmanship.

2.02 CASEWORK MATERIALS

A. Definition of cabinet components by surface visibility:

1. EXPOSED SURFACES

a. Surfaces visible when drawers and solid doors are closed.

b. Portions of cabinet visible when fixed appliances are installed.

2. SEMI-EXPOSED SURFACES

a. Surfaces visible when doors or drawers are open.

b. Bottoms of cabinets 30" or more above finished floor.

c. Interior surfaces of open units.

d. Tops of cabinets less than 78" above finished floor, or are visible from an upper floor or staircase after installation.

3. CONCEALED SURFACES

a. Surfaces not normally visible after installation.

b. Bottoms of cabinets less than 30" above finished floor.

c. Tops of cabinets over 78" above finished floor which are not visible from an upper level.

d. Stretchers, blocking, components concealed by drawers.

B. Vertical exterior laminate: GP28 vertical surface grade high-pressure laminate for exposed cabinet and table frame surfaces.

1. Color: as selected from casework manufacturer's standard range of solid colors & patterns from WilsonArt.maximum

C. Countertop laminate: Postform grade high-pressure **Chemsurf** laminate.

1. Color: as selected from manufacturer's standard range of solid colors from WilsonArt.

D. Particleboard Core: Grade 1-M-3, 48-53 lb. density, 3/4" thick except 1" for shelves.

E. Backing Sheet: White thermofused melamine except high-pressure cabinet liner to be used to balance a plastic laminate surfaced panel.

F. Plywood: 7-ply, 3/4" veneer core plywood with cross and face plies bonded with Type II water resistant glue; drawers are 9-ply, 1/2".

G. Hardboard: Wood fibers and resin binders formed under heat and pressure.

H. Glue: Laminating; Type II water resistant; assembly; Type III water resistant.

I. Edgebanding: PVC T-molding.

2.03 CASEWORK FABRICATION

A. Base Units:

1. Cabinet ends: 3/4" thick particleboard (for both exposed and concealed ends) with banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and four rows of shelf support holes. Ends to be balanced panel construction.
2. Subtop panel: Full depth, 3/4" particleboard, banded front edge, and balanced surfaces, doweled to both end panels. None on sink units.
3. Intermediate rails: All drawer units 36" or wider shall come standard with one intermediate front rail to act as a spacer between end panels.
4. Toe base: Separate, veneer core plywood, factory attached.
5. Bottoms: 3/4" thick particleboard, set flush and joined to cabinet end panels with glued 8mm dowels and metal fasteners. Front edge to be banded. Suspended unit bottoms to be 1" thick. Balanced surfaces.
6. Backs: 3/16" thick fused melamine hardboard; suspended units have 3/4" thick particleboard panel, doweled into ends, balanced surfaces;
    a. Cupboard units: One-piece, captured at subtop and bottom.
    b. Drawer units: One-piece full backs in units 36" and over, two-piece behind drawers on units less than 36".
    c. Sink units: Half-height, one-piece hardboard, rabbetted into rear rail for easy removal from inside of cabinet.
7. Vertical dividers in combination cabinets: 1-1/2" thick veneer core plywood panel (frames not permitted) glued and screwed in place, top and bottom with edgebanding on front edge.
8. Security panels: None required.
9. Shelves: 1” thick, thermofused melamine clad particleboard to match interior, PVC banded front edge to match interior color, adjustable on 32mm centers. Depth: Full depth shelf, 17-3/4" deep.
10. Drawer construction: Lock shoulder construction with sub-front, sides and back of 1/2" (12mm) PVC clad particleboard.
11. Bottom: Nominal 1/4" white coated MDF board, inset into all four sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter. Staples are not acceptable.
12. Door and removable drawer front: 3/4" particleboard core with GP28 vertical surface grade high-pressure laminate, 3mm PVC banding.
13. Fillers, kneespace panels, scribes, etc.: Shall be of the same material and finish as adjacent exposed surfaces, 3/4" thick particleboard.
14. Pullboards: 1" thick particleboard with balanced laminated faces. Front to be constructed the same as a drawer front as specified for cabinet face exterior.

Suspension to be 3/4 extension, open roller, 75 lb. dynamic load, with hold open feature and epoxy coated.

15. Knee space table frame: 3/4" particleboard; 3/4" hardwood if drawer cutouts are included.

B. Upper cases:

1. Shall be manufactured with appropriate materials and joinery methods as specified for base units except as noted below.
2. Tops: 1" thick, particleboard with banding on front edge.
3. Bottoms: Upper case: 1" thick, particleboard with banding on front edge.
4. Backs: 1/4" hardboard, thermofused melamine interior, captured in top, bottom and side panels; mounting cleat at top.
5. Shelves: 1” thick, thermofused melamine clad particleboard to match interior, PVC banded on front edge to match interior color, adjustable on 32mm centers.
6. Solid door construction: 3/4" thick particleboard core with 3mm PVC banding on all four edges, balanced construction.

C. Hardware:

1. Drawer suspension, except on files: 3/4 extension, open roller, 100 lb. dynamic load, self-closing epoxy coated.
2. Drawer and hinged door pull: 4" Wire, Black (Powder coat).
3. All pulls are mounted horizontally on drawers and vertically on doors
4. Hinges: Notch for proper fit. 5 knuckle, institutional style, hospital tipped, provide two hinges for doors up to 48" high; three hinges for doors over 48" high, Black (Powder coat).
5. Unit shelf supports: Metal pin and socket.
6. Door catches: Adjustable, spring actuated nylon roller.
7. Elbow catches: Spring type with strike.

D. Countertops with 4" high Back Splash: High-pressure Chemsurf, chemical resistant plastic laminate bonded to particleboard core. Underside to have an applied backer sheet. Provide in as long as practical continuous lengths up to 10'. No joints closer than 24 inches (610 mm) either side of sink cutout, or over knee space area. All cutouts to be properly sealed. Maximum unsupported length of 36".

PART 3 - EXECUTION

3.01 INSTALLATION

A. Casework Installation:

1. Set casework components plumb, square, and straight with no distortion and securely

anchored to building structure. Shim as required using concealed shims.

2. Fasten continuous cabinets together with joints flush, tight and uniform, with alignment of adjacent units within 1/16" tolerance.

3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.

4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8" between top units.

B. Work Surface Installation

1. Where required due to field conditions, scribe or caulk to abutting surfaces.

2. Secure joints in the field, where practicable, in the same manner as in factory, with dowels, adhesive or fasteners recommended by manufacturer.

3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

C. Sink Installation: Sinks shall be set in chemical-resistant sealing compound, secured and supported per manufacturer's recommendations.

D. Accessory Installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.

3.02 ADJUSTING

A. Repair or remove and replace defective work, as directed by Engineer upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.03 CLEANING

A. Broom clean finished casework, touch up as required.

B. Clean materials as recommended by manufacturer.

3.04 PROTECTION OF FINISHED WORK

A. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity.

B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

C. Contractor shall be required to repair or replace any damage to casework occurring before Date of Substantial Completion. Replacement of entire surface due to scratches, dings, dents, etc. may be required and is at the discretion of the architect.

END OF SECTION 12 32 16

DIVISION 22

PLUMBING

SECTION 22 00 00
PLUMBING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section covers the work necessary to furnish and install piping, fixtures, appliances, equipment, and appurtenances for complete and functional plumbing systems as indicated in the Drawings and specified herein.

B. Work included in this section is as follows:

1. Hot and cold water piping systems.
2. Natural gas piping systems.
3. Drainage and vent piping systems and connections
4. Floor drains, cleanouts and bell-ups.
5. Plumbing fixtures and appliances.

1.02 GENERAL

A. Piping and appurtenances provided under these Specifications do not require coating per Section 09 90 00 – PAINTING & COATING, except as specified herein.

B. The Drawings do not show all details of all piping systems, and instead only portray the functionality required. The Contractor shall provide all accessories, adapters, appurtenances and supports to achieve a complete and functional installation. The Contractor shall verify all piping routings and locating dimensions shown for conflicts with other piping or utilities, and shall provide any offsets required to achieve clearance at no additional cost to the Owner. In the event changes to the locations of equipment or piping shown are necessary, the Contractor shall submit such changes in writing to the Engineer before proceeding with such changes.

C. All fixtures and appliances shall be installed in complete accordance with the manufacturer's recommendations and requirements, including structural support and venting.

D. Manufacturers' references are included herein for reference and to establish the required level of quality; "or equal" products may be proposed subject to the requirements for Submittal review.

1.03 CODES, PERMITS AND COMPLIANCE

A. Plumbing work shall be performed in accordance with all applicable codes and ordinances which pertain to such work. In case of conflict between these specifications and any applicable code or ordinance, the latter shall govern. Plumbing work shall conform to the provisions of the current version of the Uniform Plumbing Code.

B. All gas piping shall be installed in accordance with the recommendations of the National

Fire Protection Association (NFPA).

C. Any permits legally required for the work under these Specifications shall be the responsibility of the Contractor to obtain. Costs of such permits and scheduling of any inspections required in conjunction with such permits or associated requirements shall be the responsibility of the Contractor.

D. Completed piping systems shall be tested by the Contractor in accordance with all applicable codes and standards before charging such piping. Natural gas piping test results must comply with all requirements of the gas supplier.

1.04 SUBMITTALS

A. In addition to the requirements of Section 01 33 00 – SUBMITTAL PROCEDURE, the following documentation shall also be provided for this equipment and accompany other required submittals:

1. Fixtures and Appliances – Provide unit weight and manufacturers' support requirements, storage and installation instructions, and operating manual.

2. Pipe Supports – Provide manufacturers' dimensions, load ratings, recommended service conditions and spacing, and types and arrangement of fasteners, including substrate requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Like items of material provided under these Specifications shall be the product of one manufacturer.

2.02 COPPER PIPE, TUBING AND FITTINGS

A. Exposed pipe for building air shall be hard drawn, Type L copper, conforming to ASTM B88, except where otherwise shown and called on the Drawings.

B. Fittings for copper pipe and tubing shall be solder-joint socket pure wrought copper, conforming to ASTM B75 and dimensions conforming to ANSI B16.22. Solder shall be 95-5 wire, lead free, ASTM B32, Alloy Grade 95 TA. Paste flux shall be used with solder, and shall meet Fed. Spec. O-F-506, Type I, Form A.

C. Insulating unions, where required, shall be brass body, dielectric type, with threaded ends, adapted to copper pipe and tubing with solder-by-NPT brass adapters.

2.03 MALLABLE IRON PIPE AND FITTINGS

A. Exposed pipe for natural gas service shall be Schedule 40 black welded steel, meeting the requirements of ASTM A53 Grade B and ANSI/ASME B1.20.1, except piping 1½-inch and smaller shall meet ASTM A106 Grade B. Pipe shall be seamless or electric resistance welded. Gas piping shall be UPC-rated for gas service.

B. Pipe joints may be NPT threaded or welded, conforming to ASTM A-120. All threaded joints shall be sealed with gas-rated thread compound.

C. Fittings shall be Schedule 40 black malleable iron, 150 psi rated, with NPT threading. Fittings shall conform to ASTM A197 and ANSI/ASME B16.3 and B1.20.1. Fittings shall be UL-listed.

2.04 GALVANIZED STEEL PIPE AND FITTINGS

A. Galvanized steel piping for miscellaneous applications as shown and called on the Drawings shall be carbon steel, Schedule 40, meeting ASTM A120, ASTM A53 Grade B, or ASTM A106 Grade B.

B. Galvanized steel pipe fittings and joints shall be threaded. Fittings shall be Schedule 40, galvanized, meeting ASTM A196 or ASTM A47. Fitting dimensions shall conform to ANSI B16.3. Unions shall be 300-pound malleable iron, galvanized, with brass to iron seats.

2.05 PVC PIPE AND FITTINGS

A. Building interior piping for ***drain, waste, and vent*** applications shall be UL-listed. PVC – Drain/Waste/Vent (DWV) Pipe and Fittings

1. DWV pipe and fittings are intended for non-pressure drainage applications where the temperature will not exceed 140°F.
2. DWV pipe shall be IPS Schedule 40 conforming to ASTM D 1785 and ASTM D 2665.
3. DWV pipe and fittings shall be manufactured from PVC compound with minimum cell class of 12454 per ASTM D 1784 and conform with NSF Standard 14.
4. Injection molded fittings shall conform to ASTM D 2665.
5. Fabricated fittings shall conform to ASTM F 1886.

B. Approved Manufacturers:

1. Georg Fischer
2. Charlotte
3. Hayward.
4. Approved equals.

C. Pipe joints shall be socket-type glued joints, except where threaded adapters or unions are shown or needed to connect to fixtures. PVC gluing materials shall conform to pipe and fitting manufacturers' recommendations, and if so recommended, may utilize solvent cement rated for use without primer. Glue shall be tinted to verify application.

D. Pipe fittings shall be Schedule 80 PVC, and recommended by the pipe manufacturer for compatibility with the pipe.

E. For interior cold-water supply applications, use Schedule 40 or Schedule 80 PVC, as indicated in the Drawings. For hot-water applications, use CPVC piping.

2.06 CPVC PIPE AND FITTINGS

A. Hot water pipe, fittings, and valves shall be manufactured from a CPVC compound which meets the requirements of class 23447-B, Type 4, Grade 1 in accordance with ASTM D1784. Compound from which the pipe is produced shall have a design stress rating of 2,000 psi at 23 degrees C, listed by the Plastic Pipe Institute (PPI).

B. Fittings and valves shall meet the requirements of ASTM F439 (schedule 80 socket) or ASTM F437 (schedule 80 threaded).

C. All socket type connections shall be joined with CPVC solvent cement conforming to the requirements of ASTM F493.

D. All CPVC shall be Schedule 80.

E. Approved Manufacturers:

1. Georg Fischer.
2. Hayward.
3. Asahi/America.
4. Spear.

2.07 PLUMBING PIPE SUPPORTS AND ACCESSORIES

A. Wall-mounted pipe supports for lines 1½-inch and smaller shall be one-hole, clamp type, and shall be *Grinnell Figure 126*, or equal.

B. Wall-mounted pipe supports for lines larger than 1½-inch shall be welded steel, heavy duty clamp type, and shall be *Grinnell Figure 199*, or equal.

C. Hanger pipe supports shall be cradle type with hanger rods and clevises, and shall be *Grinnell Figure 104* or *Figure 260*.

D. Fasteners for pipe clamps and hangers shall be as recommended by the support manufacturer, and shall be suitable for proper anchorage to the substrate material to which attached. Fasteners shall be galvanized steel.

E. Sealants shall be used on all threaded pipe joints and shall be rated for the fluid carried by the conduit. Sealants may be approved pipe thread compound(s). *Teflon* tape thread sealant may not be used.

F. Pipe and tubing wall penetrations through CMU walls shall be sleeved with Schedule 40 PVC pipe spools with a nominal diameter at least 2 inches larger than the carrier pipe, and a length equal to the wall thickness. After insertion of the carrier pipe, the annular space inside the sleeve shall be sealed at each wall surface with *Dow Chemical Great Stuff* expandable foam, or equal. Pipe and tubing penetrations through wood-framed, gypsum board walls do not require sleeves, but shall be sealed with sheetrock mud.

2.08 CORPORATION STOPS AND CURB VALVES

A. Corporation stops and curb valves for new water service shall meet all standards of the public water supply system, including end connection configurations and use of tapping saddles. Stops and valves shall be all brass construction and 175 psig pressure rated.

Stops and valves shall include double O-ring seals, and meet ANSI/AWWA C800 standards. Corporation stops and curb valves shall be *Mueller 300 series*, or equal.

B. Boxes for buried curb valves shall be cast iron, improved extension type with arch pattern base. Boxes shall have brass pentagon plugs, and shall be *Mueller H-10336*, or equal.

2.09 WATER SERVICE METERS

A. Water service meters shall meet the requirements of the public water supply system, along with AWWA C700 standards, and ANSI/NSF Standard 60 certification.

B. Meters shall be of the nominal size shown on the Drawings.

C. Meter read-out and transmitter configuration shall conform to meter reading requirements of the public water supply system.

2.10 FLOOR DRAINS AND CLEANOUTS

A. Floor drains shall be PVC body with steel-threaded inserts, equipped with ½-inch trap primer connection, and complete with a cast iron clamp collar, leveling frame and heavy-duty grate. Outlet sizing shall match pipe diameter as shown on the Drawings.

B. Floor drains shall be *Zurn FD2330*, or equal.

2.11 GATE VALVES – WATER SERVICE

A. Interior gate valves for 2-inch and smaller hot and cold water service shall be all bronze, rising stem type, with graphite-impregnated *Aramid* packing and aluminum handwheel operators. Valves shall be Class 125, rated for 200-pound WOG, and shall have threaded or solder ends. Valves shall be *Nibco Series T111*, or equal.

2.12 BALL VALVES – WATER SERVICE

A. Interior valves for 2-inch and smaller hot and cold water service shall be all bronze, end entry type, with *Teflon* seats and packing and lever operators with fixed stops. Valves shall be rated 400-pound WOG, and shall have threaded ends. Valves shall be *Nibco T-585-70, Grinnell Figure 3500*, or equal.

2.13 BALL VALVES – GAS SERVICE

A. Interior valves for gas service shall be of cast brass body and plug design, with brass stem and chrome-plated brass ball. Operators shall be tee-style lever handles. Valves shall conform to ANSI Z21.15B, and shall be *Nibco Series GB*, or equal.

2.14 GAS APPLIANCE FLUES AND VENTS

A. Gas-fired unit heaters shall be vented with a UL-listed Type B gas vent system, of the nominal size specified by the heater manufacturer. Gas vent shall be all metal, double-wall vent pipe as manufactured by *Ameri-Vent*, or equal. Outer vent pipe shall be galvanized steel, and inner pipe shall be aluminum allow 1100, 3003, or 3105. Vent routing shall include offsets of like construction as necessary to achieve the alignments shown and to clear any obstructing structural or piping members. Vents shall include a firestop support plate at the ceiling, and a flashing, storm collar, and vent cap above the roofline.

2.15 INSTANTANEOUS WATER HEATER

A. Instantaneous water heaters shall be electric under-sink, point-of-use type. Construction shall be lead-free, with copper sheathed heating elements and plastic housing. Unit shall operate from 240V, single-phase service, and be equipped with a 220V wall plug.

B. Unit shall have dual head settings of 7.2 and 3.6 kW, respectively providing 48 deg F and 24 deg F temperature rises at a flow rate of 1.0 gpm. Maximum outlet temperature shall be 135 deg F.

C. Water heater shall be UL listed, and furnished complete with mounting hardware. Inlet and outlet connections shall be 1/2" NPT.

D. Water heater shall be *Bosch Powerstream model RP7P*, or equal.

2.16 HAND WASHING SINK AND FAUCET

A. Hand-washing sink shall be wall-hung, vitreous china or porcelain basin with integral backsplash and side guards, and integral carrier. Overall sink dimensions shall be 18¼" x 20¾" x 7¾".

B. Hand-washing sink shall be NSF listed.

C. Sink shall be furnished with manufacturer's stainless steel installation kit.

D. Sink shall be furnished with manufacturer's chromed metal, deck-mounted goose-neck fixture with acrylic Hot Water and Cold Water faucet knobs at 4" O.C.

E. Sink with fixture shall be *Kohler Greenwich Model K-203*2, or equal.

2.17 TOILETS

A. Toilets shall be ADA-compliant, two-piece, elongated design with 2⅛" trapway and 12" standard rough-in;

B. Chrome trip lever shall be furnished on the tank's left side;

C. 1.28 gallons/flush;

D. Provide with matching toilet seat, bolt caps, wax ring, connector hoses and mounting hardware;

E. Color shall be standard white;

F. Unit shall be a Kohler Kingston K-78279-0 or approved equal

2.18 HOSE VALVES / WALL HYDRANTS

A. Interior hose valves shall be 3/4-inch nominal size with bronze body and internals, and aluminum handwheels. Service connection shall be NPT threaded. Hose valve shall include a vacuum breaker for protection against backsiphonage. Hose valve shall be *Watts Model SC8*, or equal.

B. Exterior hose valves (wall hydrants) shall be 3/4-inch nominal size, and of frost-proof automatic self-draining design. Operating mechanism shall be set back 12 inches from outlet. Integral backflow prevention (vacuum breaker) shall be included. Wall hydrant

construction shall be brass body with nickel plated finish, brass vacuum breaker mechanism, metal handle, and 0.8mm copper tube thickness. Wall hydrant shall be *Watts Series FHB*, or equal.

2.19 PUMP MECHANICAL SEAL FLUSH WATER TUBING

A. Tubing for process pump mechanical seal flush systems shall meet the following:

1. Rigid tubing: As shown on the Construction drawings, 316 stainless steel rated for 350 psi with flared connections, or copper tubing in accordance with the plumbing specifications.

2. Flexible tubing: braided stainless steel jacketed 200 psi neoprene

B. Pressure gages for seal flush lines shall be as specified in Section 03/400 Process Instruments. Isolation and control valves for seal flush lines are specified in Section 40 63 00 – Process Control Systems Equipment.

PART 3 - EXECUTION

3.01 GENERAL

A. All plumbing and installation of piping, appurtenances, and fixtures shall fully conform to the current edition of the *Uniform Plumbing Code* (UPC), and all applicable state and local regulations. All work shall be approved by the State Plumbing Inspector.

B. Drawings do not attempt to show the exact details of all piping. No extra payment will be allowed for fittings, adapters, appurtenances, clearances or offsets required to complete the Work. Where diagrams have been made to show piping connections, the Contractor is cautioned that these diagrams must not be used for obtaining material quantities. Changes in locations of equipment or piping, advisable in the opinion of the Contractor, must be submitted to the Engineer in writing, and cannot be executed without the Engineer's approval. All measurements and dimensions shall be verified at the site. All equipment shall be adjusted and left in a conditions satisfactory to the Engineer. All work shall be completed to provide a fully functional installation as shown and specified.

C. Unions shall be provided in piping systems where shown, and adjacent fixtures and appliances where necessary to assure proper alignment without stressing piping members of fixture connections. Insulating (dielectric) unions shall be provided on domestic hot and cold water piping at all connections between steel and copper (or brass) piping and for all connections to electrically powered appliances.

D. Plumbing fixtures shall be plumbed, trapped, and vented as required by UPC, and as shown. In the event of conflicts between the plumbing requirements shown and UPC, requirements of the Code shall take precedence.

E. And preparation of the structural components of the building required for equipment and material regarding this unit of the Contract shall be done by the particular affected trade and shall be done to the satisfaction of the Engineer, and work which is deemed unsatisfactory shall be removed and reinstalled until the approval of the Engineer is obtained. The work carried on under this Contract shall be done in a neat an orderly

fashion.

3.02 PIPING

A. Piping runs shall be level and plumb, except where slopes are specifically called or shown.

B. Pipes shall be adequately supported by clamps or hangers at intervals not to exceed 10 feet, and either side of all changes in direction. Where additional supports may be needed to provide pipe stability, they shall be provided at no additional cost.

C. Solvent-weld PVC pipe jointing shall be allowed to fully cure in an unstressed and unloaded position.

D. All piping intended to carry potable water shall be disinfected before placing into service. Disinfection procedures shall conform to AWWA C651.

E. Pipe sizes shown on the Drawings are nominal sizes, unless noted otherwise. Provide all piping which passes through walls, floors or ceilings with pipe sleeves as shown in the drawings.

F. Install unions in piping system wherever they will expedite removal of equipment and valves. Install manual air vents at high points in domestic hot water system.

G. Equipment: Drawings do not attempt to show all integral piping, vents, and accessories for equipment to be installed. The Contractor shall install equipment in accordance with manufacturer's piping diagrams and instructions.

3.03 CORPORATION STOPS AND CURB VALVES

A. Corporation stop and curb valve installation shall meet the appropriate requirements of *Montana Public Works Standard Specifications* and requirements of the public water supply system. Taping of existing mains shall be authorized by or performed by water system personnel. Curb boxes shall be plumbed and adjusted to grade.

3.04 FIXTURES AND APPLIANCES

A. Factory finishes on all fixtures and appliances shall be adequately protected during shipping, storage, and installation to prevent damage. Finish damage shall be grounds for requiring replacement of affected fixtures and appliances at the Contractor's sole cost.

B. All plumbing fixtures and appliances shall be installed, leveled, adjusted, and tested in full accordance with manufacturers' recommendations, and UPC and IBC requirements. Each plumbing fixture shall be trapped and vented as required by code. General vent locations are shown, but all details required for venting are not included in the drawings. The Contractor shall be responsible for final vent pipe routing. Fixtures and drains shall be installed true and plumb with separate stops for each fixture supply. Galvanized nipples shall not be used between copper water connections. Install chrome-plated canopy flanges at each fixture drain where P-trap arm enters wall.

C. Following installation of the completed plumbing systems, the proper function of all

fixtures and appliances shall be demonstrated in the presence of the Engineer.

3.05 DRAINS AND CLEANOUTS

A. Drain lines and fixtures shall be kept free of foreign materials at all times, and adequately protected during construction from the entry of such materials, as well as from cosmetic, structural, or functional damage.

B. All drains shall be equipped with P-traps, including floor drains. Floor drains shall have a deep-seal P-trap installed as close to the drain as possible.

C. Floor drains and floor cleanouts shall be set with their upper rims flush with the finished floor slab. During pouring and finishing concrete floor slabs, drain and cleanout fixtures shall be adequately secured to avoid movement or floating as concrete is placed. Concrete floors shall be finished to uniformly slope to floor drains, as indicated on the Drawings.

D. PVC piping and gas appliance flue roof vents (VTR's) shall be surface mounted to CMU walls, using suitable pipe clamps to secure installation. Vent and flue lines shall be plumb, and sealed through ceiling and roof surfaces. Roof penetrations shall be sealed with elastomeric roof jacks.

3.06 DRAINAGE AND VENT PIPING

A. Drainage and vent piping shall be installed where required and shall, in general, conform to the locations indicated on the Drawings. Horizontal soil and waste pipes 3 inches and small shall have a grade of 1/4-inch per foot. Horizontal soil and waste piping 4 inches and larger may have a grade of 1/8-inch per foot.

B. Drainage piping which is required to be buried beneath floors or underground shall be cast iron soil pipe or ductile iron pipe, as indicated on the Drawings and as specified in other sections, to a point not less than 5 feet beyond the outside face of the structure.

C. Cast iron soil pipe shall be service weight, hubless type. Rubber couplings shall be used.

D. Acid resistant drain piping shall be used where shown on the Drawings.

E. Bell-ups shall be installed with the top rim 2-inches above the floor surface.

F. All vents passing through roofs shall be located at least 10 inches from the intersection of a cant with the roof deck, and shall be adequately flashed as indicated on the Drawings and as specified.

3.07 PUMP MECHANICAL SEAL WATER FLUSH LINES

A. Seal flush systems for process pump mechanical seals shall be as recommended by the pump and seal manufacturers, and installed as shown on the Drawings. Seal flush water flow shall be solenoid controlled, to activate anytime pumps run, either in "auto" or "hand" control mode.

B. Seal flush lines shall be thoroughly flushed after installation and then flow tested by the Contractor using a time-to-fill container method to demonstrate delivery of the required

water flow. Flush line control solenoid interlocks to pump starting circuits shall be demonstrated and verified as operable before proceeding with process pump testing or startup.

C. Seal water flush lines flow and pressure regulators and appurtenances shall be wall-mounted, or ceiling-mounted, as shown on the Drawings. Seal water tubing connections to pump units shall use flexible, braided stainless steel jacketed tubing for the length shown connecting to pumps.

3.08 TESTING

A. Completed hot and cold water piping, including fixture connections shall be tested and demonstrated to be leak free by the Contractor by charging with water and maintaining 60 psi pressure, using the house water system, in the presence of the Engineer. Any leaks or defects shown shall be promptly remedied by the Contractor.

B. Completed drain piping shall be tested and demonstrated to be leak free by the Contractor in the presence of the Engineer by filling with clean water to the elevation of the highest point in the system, and sustaining that water level for a period of 3 hours without loss.

C. Other tests of completed piping as prescribed by the UPC shall also fully apply, and shall be conducted in the presence of the Engineer.

D. Completed natural gas piping must be fully completed and tested by the Contractor in the presence of the Engineer before gas service is connected by the gas utility. The Contractor shall assure that all gas piping and appurtenances are suitable for connection and startup, and fully conform to the all code and utility's requirements.

END OF SECTION 22 00 00

SECTION 22 13 29.16
SUBMERSIBLE SEWAGE PUMP STATION

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes furnishing and installing dual-pump lift station equipment and materials for the ***Side Stream Lift Station*** as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

1.02 RELATED DOCUMENTS

A. Related sections include but are not limited to:

1. Section 01 30 00 – Submittals
2. Section 01 40 00 – Quality Control
3. Section 01 60 00 – Common Product Requirements
4. Section 01 75 00 – Starting and Adjusting
5. Section 01 78 23 – Operation and Maintenance Data
6. Section 09 90 02 – High Performance Painting and Coating
7. Division 26 – Electrical
8. Section 40 27 20 – Process Valves
9. Section 40 27 00 – Process Piping - General
10. Section 40 27 10 – Process Piping Specialties

1.03 REFERENCES

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

B. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)

1.	ANSI B16.1	Cast iron pipe flanges & flanged fittings.
2.	ANSI/AWWA C115/A21.15	Cast/ductile iron pipe with threaded flanges.
3.	ANSI B40.1	Gauges, Pressure and Vacuum.
4.	AWWA C508	Single Swing Check Valves.
5.	AWWA C504	Plug Valves

C. American Society for Testing and Materials (ASTM)

1.	ASTM A48	Gray Iron Castings.
2.	ASTM A126	Valves, Flanges, and Pipe Fittings.
3.	ASTM A307	Carbon Steel Bolts and Studs.

4.	ASTM A36	Structural Steel.

D. Institute of Electrical and Electronics Engineers (IEEE)

1.	ANSI/IEEE Std 100	Standard Dictionary of Electrical Terms.
2.	ANSI/IEEE Std 112	Test Procedure for Polyphase Induction Motors.
3.	IEEE Std 242	Protection of Industrial and Control Power Systems.

E. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)

1.	NEC	National Electric Code.
2.	NEC 701	National Electric Code article 701.
3.	NEMA Std MG1	Motors and Generators.

F. Other Applicable Standards

1. Montana Circular DEQ-2: Design Standards for Wastewater Facilities.
2. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
3. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards
4. ISO 9001 International Organization for Standardization.
5. MDEQ Circular DEQ-2
6. NFPA – Comply with the most current edition of National Fire Protection Association Standard for Fire Protection in Wastewater Treatment and Collection Facilities for electrical equipment installed as indicated on the project drawings.

1.04 SYSTEM DESCRIPTION

A. The contractor shall furnish and install two automatically-controlled submersible pumps, piping and isolation and check valve packages capable of handling raw unscreened sewage or similar liquids.

B. The pumps and mechanical slide rail accessories shall be installed in the wet well as shown on the project plans. The pump control panel, liquid level control, valves and piping shall be installed within the Grit Building as indicated.

C. Factory built pump station equipment, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under PART 2 - PRODUCTS of this section.

1.05 PERFORMANCE CRITERIA

A. The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

B. The pump manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.

C. Each pump must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall be furnished with a 4" discharge connection. Each pump shall be selected to perform under the following operating conditions:

1.	Single Pump Capacity (gpm)	370
2.	Single Pump Total Dynamic Head (ft)	29.5
3.	Combined Two Pump Capacity (gpm)	500
4.	Combined Two Pump TDH (ft)	40
5.	Total Discharge Static Head (ft)	27.0

D. Site power furnished to pump station shall be 3 phase, 60 hertz, 460 volts, 3 or 4-wire, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Control voltage shall not exceed 132 volts.

E. Pump Performance Certifications

1. Solids Handling Capability

a. All internal passages, impeller vanes, and recirculation ports shall pass a 3” spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer’s certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

F. Certified Pump Performance Test

1. Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B at the specified head, capacity, rated speed and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity and speed.

1.06 SUBMITTALS

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit all the required copies of submittal data for review and approval.

2. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for slide rail components. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

3. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

B. Operation & Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

   a. Functional description of each major component, complete with operating instructions.

   b. Instructions for operating pumps and pump controls in all modes of operation.

   c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

   d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

   e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

   f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, valves and piping.

3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to

selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.07 QUALITY ASSURANCE

A. The manufacturer of the pump station shall have a quality management system in place and shall be ISO 9001 certified.

B. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

C. All pump openings and passages shall be of adequate size to pass 3.15" diameter spheres (minimum) and any trash or stringy material which can pass through an average house collection system.

D. The manufacturer’s technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.08 MANUFACTURER'S WARRANTY

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. Fiberglass components of the station enclosure shall be warranted for 10 years to resist UV damage, corrosion from moisture or corrosive soils, or physical failures occurring in normal service, without the need for special protective coatings, when installed according to the manufacturer's recommendations.

2. The pumping units installed in this station are warranted for a period of five (5) years or 10,000 hours of operation from the time of shipment from the factory on a pro-rated basis. The conditions of this warranty are predicated on factory approved installation and start-up of equipment in permanent municipal waste water installation. This warranty covers failures due to defects in material and workmanship. The warranty does not cover normal wear and tear on equipment. The pump station manufacturer will pay a percentage of the list price for replacement parts in labor as follows provided the pump with cable attached is returned pre-paid in accordance with the instructions:

B. Pump Warranty Obligation

C.	Months after Shipment	0-18	19-38	40-60
	Hours of Operation	0-2,999	3,000-6,499	6,500-10,000
D.	Mfctr. Share of the Costs	100%	50%	25%

1. All remaining equipment apparatus and parts furnished shall be warranted for a period of five (5) years, excepting those items that are normally consumed in service such as light bulbs, oil, grease, packing, gaskets, o-rings, etc. The pump station manufacturer shall be solely responsible for the warranty of the station and all components.

E. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.

F. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design or delays in delivery are also beyond the manufacturer's scope of liability.

G. The warranty shall become effective upon the acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. The pump station system integrator shall have a quality management system in place and shall be ISO 9001 certified.

B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

C. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). All pumping equipment and appurtenances must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer’s representative or distributor be accepted.

D. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations (including contact information).

E. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed

equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

F. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

G. The two (2) submersible pumps shall be model SFV4A with 8" impeller as manufactured by Gorman-Rupp or approved equal. This specification is not intended to eliminate other products of equal quality and performance.

2.02 STATION APPURTENANT EQUIPMENT

A. The station equipment shall include all valves, and associated controls and shall be constructed to enhance serviceability by incorporating the following design characteristics:

1. Discharge Gauge Kit - The pump station shall be equipped with a glycerin-filled pressure gauge to monitor discharge pressures. Gauge shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full scale reading. Pressure gauge shall be graduated 0 to 140 feet water column minimum. Gauge kit shall be mounted and complete with all hoses and fittings and shall include a shutoff valve installed in each connection to discharge piping and a three way valve to monitor either pump.

2. Portable Hoist and Socket - The pump station shall be provided with a portable hoist with winch assembly made from 304 stainless steel. Hoist shall be designed to lift pumps weighing up to 650 pounds. Portable hoist shall not weigh more than 100 pounds. Hoist socket shall be permanently installed on station slab. The hoist socket shall be permanently installed on the station top slab for use with the removable hoist. Hoist shall be a Halliday Products model D2B36D or approved equal.

3. Pump Removal System – Each pump shall be equipped with a slide rail and automatic discharge connection system that allows installation/removal of the pumps without the need for an operator to enter the lift station wetwell.

4. Compression Couplings - Compression couplings shall be provided for each suction and discharge connection to join plain-end ductile iron pipe to wet well piping.

2.03 PUMP DESIGN

A. Pumps for the ***Side Stream Lift Station*** shall be submersible slide rail type and be properly selected with the necessary features to provide the performance characteristics outlined in section 1.05 above. Pumps shall be similar to the Gorman-Rupp Model SFV4A.

B. The pump manufacturer shall have a quality management system in place and shall be ISO 9001 certified.

C. Hydraulic Components and Solids Handling

1. The pump casing shall be of gray iron with a gray iron or ductile iron slide rail guide shoe attached to the discharge flange as an integral assembly. Casing shall be easily removable from the motor for full inspection of impeller.
2. All pump openings and passages shall be of adequate size to pass 3" diameter spheres (minimum) and any trash or stringy material which can pass through an average house collection system. The impeller shall be recessed into the pump casing and shall not require flow of liquid through the impeller. The impeller and seal housing shall incorporate auxiliary vanes to hydraulically reduce pressure on the primary seal and force fibrous materials and solids away from the close axial clearance on the backside of the impeller. No impeller clearance adjustment or wear rings shall be required.
3. The impeller shall be a multi-vane vortex type with integral winglets on each vane. The winglet shall form an L-shaped cross section at the face of the vane for improved hydrodynamic efficiency. Impeller shall be of ductile iron and precision balanced. Balancing shall not deform or weaken the impeller. The impeller shall have a tapered locking fit onto the shaft and further be secured by a key and locking bolt. Impeller fasteners shall be non-corroding.
4. A hoisting bail shall provide for proper balance of pump and detente from the discharge connection while using a single lift cable.
5. All other major pump components such as stator housing, seal housing, and bearing brackets must be of structural grade steel or gray iron - Class 30. All external surfaces coming into contact with sewage shall be protected by an epoxy coating of 8 mils minimum thickness. All exposed fasteners and lock washers shall be of 304 stainless steel.

D. Shaft Seal

1. The pump shaft shall be sealed against leakage by a mechanical-double faced seal with combined spring system for the upper and lower portion. The lower wearing faces shall be silicon carbide. The upper faces shall be carbon and hardened stainless steel. Elastomers shall be viton.
    a. The rotating seal faces shall be lubricated from an oil filled reservoir between pump and motor; the oil serving as both lubricating and a cooling media. The reservoir shall have separate oil fill and drain plugs to insure accuracy when measuring lubricant level and for ease of maintenance.
    b. Seal shall require no special maintenance or routine adjustment; however, shall be easily inspected or replaced. No seal damage shall result from operating the pump for short periods of time without liquid.

2.04 PUMP MOTOR

A. Motor Description

1. **7** Horsepower

2. The submersible pump motors shall be explosion proof and operate in accordance with the electrical power indicated above. The motor and pump must be connected to form an integral unit. Motor shall be a squirrel-cage, induction type in an air-filled water tight enclosure. The motor shall conform to NEMA design Class B, and incorporate Class F insulation materials to withstand a continuous operating temperature of 155 degrees C (311 degrees F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40 degrees C (104 degrees F).

3. Motor shall be capable of sustaining a minimum of 10 starts per hour. The motor shall operate while only partially submerged and not require a cooling jacket or any other means of auxiliary cooling during normal continuous operation.

4. Motor housing shall be of cast iron. The stator shall consist of copper windings with copper connectors applied to high grade electrical steel laminations. The stator shall be held securely in place by a heat-shrink fit into the motor housing. Any other means of securing the stator which would require penetration of the motor housing shall not be considered acceptable.

5. Rotor shall be solid cast and dynamically balanced for vibration-free operation. Rotor end bars and short circuit rings shall be of aluminum. The pump shaft shall be of AISI type 329 stainless steel (or hardened alloy steel with protective stainless steel shaft sleeve which prevents contact of the shaft with the liquid). The shaft shall be machined with shoulders or snap ring grooves for positive placement of bearings. The upper and lower bearing shall be of heavy duty design, capable of supporting the shaft and rotor while under maximum radial and thrust loads. The bearings shall be permanently grease lubricated and sealed at the time of installation.

6. Watertight Integrity

   a. All static seals at water tight mating surfaces shall be of nitrile "O" ring type. Use of auxiliary sealing compounds shall not be required. The power and control cables shall enter the motor through a terminal housing. The entrance shall be sealed with a rubber grommet and clamp set which when compressed longitudinally causes a radial water tight seal. The clamp set shall prevent all slippage and rotation of cable while engaged, yet may be easily removed and reused during routine maintenance. Any other cable entrance design requiring use of epoxies, silicones, or similar caulking materials shall be considered unacceptable.

   b. The pump and electrical cables shall be capable of continuous submergence without loss of waterproof integrity to a depth of 65 feet.

   c. The water tight integrity of the motor housing and shaft seal shall be tested during manufacture by pressurizing the motor cavity and submerging in water with motor operating.

7. Motor Protection

   a. The motor shall be protected from thermal and moisture damage. Thermal protection shall consist of three separate thermostatic switches embedded into

the stator windings. Each switch shall open independently and terminate motor operation if temperature of the protected winding reaches the high temperature set point. Any moisture in the motor housing shall be detected by a mechanically activated moisture sensing micro-switch. The switch shall be sensitive enough to detect airborne moisture and terminate operation of motor before liquid enters the cavity. Use of probes or floats that rely on the presence of liquid to initiate signal shall not be considered acceptable. The thermal and moisture sensing devices shall be connected to the pump control panel by the contractor.

2.05 AUTOMATIC DISCHARGE CONNECTION

A. Each pump shall be furnished with a submersible discharge connection system to permit removal and installation of the pump without the necessity of an operator entering the wet well. The design must insure an automatic and firm connection of the pump to the discharge piping when lowered into place.

B. A gray iron or fabricated steel base plate with integral guide rail pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base plate shall be designed with an integral 90^0 elbow, or adapt to a commercially available elbow for connection to the vertical discharge piping utilizing standard ANSI 125 lbs. flanges. The base plate shall be coated with an epoxy coating for corrosion resistance. The manufacturer shall provide all necessary drawings to insure proper installation and alignment of baseplate within the sump.

C. Each pump shall be provided with a replaceable ductile iron slide rail guide shoe attached to pump discharge flange. A replaceable neoprene seal shall be provided as an integral part of the guide shoe to form a seal with the base plate connection and eliminate the possibility of leakage and erosive wear during operation. The seal shall contact mating faces in a static position and shall have adequate flexibility to flex under pumping pressure to increase seal efficiency. Metal-to-metal contact at the discharge connection shall not be acceptable.

D. The contractor shall provide two lengths of 1 1/2", schedule 40 stainless steel guide rail pipe for each pump.

E. Upper guide rail pilots, and a lifting cable shall be furnished for each pump. Bottom pilots shall be an integral part of the baseplate for ease of installation and proper alignment.

F. The guide shoe shall direct the pump down two vertical guide rails and onto the discharge connection in a simple lineal movement. The buildup of sludge and grease on guide rails shall not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit full weight of the pump to the base plate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails, or lifting cable.

G. Lifting cable shall consist of a 316 stainless steel braided wire cable attached to the pump lifting bail. A crimped ball end shall be provided at the upper end of this cable for attaching to the wet well access frame.

H. All bolts, machine screws, nuts, washers, and lockwashers for complete assembly of access cover, guide rails, and discharge elbow shall be stainless steel.

2.06 WET WELL ACCESS

A. The wet well access shall be as indicated on the project drawing sheets. A hinged ductile iron door within a grey iron frame shall be provided to allow access to the wet well. All hardware on access assembly shall be stainless steel with a flush upper surface without protrusions. The access hatch/frame assembly shall be a Neenah R-3498-R3GS or approved equal.

2.07 VALVES AND PIPING

A. Each pump shall be equipped with a full flow type check valve, capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron and incorporate a 3" cleanout port. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

B. Each discharge line shall be equipped with a 2-way plug valve to permit isolation of the pumps from the common discharge header. The plug valve shall be non-lubricated type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface. Valves shall have ports designed to pass 3" spherical solids.

C. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within 1/2° between flanges. Flanges shall be faced and a gasket finish applied.

2.08 SUPPORTS AND THRUST BLOCKS

A. All pipes connected to the pump station shall be supported according to good commercial practice.

2.09 ELECTRICAL CONTROL COMPONENTS

A. The pump station control panel will be tested as an integral unit by the pump station manufacturer.

B. Panel Enclosure

1. The electrical control equipment shall be mounted within a NEMA 1 stainless steel, dead front type control enclosure. The enclosure door shall be hinged and sealed with a neoprene gasket. It shall include a removable plated steel back panel on which control components shall be mounted. Back panel shall be secured to the ***interior wall of the Grit Building*** with uni-strut. Operator controls shall be mounted on the panel door. The control panel shall be equipped with vapor emission type corrosion inhibitors.

2. All components shall be of the highest industrial quality, securely fastened to a removable sub-plate with screws and lockwashers. The sub-plate shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component. All operating controls and instruments shall be securely mounted and shall be clearly labeled to indicate function.

3. A main terminal block and ground bar shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electrical Code (NEC).

C. Phase Monitor

1. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. A time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

D. Transient Voltage Surge Suppressor

1. The control panel shall be equipped with a transient voltage surge suppressor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps, and a Joule rating of 1500.

E. Motor Branch Components

1. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating of 20 amperes at 240 volts.

2. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the door,

with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position.

3. An open frame, across-the-line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size shall not be acceptable. Power contacts shall be double-break and made of cadmium oxide silver. Coils shall be epoxy molded for protection from moisture and corrosive atmospheres. The starter assembly shall be equipped with a metal mounting plate for durability. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts and coils shall be easily replaceable without removing the motor starter from its mounted position.

4. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

F. Other Control Components

1. The pump control panel shall be equipped to terminate pump operation due to high motor winding temperature or moisture in the motor housing and shall utilize the contacts in the pump motor. If either event should occur, the motor starter will drop out, and a mechanical indicator, visible on the door, shall indicate the pump motor has been shutdown. The pump motor shall automatically reset when the condition has been corrected. However, the mechanical indicator shall require manual reset. Dry contacts, wired to terminal blocks, shall be furnished for each pump for thermal/moisture shutdown.

2. The control circuit shall be protected by a normal duty thermal- magnetic air circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all control circuits.

3. Pump mode selector switches shall be connected to permit manual start and manual stop for each pump individually, and to select automatic operation of each pump under control of the liquid level control system. Manual operation shall override the liquid level control system. Selector switches shall be heavy duty, oil-tight design, with contacts rated NEMA A300 minimum.

4. Pump alternator relay contacts shall operate after pump shutdown. Relay contacts shall be rated 10 amperes minimum at 120 volts non- inductive.

5. Control panel shall be equipped with one oil-tight pilot light for each pump motor. Light shall be wired in parallel with the related pump motor starter to indicate that the motor is on or should be running.
6. Six digit elapsed time digital indicators (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours".
7. A duplex ground fault indicating utility receptacle providing 115 VAC, 60 Hertz, single phase current, shall be mounted on the door panel of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

G. Pump Start Delay

1. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

H. Wiring

1. The control panel, as furnished by the manufacturer, shall be completely wired. The contractor shall field connect the power feeder lines to the main terminal block, final connections to the remote alarm devices, and the connections between the pump and the pump motor control. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).
2. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color coded as follows:

a. Line and load circuits, AC or DC power	Black
b. AC control circuit less than line voltage	Red
c. DC control circuit	Blue
d. Interlock control circuit, from external source	Yellow
e. Equipment grounding conductor	Green
f. Current carrying ground	White
g. Hot with circuit breaker open	Orange

3. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be of 16 gauge minimum, type MTW or THW, 600 volts. Power wiring shall be 14 gauge minimum.
4. The ampacity of motor branch conductors and other power conductors shall not exceed the temperature rating of the connecting terminals. Wires shall be clearly numbered at each end in accordance with the electrical diagrams. All wires on the sub-plate shall be bundled and tied.

5. Wires connected to components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be provided to allow the door to swing to its full open position without undue stress or abrasion on the wire or insulation. Bundles shall be held in place on each side of the hinge by mechanical fastening devices.

I. Conduit requirements are as follows

1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
4. Conduit shall be sized according to the National Electric Code.

J. Grounding

1. The pump control manufacturer shall provide a common ground bar mounted on the enclosure back plate. The mounting surface of the ground bar shall have any paint removed before making final connections.
2. The contractor shall make the field connections to the main ground lug and each pump motor in accordance with the National Electric Code.

K. Identification

1. A permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:
   a. Equipment serial number
   b. Supply voltage, phase and frequency
   c. Current rating of the minimum main conductor
   d. Electrical wiring diagram number
   e. Motor horsepower and full load current
   f. Motor overload heater element
   g. Motor circuit breaker trip current rating
   h. Name and location of equipment manufacturer
2. Control components shall be permanently marked using the same identification shown on the electrical diagram. Identification label shall be mounted adjacent to the device.
3. Switches, indicators, and instruments shall be plainly marked to indicate function, position, etc. Marking shall be mounted adjacent to and above the device.

L. Pump Start Delay

1. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

2.10 LIQUID LEVEL CONTROL

A. The manufacturer of the liquid level control system shall have a quality management system in place and shall be ISO 9001 certified.

B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

C. The level control system shall be an intrinsically safe **submersible level-sensing transducer** with *backup non-mercury float switch system*.

D. The level control system shall utilize the alternator relay to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.

E. Upon operator selection of automatic operation, the control system shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the control system shall stop the lead pump. These actions shall constitute one pumping cycle.

F. Should the wet well level continue to rise after the lead pump has started, the control system shall activate the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating. In this case, both pumps will continue to run until the "pump off" level is reached, whereupon the typical alternating lead pump control scenario will be re-instituted.

G. The level control system shall activate the "high water alarm" in the event that water level continues to rise to a pre-determined setpoint after the "lead" and "lag" pumps have been activated. High water alarm shall provide a signal to the plant SCADA system that requires a manual reset at the Sidestream Lift Station control panel.

H. The backup level control system shall utilize non-mercury float switches for: "low water level alarm" and "high water level alarm". Upon failure of the level-sensing transducer, the backup float system shall alternate the pumps between high water alarm level and low water alarm level while indicating the alarm status.

2.11 CONTROL PANEL OUTPUTS

A. The ***Side Stream Lift Station*** control panel shall have the following outputs to the Grit Building PLC:

1. Pump #1 running
2. Pump #2 running
3. Pump #1 fault
4. Pump #2 fault

5. Pump #1 motor high temp
6. Pump #2 motor high temp
7. High water level
8. Low water cut-out
9. Pump panel control power confirmation

B. Control panel output voltages shall be as determined by Division 16 and as shown on the project drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

C. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.03 FIELD QUALITY CONTROL

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

2. After construction debris and foreign material has been removed form the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and

discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

B. Manufacturer Start-up Services

1. Coordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. Calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

3.04 CLEANING

A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

3.05 PROTECTION

A. The pump station should be placed into service immediately. If operation is delayed, station is to be stored and maintained per manufacturer's written instructions.

END OF SECTION 22 13 29.16

SECTION 22 33 33
LIGHT-COMMERCIAL ELECTRIC WATER HEATER

PART 1 - GENERAL

1.01 SUMMARY

A. This details the Rheem Heavy Duty Electric Commercial Water Heater or approved equal. The water heater will be installed in the basement of the Administration building to replace the existing 120 gallon AO Smith heater, generally using the existing electrical supply components. The tank will be installed in accordance with applicable plumbing codes.

1.02 SPECIFICATIONS

A. Water heater(s) shall be model **ES85-15-G,** manufactured by Rheem, having electrical input of 15 kW and a recovery rate of 62 GPH at a 100°F temperature rise. The heater shall operate on 240 V, three phase power.

B. Water heater(s) shall have a storage capacity of 85 gallons.

C. Water heater(s) shall have the UL seal of certification and be factory equipped with an CSA/ASME rated temperature and pressure relief valve. Tank(s) shall have a double coating of high temperature porcelain enamel and furnished with magnesium anode rods rigidly supported. Water heater(s) shall meet or exceed the standby loss requirements of ASHRAE. Tank(s) shall have a working pressure of 150 psi, and shall be completely assembled. Water heater(s) shall be approved-listed and constructed in accordance with UL Sanitation (NSF5).

D. Water heater(s) shall be equipped with stainless steel “screw-in” type elements. Tank shall be insulated with thick polyurethane foam insulation. Water heater(s) shall be constructed with a System Sentinel element diagnostic panel utilizing light emitting diodes. Each LED will correspond to the number and location of the heating elements and monitor their on-off function.

E. Water heater(s) shall be provided with internal power circuit fusing, control circuit fusing, magnetic contactors, 120 volt control circuit transformer and surface mounted thermostat or immersion thermostat(s) with manual reset high limit control. 1-1/2" inlet and outlet water connections for 80 through 120 gallon models shall be provided.

F. Water heater(s) shall be covered by a three year limited warranty against tank leaks.

PART 2 - PRODUCT

2.01 EFFICIENCY

A. 98% thermal efficiency

B. Thick foam insulation will be provided for minimal standby heat loss

2.02 PERFORMANCE

A. Recovery rate: Up to 62 GPH at a 100 degree rise.

B. Up to 190° F maximum delivered temperature for E series; 160° F for ES50; 180° F for ES85 and ES120

2.03 CAPACITY & SHIPPING WEIGHT

A. 85 Gal has 350 lb weight

2.04 PRODUCT REQUIREMENTS

A. Control box is located at the front of unit for easy wiring during installation . Multiple knockout holes accommodate a variety of conduit sizes

B. Provides a diagnostic panel with LEDs that correspond to the number, location and status of each element

C. Full-port, full-flow, brass drain valve for draining

D. Minimum distance to combustible is zero inches from jacket and 18 inches from access door

E. All models approved for installation on combustible flooring

F. Temperature and pressure relief valve at top of 175 gallon model and side on all other models

G. Water connections: hot and cold water inlets are 2-1/2" NPT dielectric nipples on the 175 gallon model and 1-1/2" on all other models

H. Element wattages: 5000

I. Elements are Lifeguard™ stainless steel, screw-in type that resist burn out and corrosion

J. Long life tank design: proprietary steel formulation with high temperature porcelain enamel to maximize corrosion resistance resulting in a superior tank design

K. Two anode rods are installed to ensure long life and corrosion resistance

2.05 WARRANTY

A. 3-year limited tank warranty

B. 1-year limited parts warranty

PART 3 - EXECUTION

3.01 INSTALLATION (from other spec)

A. The water tank, expansion tank and appurtenances will be installed in accordance with plumbing codes and the manufacturers recommendations.

B. Four copies of operations and maintenance manuals will be provided.

END OF SECTION 22 33 00

SECTION 22 34 13
TANKLESS WATER HEATER

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to install, ready for operation and field test two, natural gas fired, on-demand tankless water heaters as shown on the Contract Drawings and as specified herein. One heater is located in the Grit Builder and one will be located in the Main Process Building.

B. The on-demand water heaters and appurtenances shall be designed in accordance with the latest version of ANSI Z21.10.3 as modified herein and design certified by CSA.

C. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer.

D. On-demand water heaters shall be supplied with all the necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.

E. On-demand water heaters supplied under this Section shall be non-condensing models supplied by: Rinnai; American Water Heaters; Rheem, Cronomite; Noritz; or pre-approved equal.

1.02 SUBMITTALS

A. Provide the following information to confirm compliance with the specification in addition to the submittal requirements specified in Section .

1. Complete description of all materials including the material characteristics for all major functional elements.

2. Installation drawings showing all details of construction, details required for installation, dimensions, anchor bolt locations, general construction materials, venting, plumbing and power connections.

3. Complete engineering design calculations in compliance with ANSI standards latest edition.

4. Performance and efficiency information under normal operational parameters.

5. The location of the company headquarters and the location of the principle manufacturing facility. Provide the name of the company that manufactures the equipment if the supplier utilizes an outside source.

1.03 QUALITY ASSURANCE

A. The fully modulating, on-demand, gas fired tankless water heater shall have a maximum

input rating of 180,000 Btu/h, available in natural gas.

1. The heater shall have ¾ in. male NPT water and gas connections. The inlet gas supply pressures shall be 4.0 in. WC (min.) up to 10.5 in. WC (max) for NG and 8.0 in. WC (min.) up to 14 in. WC (max.) for LP.
2. The heater shall be supplied with a temperature remote, that can be installed up to 400 ft. from the heater using 20 gauge (minimum) control wire. The temperature remote shall provide diagnostic information, fault history, and heater set temperature. The heater shall operate using standard 120V/60 Hz power source. The indoor heater will incorporate a factory installed power cord.

B. The on-demand heater shall be vented with 4" diameter Category III vent pipe with a length not to exceed 50 ft. (equivalent), terminating horizontally or vertically. The heater can be direct vented with an appropriate conversion kit, using 3" diameter intake air pipe.

1. The intake pipe may use material such as PVC, ABS, aluminum, or Category III pipe and cannot exceed 50 ft. (equivalent) length.

C. The water heater shall use a commercial grade copper alloy, fin tube heat exchanger with quick release brass or bronze waterways. The heater shall be controlled by an onboard solid-state printed circuit board which uses the following factory installed components: thermistors to monitor inlet and outlet water temperature; a flow sensor to measure flow rate; a flame sensor to monitor combustion; an Air-Fuel Ratio Rod to measure and adjust operation in order to maintain optimal combustion efficiency.

1. The heater also consists of inline fusing and surge absorbers for electrical surge protection, an electronic spark igniter, aluminized stainless steel burners, a hi-limit temperature switch, modulating gas valve, an overheat cutoff fuse, ceramic heating blocks to protect the heat exchanger and water piping. The indoor heater shall incorporate auto-fire system for additional freeze protection.

D. The heater shall be design certified by CSA according to ANSI Z21.10.3, approved for sale in the United States, meets the energy efficiency requirements of the U. S. Department of Energy and ASHRAE 90.1, complies with Low NOx emissions of 40 ng/J or 55 ppm, and shall be certified by NSF to NSF/ANSI 5 Standard.

PART 2 - PRODUCT

2.01 FEATURES

A. Maximum flow rates up to 7.0 gpm

B. Available in natural gas

C. Remote control and power cord as standard features

D. Low NOx emissions

E. Complies with lead free standards

F. Heat exchanger is constructed of commercial-grade copperelement sensing

2.02 SAFETY FEATURES

A. Built in Freeze Protection

B. Manual Reset Hi Limit (Set at 194°F)

C. Overheat Cutoff Fuse

D. Inlet and Outlet Thermistors for Constant Temperature Monitoring

E. Flame Sensor

2.03 VENTING & COMBUSTION

A. 4" Category III Steel Vent

B. Vertical or Horizontal Installation

C. 50' Max Length, 5 elbows max (90° elbows = 5' equivalent length)

D. Power Vent or Power Direct Vent

E. Electronic Ignition – No Pilot Light

F. 3" Combustion Air Intake

2.04 WARRANTY

A. 15-year limited warrant on heat exchanger in proposed application

B. 5-year warranty on all parts

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of the on-demand heaters and appurtenant features shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.

B. The CONTRACTOR shall review the installation drawings and installation instruction prior to installing the heaters.

C. The heater assemblies and all plumbing, venting and power feeds shall be installed in a true vertical plane, square and plumb.

D. The CONTRACTOR shall provide and install all necessary mounting and finishing to produce an aesthetically pleasing installation in accordance with the manufacturer's recommendations and the OWNER's expectations.

3.02 FIELD TESTING

A. After installation, all on-demand heaters shall be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this Section. Each heater shall be cycled to confirm that they operate without leaking, mis-firing, overheating, improper venting or presenting any other safety or

performance concerns. The on-board and remote temperature controls shall function smoothly and without interruption.

END OF SECTION 22 34 13

SECTION 22 45 16
EYE WASH/SHOWER SAFETY EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This specification identifies two safety equipment products for emergency eyewash and shower, based on Guardian products or approved equal.

1. Faucet Mounted Eyewash Station – located in UV room in Main Process Building.
2. Combination Eyewash/shower Station – Located in Grit Handling Building.
3. Combination Eyewash/shower Station – Located in Administration Building in Lab area.

PART 2 - PRODUCTS

2.01 EYESAFE-X FAUCET MOUNTED

A. Application

1. EyeSafe-X™ faucet-mounted eyewashes converts a faucet into an emergency eyewash station without interfering with normal faucet operation. An EyeSafe-X™ unit is ideal for use with gooseneck faucets, and can be installed at any sink, close to where accidents might occur. In an emergency, the unit is quickly located and activated, and provides an unlimited supply of potable water for rinsing the user's eyes.

B. Outlet Heads

1. Outlet heads are mounted 5" apart and deliver a soft, aerated flow of water. Heads angle forward and inward toward user. Angle of heads is adjustable to permit full coverage and avoid splashing. Furnished with float-off dust covers to protect outlet heads.

C. Valve

1. Forged brass diverter valve. Pull knob to activate eyewash; water pressure holds eyewash in operation, leaving user's hands free. Push knob or turn off faucet to return to normal faucet operation.

D. Inlet

1. Body has 55/64"-27 female thread. Furnished with three adaptors (15/16"-27, 13/16"-27 and 3/8" NPS) for installing on most commonly used faucets, including laboratory-type faucets.

E. Outlet

1. Furnished with removable aerator on bottom.

F. Fixture

1. Guardian Equipment G1101 or approved equal.

G. Quality Assurance

1. Each unit is completely assembled and water tested prior to shipment.
2. Unit shall be hydrostatically tested and come with a full 2-year warranty.
3. Faucet-mounted eyewashes, whether manufactured by Guardian Equipment or other companies, require two motions to operate (turn on water, pull knob to activate eyewash flow).
4. Guardian Equipment does not believe that the faucet-mounted eyewash meets the provisions of ANSI Z358.1-2014 as eyewash units. This equipment is intended solely as supplemental units to an approved station or in locations where ANSI approved equipment is not specifically required. Faucet-mounted eyewashes should be used with cold or warm water only. Use of hot water might cause scalding.

2.02 COMBINATION EYEWASH/SHOWER

A. Design

1. Unit is constructed of polished chrome-plated brass pipe and fittings, 1" IPS and ½" IPS U.S. made polished-chrome plated brass stay-open ball valves, polished stainless steel pull rod, stainless steel shower head with 20 GPM flow control, and stainless steel eyewash bowl.
2. Unit shall have (2) polypropylene GS-Plus™ spray heads with integral "flip-top" dust covers, filters, and 1.6 GPM flow control orifices mounted on a chrome-plated brass eyewash assembly.
3. Unit shall include ANSI compliant sign.

B. Performance

1. Unit shall meet or exceed ANSI Z358.1 – 2014, and come with a full 2-year warranty.

C. Fixture

1. Guardian Equipment G1902PCC or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Safety equipment shall be installed in accordance with manufacturer's installation requirements.

END OF SECTION 22 45 16

DIVISION 23

HVAC

SECTION 23 01 00
HVAC

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section covers heating and ventilating systems for the Main Process Building and Grit Building, including natural gas-fired heaters, electric unit heaters, supply and exhaust fans, ceiling fans, motorized dampers, louvers, and ductwork.

B. Electrical systems to support HVAC equipment are detailed in the Section 26 – Electrical.

C. Natural gas piping and vent/flue systems to support HVAC equipment are specified in Section 22 00 00 - Plumbing.

D. Building automation and controls are specified in Section 23 09 23

1.02 SUBMITTALS

A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.

1. Manufacturer's catalog cuts and specification sheets.
2. Performance data for airflow and electrical draw.
3. Detailed dimensional drawings.
4. Installation instructions, including wiring diagrams.
5. Heating efficiencies and energy consumption.
6. Operation and maintenance manuals.

1.03 COORDINATION OF WORK

A. Heating and ventilation work shall be carefully coordinated with all other work to assure proper support, clearance, electrical service, and final performance.

1.04 GENERAL REQUIREMENTS

A. Standard Products. Equipment furnished under this section shall be the standard product of the manufacturer. Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer; however, all the component parts of each system need not be the product of one manufacturer unless specified herein.

B. Accuracy of Data. The Drawings show the work contemplated, but the Contractor shall be solely responsible for making his own measurements and installing his work to fit the conditions encountered. Before beginning any work, the Contractor shall examine all Drawings and report to the Engineer any apparent discrepancies or interferences.

C. Metal Gauge. The gauge of sheet metal specified herein refers to U.S. Standard gauge and is the minimum permissible thickness.

D. Balancing of Fans and Blowers. All fans and blowers shall be statically and dynamically balanced by the manufacturer before shipment. Whenever possible, the balancing shall be done with the fan wheels mounted on the shaft on which they will operate. Fan shafts shall not pass through their first critical speed as the unit comes up to the rated rpm. Any fan or blower determined to be out of balance by the Engineer shall be field-balanced by a certified balancing contractor. Equipment vibration shall not exceed 3 mils peak-to-peak at bearings of equipment in the vertical, horizontal or axial directions.

E. Equipment Guards. All rotating equipment shall be provided with adequate guards which conform to OSHA requirements.

F. Lubrication and Tools. Equipment requiring lubrication prior to startup shall be lubricated. Any special tools required for the operation or adjustment of equipment shall be furnished.

G. UL Listing. All electrically operated ventilation equipment shall be UL listed.

1.05 QUALITY ASSURANCE

A. Governing Standards and Codes. All work covered by this section shall be performed in accordance with all applicable codes, laws, and regulations. In case of conflict between these Specifications and any code, law, or regulations, the latter shall govern. All work shall comply with UL safety requirements.

B. Materials and Equipment. All major items of mechanical equipment shall be of the best quality normally used for the purpose in good commercial practice and shall be the product of reputable manufacturers. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a nameplate securely affixed in a conspicuous place. The nameplate of a distributing agent only will not be acceptable.

C. Prevention of Rust. Unless otherwise specified, all ferrous sheet metal surfaces other than ductwork shall be shop-painted using a rust-inhibiting treatment consisting of galvanizing or bonderizing, followed by a rust-inhibiting primer and finish paint. Field painting, if required, shall be in accordance with the painting section. Surface finish damaged during installation shall be repaired in accordance with the painting section.

D. Operation and Maintenance Instructions. Copies of all instruction books, parts lists, and wiring diagrams covering all equipment items furnished shall be provided in accordance with the submittals section. The copies shall be bound and delivered.

PART 2 - MATERIALS

2.01 GENERAL

A. Refer to the HVAC Schedules in the Construction Drawings for specific manufacturer model numbers and capacities for all HVAC equipment required for the project. “Or equal” alternatives to manufacturers and models listed will be considered, subject to equivalency in performance, functionality and quality, and based on the requirements for Submittal review.

B. Dampers and wall-mounted fans shall be suitable for insertion in appropriately sized block-outs in 10" nominal depth, precast building walls. Unit frames shall span full masonry depth, or flashing matching frame material shall be installed to span the difference between the frame and wall depths.

C. Louver and damper performance data shall be licensed under the AMCA Certified Ratings Program and shall bear the AMCA Certified Ratings Seal. This certified performance data shall include airflow, pressure loss, and water penetration. Power ventilators shall be AMCA licensed for air and sound performance data.

2.02 REVERSIBLE INDUSTRIAL CEILING FANS

(Grit Building CF-1 through CF-4 and Main Process Building CF-1 through CF-6)

A. Size 56"

CFM: 34,500

RPM: 350

Voltage: 120 VAC, 60 Hz

B. Fans shall have a cast iron yoke and straight aluminum blades. Fans to be UL listed, be moisture and dust resistant, and utilize chrome ball bearings.

C. Finish to be baked enamel, white.

D. Accessories to be provided include (2) reversing, variable speed fan controllers to control the fans being provided as shown in the drawings.

E. Ceiling fans to be *Northwest Envirofan 160C-7* or equal. Fan controllers to be *Northwest Environfan Model 105 FR* or equal.

2.03 COMBINATION LOUVER/DAMPERS

(Grit Building ID-1 Through ID-3 and Main Process Building ED-1 through ED-7)

A. Intake dampers shall be of parallel blade design. Damper blades shall be extruded 6063-T5 aluminum alloy 0.081" in thickness (0.063" thickness allowed on damper widths 48" and greater). Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow and operation in either direction through the damper. Blade shafts shall be plated solid square steel of 0.375" minimum dimension, and positively locked into the damper blade. Drive shafts shall extend 5" beyond jambs and shall be 0.50" minimum diameter. Bearings shall be corrosion resistant, synthetic in extruded holes in the damper frame for maximum service. Blade seals shall be extruded vinyl. Linkage shall be plated steel, concealed in the jamb.

B. Intake damper frames shall be extruded 6063-T5 aluminum alloy, 0.125" in thickness, with reinforced corners. Jamb seals shall be flexible aluminum compression type to prevent leakage between blade end and damper frame.

C. Louver/dampers shall be supplied with standard mill finish.

D. Combination louver/dampers shall be provided with the manufacturer's optional insect screen. Screens shall be corrosion resistant, flat expanded metal.

E. Dampers shall be rated for pressures to 5.0" w.c., velocities to 3000 fpm, and temperatures to 180^{o}F. Testing and ratings shall be per AMCA Standard 500.

F. Motorized operators for dampers shall be of proper size and quantity to control the damper without exceeding the design of the operator. Electric operators shall be two-position, 120 VAC with 75-second stroke timing and 160 degree stroke. Operator accessories shall be provided for respective operators, including mounting brackets, screws, couplings, and linkages for correct installation of operator. Units shall "fail closed" and include spring assist. Operators shall be 2-position to allow for open close position to be relayed to building automation system. Operators may be located in the damper airstream.

G. Motorized dampers shall include integral fixed louvers, with fixed blades of 0.081" minimum thickness. Fixed louver blades shall be set in a common from with the moveable damper.

H. Motorized Intake Louver/Dampers shall be *Greenheck EAC series*, or equal.

2.04 SPARK AND CORROSION RESISTANT DAMPER WITH EXPLOSION PROOF ACTUATOR

(Grit Building ID-4 and ID-5)

A. Construction: Damper frame shall be a minimum of 14 ga. 316SS formed into a 8" x 2" channel with 2" flanges. Damper blades shall be extruded airfoil shaped, aluminum construction (.080 in.) thick with metal blade to metal blade overlap. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal with parallel operation. Blades shall be contained within the damper frame. Dampers shall be spark resistant and nonferrous. Each blade stop (at top and bottom of damper frame) shall occupy no more than ½" of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper. Blade Edge Shall be Silicone. Jamb shall be flexible type 301 stainless steel compression type seals.

B. Actuators: Shall be Commercial Grade 120V with Spring Return. Actuators shall be 2 position, and housed in a nema 4x housing. All actuators shall be explosion proof.

C. Spark and corrosion resistant damper with explosion proof actuator shall be *Greenheck HCD series*, or equal.

2.05 ROOF MOUNTED SUPPLY FANS

(Main Process Building SF-1 through SF-7)

A. Wheel to be constructed of die formed aluminum blades riveted to steel hub.

B. Motor to be open driproof, permanently lubricated, heavy duty ball bearing type. Motor shall be sized to match the fan load. Motor is to be mounted on vibration isolators.

C. Housing/Hood to be leak proof and constructed of aluminum with rigid internal support structure. Housing support frame to be constructed of heavy duty zinc plated steel and provided with aluminum bird screen.

D. Fan shroud and motor cover to be aluminum. Motor cover to be attached with stainless steel hardware.

E. Provide NEMA 3R Disconnect switch wired from fan motor to junction box.

F. Curb caps to be aluminum with pre-punched mounting holes.

G. Provide gravity damper balanced for minimal resistance to flow that prevents outside air from entering when the fan is off.

H. Roof Mounted Supply Fans shall be *Greenheck AS series* or equal.

2.06 ROOF MOUNTED EXHAUST FAN

(Grit Building EF-1 through EF-5)

A. Wheel to be aluminum, non-overloading, backward inclined centrifugal.

B. Provide with aluminum bird screen.

C. Motor to be open driproof, permanently lubricated, heavy duty ball bearing type. Motor shall be sized to match the fan load. Motor is to be mounted on vibration isolators. EF-4 and EF-5 shall be explosion proof.

D. Provide NEMA 3R Disconnect switch wired from fan motor to junction box.

E. Housing, curb cap, and wind band, and motor compartment, and motor cover to be constructed of aluminum. Housing shall have internal rigid support structure. Curb cap base to be fully welded to windband to ensure leak proof construction. Curb cap to have integral deep spun inlet venture and pre-punched mounting holes. Drive frame assembly shall be constructed of heavy gauge steel and mounted on vibration isolators. Provide breather tube of 10 square inches for fresh air motor cooling.

F. Vibration isolation shall be double studded true isolators with no metal to metal contact.

G. Dampers shall be rated for pressures to 5.0" w.c., velocities to 3000 fpm, and temperatures to 180^{o}F. Testing and ratings shall be per AMCA Standard 500.

H. Provide gravity exhaust damper balanced for minimal resistance to flow that prevents outside air from entering when the fan is off.

I. Roof Mounted Exhaust Fans to be *Greenheck GB series* or equal.

2.07 CEILING MOUNTED ROOM EXHAUST FAN

(Grit Building EF-6 and Main Process Building EF-7)

A. Wheel constructed of calcium carbonate filled polypropylene. Open driproof motor, compatible with speed controls. Motor provided with thermal overload protection.

Housing to be galvanized steel. Unit to include backdraft damper to prevent air from entering the building when the fan is off. Outlet shall be a steel duct collar. Grille to be calcium carbonate.

B. Provide frosted lens for incandescent lighting where called out in the drawings.

C. Provide speed control and or switch as shown on the Drawings.

D. Ceiling Mounted Room Fans to be *Greenheck Model SP-B series,* or equal.

2.08 ROOF MOUNTED INLINE FAN

(Main Process Building IF-1 through IF-4)

A. Base fan performance at standard conditions (density 0.075 Lb. /ft3). Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values. Each fan shall be belt driven in AMCA arrangement 9 only with wheel secured to the fan shaft. Fans are to be equipped with lifting lugs.After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.

B. Fan housing to be aerodynamically designed with punched inlet and outlet flanges for ductwork connection on inline fans. Fan housing shall be constructed of rolled steel with a continuous seam weld. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings. Either an OSHA compliant weatherhood, or an OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s).

C. Curb cap shall be constructed of painted steel and welded to the fan housing.Hoods shall be inter-locking panel style for superior strength. Hood construction shall be painted steel.

D. The fan wheel shall be of the non-overloading backward inclined centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.

E. Wheel shall be constructed with completely welded aluminum. The maximum pressure capabilities shall be 4.5 inches W.G. Aluminum parts shall not require protective coating. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

F. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Open Drip Proof (ODP) [Totally Enclosed Fan Cooled (TEFC). Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or

roller pillow block type. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration. Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class {Average Life or (L-50) of 400,000 hours}. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed. Bearings shall have extended lube lines with Zerk fittings to allow for lubrication.

2.09 EXPLOSION-PROOF ELECTRIC UNIT HEATERS

(Grit Building UH-3)

A. Explosion-proof electric unit heaters to be installed in the Headworks Room shall meet NEC Class I, Group D, Division 1 requirements. Unit heaters shall be equipped with liquid-to-air heat exchanger with steel tubes and aluminum fins, and utilize a non-toxic heat transfer fluid. A fluid pressure relief plug shall be provided.

B. Units shall be 480V, three-phase explosion proof, with ball bearing fan motors and thermal overload protection. Heater cabinets shall be powder coated heavy gauge steel surrounding a 14-gage steel frame supporting internal components. Heater shall be ceiling mounted, and the manufacturer's optional ceiling hung mounting kit shall be provided with the heaters.

C. Unit heaters shall include a self-contained control center with automatic reset thermal limit, a magnetic contactor, and 24V control circuit transformer.

D. Electric unit heaters shall be furnished with full line power, three-phase disconnects provided by the heater manufacturer and integral with each unit, meeting NEC Class I, Group D, Division 1 requirements. Integral heater disconnects shall have 30 A rated contacts.

E. Explosion-proof electric unit heaters shall be *Q'Mark GUX series*, or equal.

2.10 NATURAL GAS UNIT HEATERS

(Grit Building UH-1 and UH-2 and Main Process Building UH-1 through UH-7)

A. Natural Gas Fired Unit Heaters shall be ultra-high efficiency with thermal efficiencies up to 97%.

B. All units are supplied with power exhauster with a round vent pipe and combustion air inlet pipe connections.

C. Units shall be equipped with automatic reset vent pressure switch is supplied on all units and is designed to prevent operation of the main burner in the event there is restricted venting of flue products. This restriction may occur due to an improper vent diameter, long vent runs, un-approved vent terminal, high winds, high negative pressure within

space, etc. After the cause of the restriction has been corrected, the pressure switch will reset automatically.

D. The control step down transformer shall be located in the electrical junction box. The transformer is used to step down from 115V to 24V for the gas controls, fan delay relay, field supplied motor starter, etc.

E. Units Shall have an integrated direct spark ignition control combining all furnace control functions. The integrated board provides digital control of the air mover, inducer, ignition, gas valve and flame sense as well as monitoring the safety circuit at all times. The board includes LED diagnostics for trouble shooting and a fused power supply. Ignition control is 100% shut-off with continuous retry.

F. Heaters shall have a flame sensor verifing ignition of all burners, monitors the flame signal and communicates with the integrated circuit board.

G. The main gas valve is factory installed on the unit heater gas train. The main gas valve provides regulator, main gas, and manual shutoff functions. The valve is redundant and provides 100% shut off.

H. Flame roll out switches shall be mounted near the burners and will shut off the gas supply in the event of an unsafe flame roll out condition.

I. Unit shall have a direct spark igniter providing spark for direct ignition of the burners.

J. Unit shall be equipped with high limit switches. One limit control is mounted in the air stream and will shut off the gas supply in the event of overheating. The other limit control is mounted on the power exhauster housing and will shut off the gas supply in the event of overheating flue gas temperatures.

K. Heater shall have a condensate drain overflow switch, shutting down gas controls if condensate is not properly draining from the unit.

L. Unit heaters shall be equipped with external junction box featuring simple connection of supply power wiring internally, thermostat wiring to terminals externally, an On/Off switch, a single 115V outlet for connection of an external condensate pump, and status indicator lights to display the operational state of the unit.

M. Horizontal air deflector blades shall be factory mounted on the discharge of the unit, the blades can be adjusted to provide horizontal (up and down) delivery control of the heated air. Vertical deflector blades are available as a field installed accessory.

N. Blower motors smaller than 3 HP are factory installed on the blower housing. The blower motor is supplied with an adjustable sheave that can be used to increase/decrease the blower RPM, and the blower motor can be provided in a variety of supply voltages and motor horsepower’s.

O. Unit Heater Shall be *Modine Effinity PTC,* or approved equal

2.11 BATHROOM HEATER

(Grit Building BH-1 and Main Process Building BH-1)

A. The heaters shall be fabricated of minimum .024 in. steel with minimum .040 in. steel control boxes. Support brackets shall be .035 in. steel. Junction box enclosure to have provisions for incoming and outgoing cable with cable clamp for restraining without additional hardware. Ground wire pigtail provided in each junction box for grounding.

B. The front cover shall be fabricated of minimum .048 in. steel.

C. The heating element wire shall consist of 80% nickel, 20% chromium, and shall be encased in steel sheath to assure long and trouble free life. Aluminum fins shall be so designed as to block sheath radiation to front and back of heater body and pressure bonded to steel sheath.

D. Heaters shall be designed to permit use of supply conductors with 60°C insulation.

E. Navajo White durable textured polyester powder coat finish for corroison resistance. Linear thermal cut-out shall be factory installed to automatically shut off heater in event of overheating and reactivate heater when temperatures return to normal. The complete heater shall have a height of 6-3/4 inches and a depth of 2-7/8 inches. Heaters shall have cULus approval for mounting on any floor surface including carpeting

2.12 DUCTLESS HEAT PUMP

(Main Process Blower HP-1 and HP-2)

A. Ductless mini split air conditioner 208/1/60 2.5 ton unit. The system shall consist of an indoor wall mounted unit and an outdoor pad mounted unit with liquid and gas line connecting the units. Unit shall be capable of cooling and heating.

B. System shall be rated for a 33,400 Btu/hr cooling capacity with a cooling input power of 2.8 kW.

C. System shall be rated for a 38,000 Btu/hr heating capacity with a heating input power of 3.4 kW.

D. Unit shall be supplied with R-410A refrigerant and capable of holding 12lbs.

E. Unit shall be capable of cooling between 0-115 degrees Fahrenheit and heating between -13-70 degrees Fahrenheit.

F. System shall have internal thermostat in the wall mounted unit.

G. Units shall be capable of being controlled by the building automation system with all applicable inputs and outputs needed.

H. Unit shall be *Daikin model FTX30LVJURXS30LVJU or approved equal*

2.13 DUCTWORK

A. Ductwork shall be sized and routed as shown on the Drawings, providing adapters and transitions as necessary to fit nominal dimensions and penetrations as shown. Where called on the Drawings, double-wall insulated duct shall be used. Duct routings shall be laid out to clear all existing obstacles, including those not shown on the Drawings. The Contractor shall provide transitions and adjustments to nominal duct dimensions shown shall be made as necessary to avoid spatial conflicts.

B. Ductwork shall be supported on adjacent wall and ceiling surfaces with steel straps and suitable fasteners. Steel straps shall be 12-gage, galvanized or stainless steel to match duct material being supported. Ductwork installation shall include adequate supports to provide a stable, secure finished installation.

C. Manufactured Galvanized Round Duct:

1. Single-wall Round Duct: Unless otherwise shown on the Drawings, round duct shall be spiral lockseam, single-wall duct constructed with an interlocking helical seam running the length of the duct. Duct shall be manufactured from 18-gauge, galvanized (both sides) sheet steel.

2. Fittings for round duct shall be of the same manufacturer as, and fully compatible the duct. Fittings shall be of the same type of construction as the duct to which they're attached – single-wall or double-wall insulated

3. Single-wall round duct and fittings shall be *McGill AirFlow Corporation UNI-SEAL* duct, or equal.

4. Grilles for round duct shall be framed galvanized steel units of the sizes and orientations shown on the Drawings, and shall be from the same manufacturer as duct. Grilles shall include closed cell foam gasketing around their full perimeter. Grilles shall be *McGill AirFlow Corporation* model *DDF-G Series*, or equal.

D. Round PVC Duct:

1. PVC duct and fittings shall meet requirements of ASTMD-1784. Fittings and duct shall be gray in color.

2. All duct piping, sizes 6" through 24", shall be PVC seamless extruded type, This duct pipe shall be extruded from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784, trade name H707 PVC. All extruded PVC duct shall have a maximum flame spread rating of 25 or less per ULC S102.2. Material shall carry a maximum temperature rating of 140°F. All extruded PVC duct pipe shall be marked with the manufacturer's name or identifying symbol.

3. Joints to be solvent welded or hot air welded per manufacturer recommendation. Provide flanges as shown in the Drawings.

4. PVC duct and fittings shall be *Harvel, Harrison Plastics*, *Spears*, or equal.

E. Rectangular duct shall be fabricated of shall be 16-gauge, galvanized (both sides) sheet steel. Duct joints shall be flanged or crimped. Crimped insertion type joints shall be riveted with self-expanding aluminum rivets spaced at a maximum of 6" O.C. The interior of finished ductwork sheet metal shall be trimmed of protrusions and obstructions.

F. Elastomeric bellows or flexible duct sections, compatible with adjacent rigid ducting, shall be provided at outlet connections of rotating HVAC equipment to attenuate resonance and vibration.

G. Outdoor Duct Insulation

1. Outdoor Duct Insulation shall consist of two outer layers of aluminum foil that reflect 97% of radiant heat. The outside layer of foil is made of heavier foil. Each layer of foil is bonded to a tough layer of polyethylene for strength. Two inner layers of insulating bubbles resist conductive heat flow while a center layer of polyethylene. Insulation shall be *Reflectix* or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Installation of heating and ventilating equipment shall be performed by qualified and experienced workmen in strict conformance with the Drawings and approved manufacturer's installation submittals.

3.02 EQUIPMENT MOUNTING

A. Wall openings to install HVAC equipment in buildings shall be made as part of the Work. Openings shall be true and clean, taking care to maintain the integrity of interior and exterior surfaces, insulation, and framing members. Provide temporary closures during installation to prevent moisture, rodents, and insects from entering wall cavities.

B. Contractor shall provide mounting members, wall openings, and closures as necessary to adapt equipment to building walls and structures. Supplemental wood or metal structural support members shall be added as required for a secure and finished installation. No exposed insulation or openings to the core of building walls will be permitted in the finished installation; provide adequate closures as part of the Work.

C. Equipment mounting shall utilize the manufacturer’s flanging or self-framing accessories where available.

D. Installations shall be completed to isolate vibration and prevent excessive noise.

3.03 WIRING AND CONTROLS

A. Wiring and controls for ventilation equipment shall be provided and installed as shown on the Drawings, and specified in Section 26, ELECTRICAL.

B. Ventilation equipment shall be wired on dedicated circuits, not in combination with lighting or other electrical equipment, unless specifically shown otherwise on the Drawings.

3.04 SYSTEM DEMONSTRATION

A. Once installation is complete, equipment and controls shall be demonstrated by the Contractor in the presence of the Engineer and the Owner. Any modifications or adjustments needed to equipment operation shall be made by the Contractor, following the demonstration, and the system(s) demonstrated once again.

END OF SECTION 23 01 00

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Include:

1. Balancing Air Systems:

a. Constant-volume air systems.

2. Testing, adjusting, and balancing existing systems and equipment.

1.03 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.04 INFORMATION SUBMITTALS

A. Certified TAB reports.

B. Instrument

1. Instrument type and make.

2. Serial number.

3. Application.

4. Dates of use.

5. Dates of calibration.

1.05 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.

2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, “Instrumentation”.

1.06 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine equipment performance data including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

E. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

F. Examine heat-transfer coils for clean and straight fins.

G. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Duct systems are complete with terminals installed.

b. Volume dampers are open and functional.

c. Clean filters are installed.

d. Fans are operating, free of vibration, and rotating in correct direction.

e. Automatic temperature-control systems are operational.

f. Ceilings are installed.

g. Windows and doors are installed.

h. Suitable access to balancing devices and equipment is provided.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. After testing and balancing, install test ports and duct access doors.

C. Mark equipment and balancing devices, including damper-control positions and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

C. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

D. Check dampers for proper position to achieve desired airflow path.

E. Check for airflow blockages.

F. Check condensate drains for proper connections and functioning.

G. Check for proper sealing of air-handling-unit components.

H. Verify that air duct system is sealed as specified in Section 233113 “Metal Ducts”.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air dampers for proper position that simulates minimum outdoor-air conditions.

b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses, close to the fan and prior to any outlets, to obtain total airflow.

c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.

b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.

d. Report artificial loading of filters at the time static pressures are measured.

3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors.

B. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

2. Measure inlets and outlets airflow.

3. Adjust each inlet and outlet for specified airflow.

4. Re-measure each inlet and outlet after they have been adjusted.

C. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor airflows are within design. Readjust to design if necessary.

2. Re-measure and confirm that total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, and static profile

4. Mark all final settings.

5. Measure and record all operating data.

6. Record final fan-performance data.

3.06 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.

2. Measure motor voltage and amperage. Compare the values to motor nameplate information.

3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. Balance each air outlet.

3.07 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.08 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect’s name and address.
6. Engineer’s name and address.
7. Contractor’s name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans and performance forms including the following:
    a. Conditions of filters.
    b. Cooling, coil, wet- and dry-bulb conditions.
    c. Other system operating conditions that affect performance.

C. Instrument Calibration Reports:

1. Report Data:
    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.09 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 23 05 93

SECTION 23 09 23
BUILDING AUTOMATION AND CONTROLS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish a totally native BACnet-based system, including a Microsoft Windows 10 compatible operator's workstation. This system shall be an extension of the existing Alerton Compass System that the City of Whitefish currently uses at its water treatment plant. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2008, BACnet. In other words, all workstations and controllers, including unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section.

B. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.

C. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.

D. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.

E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.

F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.

G. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.

H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.

I. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.

J. Provide a comprehensive operator and technician training program as described herein.

K. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

L. Provide new sensors, dampers, valves, and install only new electronic actuators. No used

components shall be used as any part or piece of installed system.

1.02 SYSTEM DESCRIPTION

A. A distributed logic control system complete with all hardware functions shall be provided and installed. The system shall be an extension of the existing Alerton BACnet Control System. System shall use all existing Alerton Software, including programming tools and graphic layouts. System shall be completely based on ANSI/ASHRAE Standard 135-2008. This system is to control all mechanical equipment, including all unitary equipment such as Exhaust Fans and Unit Heaters, etc., and all other equipment listed for DDC control. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.

B. Existing Alerton Software shall use Microsoft Windows 10 as the computer operating system, this server is existing. The existing Alerton Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, and a full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. All software required to program application specific controllers and all field level devices and controllers will be left with the owner. All software passwords required to program and make future changes to the system will also become the property of the owner. All software required to make any program changes anywhere in the system, along with scheduling and trending applications, will be left with the owner. All software passwords required to program and make future changes to schedules, trends and related program changes will also become the property of the owner. All software required for all field engineering tools including graphical programming and applications will be left with the owner. All software passwords required to program and make future changes to field engineering tools, including graphical programming and applications will be left with the owner.

C. New Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator’s terminal. Operator’s terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.

D. Room sensors shall be provided with digital readout that allow the user to view room temperature, view outside air temperature, adjust the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor. Include all necessary wiring and firmware such that room sensor includes field service mode. Field service mode shall allow a technician to balance VAV zones and access any parameter in zone controller directly from the room sensor. Field service

mode shall have the ability to be locked out.

E. All application controllers for every unit (EF, UH, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller through BACnet LAN.

1.03 APPROVED MANUFACTURERS

A. The system shall be the Compass system from Alerton. The system shall be an extension of the existing Alerton Control System.

1.04 QUALITY ASSURANCE

A. The Building Automation System (BAS) system shall be designed, installed, commissioned, and serviced by manufacturer authorized and trained personnel. System provider shall have an in-place support facility within 2 hours response time of the site with technical staff, spare parts inventory, and necessary test and diagnostic equipment.

B. The Bidder shall be regularly engaged in the design, installation and maintenance of BAS systems and shall have demonstrated technical expertise and experience in the design, installation and maintenance of BAS systems similar in size and complexity to this project.

C. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.

D. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.

E. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

F. Control system shall be engineered, programmed and supported completely by representative’s local office that must be within **150 miles** of project site.

1.05 REFERENCE STANDARDS

A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:

1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
2. ANSI/ASHRAE Standard 135-2008, BACnet.
3. Uniform Building Code (UBC), including local amendments.
4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
5. National Electrical Code (NEC).
6. FCC Part 15, Subpart J, Class A.

7. EMC Directive 89/336/EEC (European CE Mark).
8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.

B. City, county, state, and federal regulations and codes in effect as of contract date.

C. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work, and arrange for necessary approvals by the governing authorities.

1.06 SUBMITTALS

A. Drawings

1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
2. Drawings shall be submitted in the following standard sizes: 11” x 17” (ANSI B).
3. Eight complete sets (copies) of submittal drawings shall be provided.
4. Drawings shall be available on CD-ROM.

B. System Documentation

Include the following in submittal package:

1. System configuration diagrams in simplified block format.
2. All input/output object listings and an alarm point summary listing.
3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
4. Complete bill of materials, valve schedule and damper schedule.
5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
6. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
7. For all system elements—operator’s workstation(s), building controller(s), application controllers, routers, and repeaters—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
8. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
9. A list of all functions available and a sample of function block programming that shall be part of delivered system.

C. Project Management

1. The vendor shall provide a detailed project design and installation schedule with

time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents, and shall indicate timing and dates for system installation, debugging, and commissioning.

1.07 WARRANTY

A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from substantial completion of the project.

B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours, Monday through Friday and 48 hours on Saturday and Sunday.

C. This warranty shall apply equally to both hardware and software.

PART 2 - PRODUCTS

2.01 ADVANCED WORKSTATION

(AWS) The existing Alerton Computer System will be used.

A. Data Displays

1. Project graphics development shall start with a Graphics Orientation Meeting between the end-user/owner and the graphics design team from the building automation system control contractor. During this meeting floor plan presentations shall be determined along with animation details for equipment specified. Custom graphics that outline the as-built system central plants and equipment layouts such as AHU's, and MUA units are only accepted. Canned graphics that do not match installed equipment is not allowed. Data displays shall render all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings, and wiring diagrams from as-built drawings.

B. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.

C. Operator Activity Log

1. An Operator Activity Log that tracks all operator changes and activities shall be included with AWS. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity Log display.

D. Scheduling

1. AWS, Thick Client and Web Client shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate access privileges.
4. AWS and Thick Client shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.
6. Schedule list shall show all schedules currently defined. This list shall include all standard, holiday and event schedules. In addition, user shall be able to select a list that shows all scheduled points and zones.
7. Display of all three schedules must show all ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show all points and zones affected. User shall be able to set time for one day and select all days of the week that shall be affected as a recurrence of that same schedule for that given day.
8. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule allow the point to be scheduled.
9. Schedule editor shall support drag-n-drop events and holidays onto the schedule calendar.
10. Schedule editor shall support drag-n-drop events default to a two-hour period, which can then be adjusted by the user.
11. Schedule editor shall support drag-n-drop holidays default for OFF all day and can be edited for multiple-day holidays.

12. Schedule editor shall support the view of affected zones when adding or editing timed events of a schedule.

13. The web client shall have the ability to search a list of all scheduled points and zones to access the schedule calendar.

14. Schedule time blocks shall present schedule detail via mouse-over information.

E. Alarm Indication and Handling

1. AWS shall provide visual, printed, and email means of alarm indication. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level.

2. Web client shall display a persistent alarm state for the system regardless of the data view including points in alarm but not acknowledged, and points that have gone into alarm and returned to normal without being acknowledged.

3. Alarm History shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the AWS. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.

F. Trendlog Information

1. AWS shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive data. Samples may be viewed at the web client. All trendlog records shall

G. Workstation Hardware – Existing Alerton System Shall Be Used

2.02 BUILDING CONTROLLER

A. General Requirements

1. BACnet Conformance

a. Building Controller shall be approved by the BACnet Testing Laboratories (BTL) as meeting the BACnet Building Controller requirements.

b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

2. Building controller shall be of scalable design such that the number of trunks and

protocols may be selected to fit the specific requirements of a given project.

3. The controller shall be capable of panel-mounted on DIN rail and/or mounting screws.
4. The controller shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller.
5. The controller shall be capable of running up to six (6) independent control strategies simultaneously. The modification of one control strategy does not interrupt the function or runtime others.
6. The software program implementing the DDC strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a wide area network (WAN) or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
7. Programming shall be object-oriented using control function blocks and support DDC functions. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
8. The programming tool shall provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
9. Controller shall have 6,000 Analog Values and 6,000 Binary Values.
10. Controller IP configuration can be done via a direct USB connect with an operator's workstation or field computer.
11. Controller shall have at a minimum a Quad Core 996Ghz processor to ensure fast processing speeds.
12. Global control algorithms and automated control functions shall execute using a 64-bit processor.
13. Controller shall have a minimum of 1 GB of DDR3 SDRAM on a 533Mhz bus to ensure high speed data recording, large data storage capacity and reliability.
14. Controller shall support two (2) on-board EIA-485 ports capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus.
    a. Ports are capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus.
15. Controller shall support two (2) ports—each of gigabit speed—Ethernet (10/100/1000) ports.

a. Ports are capable of supporting various Ethernet protocols including, but not limited to BACnet IP, FOX, and Modbus.

16. All ports shall be capable of having protocol(s) assigned to utilize the port's physical connection.

17. The controller shall have at a minimum four (4) onboard inputs, two (2) universal inputs and two (2) binary inputs.

18. Schedules

    a. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.

    b. Each building controller shall support a minimum of 380 BACnet Schedule Objects and 380 BACnet Calendar Objects.

19. Logging Capabilities

    a. Each building controller shall log as minimum 2,000 objects at 15-minute intervals. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.

    b. Logs may be viewed both on-site or off-site using WAN or remote communication.

    c. Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.

    d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

20. Alarm Generation

    a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.

    b. Each alarm may be dialed out as noted elsewhere.

    c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.

    d. Controller must be able to handle up to 2,000 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

21. Demand Limiting

    a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 1,200 loads using a minimum of two types of shed programs.

    b. Load shedding programs in building controller modules shall operate as defined

in section 2.1.J of this specification.

22. Tenant Activity Logging

    a. Tenant Activity logging shall be supported by a building controller module. Each independent module shall support a minimum of 380 zones.

    b. Tenant Activity logging shall function as defined in section 2.1.K of this specification.

B. BACnet MS/TP

1. BACnet MS/TP LAN must be software-configurable from 9.6 to 115.4Kbps

    a. Each BACnet MS/TP LAN shall support 64 BACnet devices at a minimum.

    b. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. BACnet IP

1. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the local area network (LAN).

2. Must support interoperability on WANs and campus area networks (CANs), and function as a BACnet Broadcast Management Device (BBMD).

3. Each controller shall support at a minimum 128 BBMD entries.

4. BBMD management architecture shall support 3,000 subnets at a minimum.

5. Shall support BACnet Network Address Translation.

6. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

2.03 CENTRAL PLANT AND AIR HANDLER APPLICATION CONTROLLERS

A. Provide one or more native BACnet application controllers for each air handler and provide native BACnet application controllers as needed for central plant control that adequately cover all objects listed in object list. All controllers shall interface to building controller through either MS/TP LAN using BACnet protocol, or Ethernet LAN using BACnet over Ethernet or BACnet TCP/IP. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.

B. BACnet Conformance

1. Application controllers shall be approved by the BTL as meeting the BACnet

Advanced Application Controller requirements.

2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Multi-state Values, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 12-bit resolution that accept 3K and 10K thermistors, 0–10VDC, Platinum 1000 ohm RTD, 0–5VDC, 4–20mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs with 12-bit resolution shall support either 0–10VDC or 0–20mA. Binary outputs shall have LED indication of status. Software shall include scaling features for analog outputs. Application controller shall include 20VDC voltage supply for use as power supply to external sensors.

1. All outputs must have onboard Hand-Off-Auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.

2. The position of each and every HOA switch shall be available system wide as a BACnet object property.

D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller up to 20 times per second (minimum of 10 times per second) and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator’s terminal.

1. The following control blocks shall be supported:

   a. Natural Log

   b. Exponential

   c. Log base 10

   d. X to the power of Y

e. Nth square root of X

f. 5th Order Polynomial Equations

g. Astronomical Clock (sunrise/sunset calculation)

h. Time based schedules

E. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.

F. Application controller shall include support for intelligent room sensor (see Section 2.10.B.) Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode, based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

G. Schedules

1. The controller shall support a minimum of 3 BACnet Schedule Objects and have a real time clock on board with battery backup to maintain time through a power loss.

H. Logging Capabilities

1. Controller shall support a minimum of 50 trendlogs. Any object in the controller (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.

2. Controller shall periodically upload trended data to system server for long-term archiving if desired. Archived data stored in (MS Jet Database or SQL) database form and shall be available for use in third-party spreadsheet or database programs.

I. Alarm Generation

1. Alarms may be generated within the controller for any object change of value or state (either real or calculated). This includes things such as analog object value changes, and binary object state changes.

2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.

3. Controller must be able to handle up to 25 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

J. The controller processor shall be a 32-bit processor.

K. The packaging of the controller shall provide operable doors to cover the terminals once installation is complete. The housing of the controller shall provide for DIN rail mounting and also fully enclose circuit board.

2.04 APPLICATION CONTROLLERS (UH, Exhaust Fans)

A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance

1. Application controllers shall, as a minimum, support MS/TP BACnet LAN types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support all BACnet services necessary to provide the following BACnet functional groups:

a. Files Functional Group

b. Reinitialize Functional Group

c. Device Communications Functional Group

2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5VDC, 4–20mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.

D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.

E. Application controller shall include support for intelligent room sensor (see Section 2.10.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.05 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

1. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

B. Intelligent Room Sensor with Touchscreen

1. Hardware

a. Room sensor shall include:

i. Backlit touchscreen LCD digital display

ii. Temperature sensor

iii. Humidity sensor

iv. Programmable Status Light indicator. Temperature sensor shall be a Uni-Curve Type II thermistor with an accuracy of +/- 0.36 °F (0.3 °C) at calibration point over the range of 32 to 158 °F or better.

b. Humidity sensor shall have an accuracy of +/-3% from 10 to 90% relative humidity (RH) or better, non-condensing.

c. The intelligent room sensor’s Status Light indicator shall have a minimum of four (4) colors (blue, red, amber and green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of the Status Light indicator shall be fully programmable.

d. The user shall interact with the smart sensor using a touchscreen, with no buttons allowed.

e. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.

f. The touchscreen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.

g. Controller shall function as room control unit, and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.

2. Display Content

   a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.

   b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temperature to customize the view for the customer.

   c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Celsius.

   d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.

   e. Information about the version of firmware shall be displayable on the LCD screen.

   f. A cleaning mode will be provided to allow for the touchscreen to be cleaned without inadvertently making changes to system parameters.

   g. The intelligent room sensor shall have the ability to display the status of a lighting zone and control the on/off state of the zone from the touchscreen using a tenant-accessible display page.

   h. The intelligent room sensor shall have the ability to display the status of a window zone (e.g., blinds) and control the on/off state of the zone from the touchscreen using a tenant-accessible display page.

   i. After Hours Override shall:

      i. Override time may be set and viewed in 30-minute increments.

      ii. Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor.

      iii. Time remaining shall be displayed.

      iv. Display shall show the word “OFF” in unoccupied mode unless a function button is pressed.

3. Other Modes

   a. The intelligent room sensor shall also allow service technician access to hidden functions for advanced system configuration. This functionality shall be accessed-protected with a configurable PIN number.

   b. Field Service Mode shall allow access to common parameters as dictated by the application’s sequence of operations. The parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool

needed.

c. If the intelligent room sensor is connected to VAV controller, Balance Mode shall allow a VAV box to be balanced and all air flow parameters viewed. The balancing parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

4. Intelligent Room Sensor shall be in compliance of the following:

a. UL Standard for Safety 916

b. FCC Part 15.107 & 109, Class B, CFR47-15

c. EMC Directive 89/336/EEC (European CE Mark)

2.06 ENCLOSURES

A. All controllers, power supplies and relays shall be mounted in enclosures.

B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.

C. Enclosures shall have hinged, locking doors.

D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 0.125 inches thick and appropriately sized to make label easy to read.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

B. Notify the owner’s representative in writing of conditions detrimental to the proper and timely completion of the work.

C. Do not begin work until all unsatisfactory conditions are resolved.

3.02 INSTALLATION (GENERAL)

A. Install in accordance with manufacturer's instructions.

B. Provide all miscellaneous devices, hardware, software, interconnections, installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.03 LOCATION AND INSTALLATION OF COMPONENTS

A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3 feet of clear access space in front of units. Obtain approval on locations from owner’s representative prior to installation.

B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.

C. Identify all equipment and panels. Provide permanently mounted tags for all panels.

D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections, and sized to suit pipe diameter without restricting flow.

3.04 INTERLOCKING AND CONTROL WIRING

A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.

B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.

C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.

D. Provide auxiliary pilot duty relays on motor starters as required for control function.

E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.

F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum-rated cable (without conduit).

G. The Electrical Contractor shall provide and install all conduit for the DDC system including the explosion proof conduits and panels located in the Grit Building.

3.05 AS-BUILT DOCUMENTATION REQUIRED

A. Provide all system as build documentation including all redline and field modification completions.

3.06 TRAINING

A. DDC Control Contractor shall employ a full time Systems Training Instructor and be Factory Certified to Provide Factory Certifications on Alerton and System products.

B. System Training Instructor shall instruct owner in operation of systems and equipment as follows.

3.07 DEMONSTRATION

A. Demonstrate complete operating system to owner's representative.

B. Provide certificate stating that control system has been tested and adjusted for proper operation.

PART 4 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

4.01 GENERAL

A. Provide a complete and operational temperature control and building automation system based on the following points and sequence of operation. The system shall be complete as to sequences and standard control practices. The determined point list is the minimum amount of points that are to be provided. If additional points are required to meet the sequence of operation, they will be provided.

B. BACnet Object List

1. The following points as defined for each piece of equipment are designated as follows:

a. Binary Out (BO): Defined as any two-state output (start/stop) (enable/disable), etc.

b. Binary In (BI): Defined as any two-state input (alarm, status), etc.

c. Analog In (AI): Defined as any variable input (temperature) (position), etc.

d. Analog Out (AO): Defined as any electrical variable output. 0–20mA, 4–20mA and 0–10VDC are the only acceptable analog outputs. The driver for analog outputs must come from both hardware and software resident in the controllers. Transducers will not be acceptable under any circumstance.

e. Analog Value (AV):

Remarks	Inputs		Inputs	Outputs	Outputs		Remarks
	AI	BI			AO	BO	
Grit Building							
EMCP Controller -1							
Current Sensing Relay		x	Exhaust Fan-1 Status	Exhaust Fan-1 Enable		x	Idec Relay
Current Sensing Relay		x	Exhaust Fan-2 Status	Exhaust Fan-2 Enable		x	Idec Relay
Current Sensing Relay		x	Exhaust Fan-3 Status	Exhaust Fan-3 Enable		x	Idec Relay
Current Sensing Relay		x	Exhaust Fan-4 Status	Exhaust Fan-4 Enable		x	Idec Relay
Current Sensing Relay		x	Exhaust Fan-5 Status	Exhaust Fan-5 Enable		x	Idec Relay
Current Sensing Relay		x	Exhaust Fan-6 Status	Exhaust Fan-6 Enable		x	Idec Relay
Current Sensing Relay		x	Baseboard Heater-1 Status	Baseboard Heater-1 Enable		x	Idec Relay
Microset 4	x		Baseboard Heater-1 Space Temp				
OSA Temp Sensor	x		OSA Temp Sensor				
EMCP Controller - 2							
From Actuator		x	Inlet Damper-1 Open Feedback	Damper-1 Open/Close		x	Idec Relay
From Actuator		x	Inlet Damper-2 Open Feedback	Damper-2 Open/Close		x	Idec Relay
From Actuator		x	Inlet Damper-3 Open Feedback	Damper-3 Open/Close		x	Idec Relay
From Actuator		x	Inlet Damper-4 Open Feedback	Damper-4 Open/Close		x	Idec Relay
From Actuator		x	Inlet Damper-5 Open Feedback	Damper-5 Open/Close		x	Idec Relay
Current Sensing Relay		x	Unit Heater-1 Status	Unit Heater-1 Enable		x	Idec Relay
Current Sensing Relay		x	Unit Heater-2 Status	Unit Heater-2 Enable		x	Idec Relay
Current Sensing Relay		x	Unit Heater-3 Status	Unit Heater-3 Enable		x	Idec Relay
Microset 4	x		Unit Heater-1 Space Temp				
Microset 4	x		Unit Heater-2 Space Temp				
Stainless Steel Blank Plate Sensor	x		Electrical Room Space Temp				

Remarks	Inputs		Inputs	Outputs	Outputs		Remarks
	AI	BI			AO	BO	
Main Process Building							
EMCP Controller -1							
Current Sensing Relay		x	Inline Fan-1 Status	Inline Fan-1 Enable		x	Idec Relay
Current Sensing Relay		x	Inline Fan-2 Status	Inline Fan-2 Enable		x	Idec Relay
Current Sensing Relay		x	Inline Fan-3 Status	Inline Fan-3 Enable		x	Idec Relay
Current Sensing Relay		x	Inline Fan-4 Status	Inline Fan-4 Enable		x	Idec Relay
Current Sensing Relay		x	Supply Fan-1 Status	Supply Fan-1 Status		x	Idec Relay
Current Sensing Relay		x	Supply Fan-2 Status	Supply Fan-2 Status		x	Idec Relay
Current Sensing Relay		x	Supply Fan-3 Status	Supply Fan-3 Status		x	Idec Relay
Current Sensing Relay		x	Supply Fan-4 Status	Supply Fan-4 Status		x	Idec Relay
Current Sensing Relay		x	Supply Fan-5 Status	Supply Fan-5 Status		x	Idec Relay
Current Sensing Relay		x	Supply Fan-6 Status	Supply Fan-6 Status		x	Idec Relay
Current Sensing Relay		x	Supply Fan-7 Status	Supply Fan-7 Status		x	Idec Relay
EMCP Controller - 2							
From Actuator		x	Exhaust Damper-1 Open Feedback	Exhaust Damper-1 Open/Close		x	Idec Relay
From Actuator		x	Exhaust Damper-2 Open Feedback	Exhaust Damper-2 Open/Close		x	Idec Relay
From Actuator		x	Exhaust Damper-3 Open Feedback	Exhaust Damper-3 Open/Close		x	Idec Relay
From Actuator		x	Exhaust Damper-4 Open Feedback	Exhaust Damper-4 Open/Close		x	Idec Relay
From Actuator		x	Exhaust Damper-5 Open Feedback	Exhaust Damper-5 Open/Close		x	Idec Relay
From Actuator		x	Exhaust Damper-6 Open Feedback	Exhaust Damper-6 Open/Close		x	Idec Relay
From Actuator		x	Exhaust Damper-7 Open Feedback	Exhaust Damper-7 Open/Close		x	Idec Relay
EMCP Controller - 3							
Current Sensing Relay		x	Unit Heater-1 Status	Unit Heater-1 Enable		x	Idec Relay
Current Sensing Relay		x	Unit Heater-2 Status	Unit Heater-2 Enable		x	Idec

							Relay
Current Sensing Relay		x	Unit Heater-3 Status	Unit Heater-3 Enable		x	Idec Relay
Current Sensing Relay		x	Unit Heater-4 Status	Unit Heater-4 Enable		x	Idec Relay
Current Sensing Relay		x	Unit Heater-5 Status	Unit Heater-5 Enable		x	Idec Relay
Current Sensing Relay		x	Unit Heater-6 Status	Unit Heater-6 Enable		x	Idec Relay
Current Sensing Relay		x	Unit Heater-7 Status	Unit Heater-7 Enable		x	Idec Relay
Current Sensing Relay		x	Baseboard Heater-1 Status	Baseboard Heater-1 Enable		x	Idec Relay
Microset 4	x		Unit Heater-1 Space Temp				
Microset 4	x		Unit Heater-2 Space Temp				
Microset 4	x		Unit Heater-3 Space Temp				
Microset 4	x		Unit Heater-4 Space Temp				
Microset 4	x		Unit Heater-5 Space Temp				
Microset 4	x		Unit Heater-6 Space Temp				
Microset 4	x		Unit Heater-7 Space Temp				
Stainless Steel Blank Plate Sensor	x		Electrical Room Space Temp				

END OF SECTION 23 09 23

SECTION 23 31 13
METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.02 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's “HVAC Duct Construction Standards - Metal and Flexible”, Figure 2-1, “Rectangular Duct/Transverse Joints”, for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's “HVAC Duct Construction Standards - Metal and Flexible”.

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's

"HVAC Duct Construction Standards - Metal and Flexible", Figure 2-2, "Rectangular Duct/Longitudinal Seams", for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

2.03 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", Ch. 3, "Round, Oval, and Flexible Duct", based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated

B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", Figure 3-1, "Round Duct Transverse Joints", for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", Figure 3-2, "Round Duct Longitudinal Seams", for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

2.04 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.

2.05 SEALANT AND GASKETS

A. General

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.

4. Water resistant.

5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.

8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel.

2.06 HANGERS AND SUPPORTS

A. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

B. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved in writing.

B. Install ducts in accordance with SMACNA's “HVAC Duct Construction Standards - Metal and Flexible” unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install dampers and all other duct-mounted accessories in air ducts where indicated on Drawings.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's “IAQ Guidelines for Occupied Buildings Under Construction”, Appendix G, “Duct Cleanliness for New

Construction Guidelines", Intermediate Cleanliness Level.

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

D. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS

A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.

B. Provide a drain pocket at each low point and at the base of each riser with a 1-inchtrapped copper drain from each drain pocket to open site floor drain.

C. Minimize number of transverse seams.

D. Do not locate longitudinal seams on bottom of duct.

3.04 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

2. Unconditioned Space, Return-Air Ducts: Seal Class B.

3. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.

4. Conditioned Space, Exhaust Ducts: Seal Class A.

5. Conditioned Space, Return-Air Ducts: Seal Class C.

3.05 HANGERS AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", Chapter 5, "Hangers and Supports".

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel

fasteners appropriate for construction materials to which hangers are being attached.

1. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inchesthick.

C. Hanger Spacing: Comply with SMACNA's “HVAC Duct Construction Standards - Metal and Flexible”, Table 5-1, “Rectangular Duct Hangers Minimum Size”, and Table 5-2, “Minimum Hanger Sizes for Round Duct”, for maximum hanger spacing; install hangers and supports within 24 inchesof each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Steel cables and end connections.

E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.06 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.07 STARTUP

A. Air Balance: Comply with requirements in Section 23 05 93 “Testing, Adjusting, and Balancing for HVAC”.

3.08 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Pressure Class: Positive 1-inch wg.
2. Minimum SMACNA Seal Class: B

C. Return Ducts:

1. Ducts Connected to Furnaces:
    a. Pressure Class: Positive or negative 1-inch wg.
    b. Minimum SMACNA Seal Class: C

D. Exhaust Ducts:

1. Ducts Connected to residential range hoods:
    a. Pressure Class: Negative 1-inch wg.
    b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.

END OF SECTION 23 31 13

SECTION 23 37 13.23
REGISTERS AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Adjustable blade face registers.
2. Fixed face registers and grilles

B. Related Requirements:

1. Section 23 33 00 “Air Duct Accessories” for fire and smoke dampers and volume-control dampers not integral to registers and grilles.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Register and Grille Schedule: Indicate drawing designation, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.01 REGISTERS

A. Adjustable Blade Face Register:

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
    a. Krueger.
    b. Nailor Industries Inc.
    c. Price Industries.
    d. Titus.
2. Material: Aluminum.
3. Finish: Clear Anodized.
4. Face Blade Arrangement: Horizontal.

5. Rear-Blade Arrangement: Vertical.

B. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Krueger.

b. Nailor Industries Inc.

c. Price Industries.

d. Titus.

2. Material: Steel.

3. Finish: Baked enamel, color selected by Architect.

4. Face Blade Arrangement: Horizontal.

2.02 GRILLES

A. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Krueger.

b. Nailor Industries Inc.

c. Price Industries.

d. Titus.

2. Material: Steel.

3. Face Blade Arrangement: Horizontal.

2.03 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, “Method of Testing for Rating the Performance of Air Outlets and Inlets”.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.23

SECTION 23 82 39.19
WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details of anchorages and attachments to structure and to supported equipment.
4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
5. Wiring Diagrams: Power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Berko; Marley Engineered Products.
2. King Electric.
3. Markel Products; TPI Corporation.
4. Marley Engineered Products.
5. Ouellet Canada Inc.
6. QMark; Marley Engineered Products.

2.02 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.03 CABINET

A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.04 COIL

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection.

2.05 FAN AND MOTOR

A. Fan: Aluminum propeller directly connected to motor.

B. Motor: Permanently lubricated.

2.06 CONTROLS

A. Controls: Unit-mounted thermostat.

B. Electrical Connection: Factory wire motors and controls for a single field connection.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install wall and ceiling unit heaters level and plumb.

END OF SECTION 23 82 39.19

DIVISION 26

ELECTRICAL

SECTION 26 03 00
DEMOLITION/REMODEL

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes general requirements and methods of execution relating to the Demolition of portions of the electrical system for the Project.

1.02 DEMOLITION/REMODEL WORK

A. The Contractor shall carefully examine the Drawings and Specifications, visit the project site, and make note of all existing conditions, dimensions, and limitations prior to Bid and make allowances thereto.

B. No Change Orders shall be issued due to the Contractor's lack of knowledge of the existing conditions of the Project and of the amount and difficulty of the remodel and/or demolition work necessary for a complete installation of the systems shown.

C. The Contractor shall also notify all corporations, companies, individuals or local authorities owning, or having jurisdiction over existing utilities and services which interfere in any manner with the execution of the Work under this Contract, and shall remove, relocate or protect such utilities or equipment as required by the parties having jurisdiction over same.

D. If existing active or nonactive services (which may not be shown on Plans) are encountered that require relocation or disconnecting, the Electrical Contractor shall make written request for decision on proper handling of the services. The Electrical Contractor shall not proceed with the Work until so authorized by the Architect.

E. When areas of the existing buildings are adjacent to the area of construction in which work is going on and are occupied, then this Contractor shall arrange the Work so as to reduce to a minimum the periods of interruption or outages in the various services.

F. Not less than one week before any system is to be put out of service, the Contractor shall notify and coordinate with other trades and the Owner of such necessity including the extent of the Work to be done during the outage, possible length of time required for that phase of the Work, and the desired time at which the outage is to begin.

G. Balance additional loads to existing circuitry between phases. Furnish a revised, typed panel directory on existing panelboards where circuitry is changed.

H. Carefully lay out all work in advance to minimize cutting, channeling, or drilling. Where necessary, all cutting and patching shall be done in a manner approved by the Architect. Do not endanger the stability of the structure. Restore any damaged surfaces to original conditions. Contractor at fault to assume all costs.

I. Remove or relocate existing conduits, wires, equipment, devices, or fixtures indicated on Drawings and as required by remodel operations. Where the reuse of existing conduits, wires, devices, or fixture is permitted, verify that wiring is continuous. Existing outlets

or junction boxes shall not be rendered inaccessible by structural changes made to the building. Where existing walls are being furred out or refinished, extend existing outlets and devices to new surface as required.

J. Existing equipment which is indicated as being removed and not indicated for re-use shall be disposed of unless stated otherwise. Remove and dispose of any material, except fluorescent lamps and ballasts. Contractor shall be responsible for disposal of all removed lamps and ballasts. Ballasts may contain PCB's and shall be disposed of according to environmental regulations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 26 03 00

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and all Division 26.

1.02 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.03 QUALITY ASSURANCE

A. Comply with latest adopted IBC Codes, NFPA Codes, Elevator Codes, ANSI, UL, ADAAG, and applicable Local and State Codes. Also comply with Utility Company regulations, industry standards and Construction Documents.

B. Work shall be done by only trained, licensed and experienced workmen familiar with the requirements.

C. All microprocessor based equipment and software with equipment shall utilize 4 digits for the year part of all dates. A two-digit date shall be an option only for printing at Owner's preference.

1.04 EXTENT OF DRAWINGS / SPECIFICATION

A. Drawings indicate intent and general layout of electrical systems for the Project. Drawings are partly diagrammatic and do not indicate all fittings and accessories which may be required. Provide such fittings and accessories as required to form a complete and operating system in general conformance with Specifications and Drawings.

1.05 PRIOR APPROVALS

A. All products submitted for prior approval shall be received by the Engineer 10 business days prior to Bid. Supply technical data, photometrics and dimensional Drawings showing that substitutes are equal to product specified. Faxed prior approvals will not be accepted.

1.06 DISCREPANCIES

A. Prior to submitting Bid, Contractor shall refer any apparent discrepancies or omissions to

Engineer for clarification. The more stringent provisions shall take precedence where codes, Specifications and Drawings differ with one another. The Contractor shall Bid the more expensive requirement, unless discrepancy is addressed by Addendum prior to Bid.

1.07 TEMPORARY LIGHTING/POWER

A. Provide temporary electrical power and lighting for all trades that require service during the course of this Project. Provide temporary service and distribution as required. Comply with the NEC and OSHA requirements. Energy Costs by General Contractor.

1.08 SHOP DRAWING SUBMITTALS

A. General: Follow the procedures specified in Division 01 Section "Submittal Procedures". Submit for final and official approval through the General Contractor.

B. Provide the number of electrical related Shop Drawings, product data, and samples submitted, to allow for required distribution plus one copy of each submittal required, which will be retained by the Electrical Consulting Engineer.

1. Engineer – 1 copy.
2. General Contractor – 2 copies.
3. Subcontractor – copies as required.

C. All Shop Drawings shall be bound in PDF format. Provide title sheet for each Specification Section indicating the Specification number and name. Copies of price list sheets not acceptable.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.

E. Coordinate connecting electrical service to components furnished under other Sections.

F. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Coordinate requirements for access panels and doors where electrical items requiring access are concealed by finished surfaces. Access panels and doors are specified in Division 08 Section "Standard Steel Doors and Frames".

1.10 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements in Division 01 Section

"Closeout Procedures". In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Actual location of all electrical service gear/feeders, panel/motor/special equipment feeders, all major underground or underslab conduits, all conduit stubs for future use, any change in branch circuitry from Drawings, key junction boxes and pull boxes not indicated on Drawings, any control locations or indicator lights not shown on Drawings.
2. Addendum items, Change Order items and all changes made to Drawings from Bidding phase through to Project completion.
3. Actual equipment and materials installed. Where manufacturer and catalog number are indicated on Drawings, generally or in fixture or equipment schedules, change to reflect actual products installed.
4. Change service panel and branch panel breaker locations and schedules to reflect actual installed conditions.

1.11 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01 Section "Closeout Procedures". In addition to the requirements specified in Division 01. Assemble O & M Manuals as follows:

1. Compile Operating and Maintenance Manuals for the electrical systems and equipment. The manuals shall be provided to the Architect for approval complete and at one time, prior to requesting final payment. Partial or separate data will be returned for completion.
2. Manuals shall be assembled in three-ring binders. Binders shall be 3 inch thick or less and have slip sleeve jacket on binder side and front. More than one binder shall be used for each set of data if required to prevent overfilling of one binder. All information shall be arranged in Sections and each Section shall have a blank buff colored, heavy paper divider with a protruding tab clearly labeled. Sections shall be arranged in the same order that the equipment is listed in the Specification and each Specification Section shall have a separate tab. Shop Drawings which are larger than 8-1/2-inch by 11 inch shall be individually folded so they are 8-1/2-inch by 11 inch or less and inserted behind the appropriate tab.
3. Tabs shall be labeled and arranged as follows:
    a. Index: Furnish under the first tab an index of Sections listing name of Section and Specification numbers.
    b. Equipment Manufactures: Furnish under the second tab a complete typed list of equipment suppliers and manufacturers representative including type of equipment, name, address and phone number. The company listed here should be the one which could furnish replacement parts and offer technical information about the equipment.

c. Product Literature: Each tab, starting with the third shall contain the name of a Specification Section. Behind each tab shall be the previously submitted and approved Shop Drawing, factory published operation and maintenance instructions and parts lists. Also include description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions. Servicing instructions and lubrication charts and schedules.

4. Upon completion and approval of the booklets, one copy shall be given to the Architect, and two to the Owner. Using the booklet, the Electrical Contractor shall explain in detail and instruct the Owner's operating personnel in the correct operation and maintenance of the equipment.

1.12 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section “Standard Steel Doors and Frames”.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Joint Sealers”.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center

of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION 26 05 00

SECTION 26 05 19
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

B. Related Sections include the following:

1. Division 27 Section “Communications Copper Horizontal Cabling” for cabling used for voice and data circuits.

1.03 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.06 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Feeders: Copper THHN-THWN. Solid for No. 10 AWG and smaller; stranded for No. 8

AWG and larger.

B. Branch Circuits: Copper THHN-THWN. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Multiconductor Cable: Copper Type AC and Type MC with ground wire. (Only permitted where specifically noted on Construction Documents.)

2.02 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section 26 05 29 “Hangers and Supports for Electrical Systems”.

F. Identify and color-code conductors and cables according to Division 26 Section 26 05 53 “Identification for Electrical Systems”.

G. Feeders and branch circuits shall not be installed in concrete slabs, but are permitted to be routed through concrete slabs perpendicularly and under slabs.

H. Install all wire in raceway; minimum size shall be #12 AWG.

I. Shared neutral conductors are not allowed.

3.02 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.03 COLOR CODING FOR PHASE IDENTIFICATION

A. Color code secondary feeder and branch circuit conductors with factory applied color as follows:

120/208	Phase	277/480 Volts
Black	A	Brown
Red	B	Purple
Blue	C	Yellow
White	N	Grey
Green	G	Green

3.04 FIELD QUALITY CONTROL

A. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.
4. Grounding conductors.
5. Grounding connectors.
6. Grounding busbars.

1.03 DEFINITIONS

A. BCT: Bonding Conductor for Telecommunications.

B. TGB: Tele-communications grounding busbar.

C. TMGB: Tele-communications main grounding busbar.

D. Service Provider: The operator of a service that provides tele-communications transmission delivered over access provider facilities.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in “Field Quality Control” Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.
5. BCT, TMGB, TGB's and routing of their bonding conductors.

6. Busbars.
7. Lugs.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 1 “General Requirements”, include the following:

a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

i. Test wells.

ii. Ground rods.

iii. Ground rings.

iv. Grounding arrangements and connections for separately derived systems.

b. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NETA MTS.

i. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.

ii. Include recommended testing intervals.

c. Results of ground resistance testing.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with NFPA 780 and UL 96 when interconnecting with the lighting protection system.

D. Comply with TIA-607-C for communications systems.

2.02 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required

by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Communications Cable Tray Grounding Bonding Jumper: Minimum No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall be a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by the cable tray manufacturer

2.03 GROUNDING BUSBARS

A. Electrical System Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

B. Communications System Ground Bus: Predrilled rectangular bars of hard-drawn solid copper. The busbar shall be for wall mounting (TMGB, TGB), shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-C. See Construction Documents for sizes. If no sizes are shown on the Drawings, size per 2.3A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2 inch (50 mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. Communications Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.

2.04 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for

applications in which used and for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-UL 486B.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Busbar Connectors: Mechanical lug type.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

L. Straps: Solid copper, copper lugs. Rated for 600 A.

M. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.

N. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

O. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Bronze or brass.

b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

P. Signal Reference Grid Connectors: Combination of mechanical lug type connectors, access floor grounding clamps, bronze u-bolt clamps, and copper split-bolt connectors, designed for this purpose.

2.05 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad; 3/4 inch by 10 feet (19 mm by 3 m).

B. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

2.06 IDENTIFICATION

A. Comply with requirements for identification products in Section 26 05 53.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated. Minimum bonding conductors between TMGB and TB's and structural steel shall be No. 6 AWG.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 30 inches (750 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

E. Grounding Bus: Install in electrical and communications equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

F. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.04 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.05 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70.

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit

and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.06 COMMUNICATIONS EQUIPMENT GROUNDING AND BONDING

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install rack

grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.

J. Rack and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the TGB.

L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.

1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.

2. Bond the TGB of the equipment room to the reference grid at two or more locations.

3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

3.07 FENCE GROUNDING

A. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) except as follows:

1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m).

a. Gates and Other Fence Openings: Ground fence on each side of opening.

i. Bond metal gates to gate posts.

ii. Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.

C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.08 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. Use exothermic welds for all below-grade connections.

3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260533 “Raceways and Boxes for Electrical Systems,” and shall be at least 12 inches (300 mm) deep, with cover.

1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install copper bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel, unless noted otherwise on the Construction Documents.

2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

K. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.09 ELECTRICAL SYSTEM FIELD QUALITY CONTROL

A. Perform test and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.

5. Substations and Pad-Mounted Equipment: 5 ohms.

6. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.10 COMMUNICATIONS FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.

C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

2. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

3. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 07 90 00 "Joint Sealers" for firestopping at conduit and box entrances.

1.03 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

D. EMT: Electrical metallic conduit.

E. ENT: Electrical non-metallic conduit.

F. FMC: Flexible metal conduit.

G. LFMC: Liquid flexible metal conduit.

H. LFNC: Liquid flexible non-metallic conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. GRC: Comply with ANSI C80.1 and UL 6.

3. ARC: Not allowed.

4. IMC: Comply with ANSI C80.6 and UL 1242.

5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

a. Comply with NEMA RN 1.

b. Coating Thickness: 0.040 inch, minimum.

6. EMT: Comply with ANSI C80.3 and UL 797.

7. FMC: Comply with UL 1; zinc-coated steel.

8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
    a. Material: Steel.
    b. Type: Setscrew.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

D. Comply with TIA-569-D for communication systems applications.

2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Fiberglass:
    a. Comply with NEMA TC 14.
    b. Comply with UL 2515 for aboveground raceways.
    c. Comply with UL 2420 for belowground raceways.
3. ENT: Not allowed.
4. RNC: Type EPC-40-PVC with EPC-80 PVC fittings, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
5. LFNC: Comply with UL 1660.
6. Rigid HDPE: Not allowed.

7. Continuous HDPE: Not allowed.
8. Coilable HDPE: Not allowed.
9. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

1. Fittings, General: Listed and labeled for type of conduit, location, and use.
2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
    a. Fittings for LFNC: Comply with UL 514B.
3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, type as indicated on Construction Documents, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

2.04 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS (only where called out on Construction Documents)

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Comply with TIA-569-D for communication systems applications.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.05 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

D. Tele-Power Poles:

1. See Construction Documents for the specified product.

2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.06 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations. Comply with TIA-569-D for communications systems.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C (only where called out on Construction Documents).

E. Metal Floor Boxes:

1. See Construction Drawings for specified product.

2. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable (only where called out on Construction Documents).

1. See Construction Drawings for specified product.

2. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, NEMA, enclosure type as indicated on Construction Documents with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, NEMA enclosure type as indicated on Construction Documents, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.07 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Standard: Comply with SCTE 77.

2. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

5. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATIONS" or as indicated for each service type.

6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

7. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.08 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

2.09 COMMUNICATION CABLING HOOKS

A. Description: Pre-fabricated sheet metal cable supports for communications cabling.

1. Listed and labeled as defined in NFPA 70, by an NRTL and marked for intended location and application.

2. Comply with TIA-569-D.

3. Steel J type.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC with Type EPC-80-PVC fittings.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:
    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Aluminum conduits, boxes, or fittings are not allowed.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors. Comply with NECA 105, NECA III and TIA-569-D for communication systems.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any electrical power or lighting conduit. Support within 12 inches (300 mm) of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Raceways Embedded in Slabs: Not allowed unless specifically indicated on the Construction Documents.

M. Stub-Ups to Above Recessed Ceilings:

1. Use EMT or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

V. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50-inch (15 m).

2. 1-inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75-feet (23 m).

3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

W. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

X. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

Y. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

Z. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

AA. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

BB. Communications Cabling Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.

2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.

3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.

4. Space hooks no more than 5 feet (1.5 m) o.c.

5. Provide a hook at each change in direction.

CC. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

DD. Mount boxes at heights indicated on Drawings. Install boxes with height measured to center of box unless otherwise indicated.

EE. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

FF. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

GG. Locate boxes so that cover or plate will not span different building finishes.

HH. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

II. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

JJ. Set metal floor boxes level and flush with finished floor surface.

KK. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 23 33 "Trenching and Backfilling" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 31 23 33 "Trenching and Backfilling".

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 23 33 "Trenching and Backfilling".

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 90 00 "Joint Sealers”.

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 36
CABLE TRAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Common Work Results for Electrical, apply to this Section.

1.02 SUMMARY

A. The Work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete wire basket support systems as shown on the Drawings.

B. Wire basket support systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

C. NEMA VE 2-2000 - Cable Tray Installation Guidelines.

1.04 DRAWINGS

A. The Drawings, which constitute a part of these Specifications, indicate the general route of the wire basket support systems. Data presented on these Drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

B. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor shall coordinate installation routing with other trades prior to ordering tray and fittings.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer’s data on wire basket support system including, but not limited to, types, materials, finishes and inside depths.

B. Shop Drawings: Submit Drawings of wire basket and accessories including connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps and hold down plates showing accurately scaled components.

1.06 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC, as applicable to construction and installation of cable tray and cable channel systems (Article 318, NEC).

B. NFPA Compliance Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver wire basket support systems and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment.

B. Store wire basket and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with these Specifications, wire basket support systems to be installed shall be as manufactured by one of the following:

1. Cablofil.
2. Chatsworth.
3. Cooper B-Line, Inc.
4. HP Husky.
5. Snake Tray.
6. T&B Express Tray.

2.02 CABLE TRAY SECTIONS AND COMPONENTS

A. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

B. Materials and Finish: Material and finish specifications for each tray type are as follows:

1. Aluminum: Straight section and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. All fabricated parts shall be made from Aluminum Association Alloy 5052.
2. Pre-galvanized Steel: Straight sections, fitting side rails, rungs, and covers shall be made from steel meeting the minimum mechanical properties and mill galvanized in accordance with ASTM A653 SS, Grade 33, coating designation G90.
3. Hot-dip Galvanized Steel: Straight section and fitting side rails and rungs shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 for 14 gauge and heavier, ASTM A1008, Grade 33, Type 2 for 16 gauge and lighter, and shall be hot-dip galvanized after fabrication in accordance with ASTM A123. All covers and splice plates must also be hot-dip galvanized after fabrication; mill galvanized covers are not acceptable for hot-dipped galvanized cable tray. All hot-dip galvanized after fabrication steel cable trays must be returned

to point of manufacture after coating for inspection and removal of all icicles and excess zinc. Failure to do so can cause damage to cables and/or injury to installers.

4. Stainless Steel: Straight section and fitting side rails and rungs shall be made of AISI Type 304 or Type 316 stainless steel. Transverse members (rungs) or corrugated bottoms shall be welded to the side rails with Type 316 stainless steel welding wire.

2.03 LADDER CABLE TRAYS

A. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 6 inches on center. Spacing in radiused fittings shall be 9 inches and measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface of 7/8 inch with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails.

B. Tray Sizes shall have 4 inch minimum usable load depth, or as noted on the Drawing.

C. Straight tray sections shall have side rails fabricated as I-Beams. All straight sections shall be supplied in standard 12 foot lengths, except where shorter lengths are permitted to facilitate tray assembly lengths as shown on Drawings.

D. Tray widths shall be 18 inches or as shown on Drawings.

E. All fittings must have a minimum radius of 12 inches.

F. Splice plates shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between adjacent sections of tray shall not exceed .00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray.

1. Aluminum Tray: Splice plates shall be made of 6063-T6 aluminum, using four square neck carriage bolts and serrated flange locknuts. Hardware shall be zinc plated in accordance with ASTM B633, SC1. If aluminum cable tray is to be used outdoors then hardware shall be Type 316 stainless.

2. Steel (including Pre-galvanized and Hot-dip galvanized): Splice plates shall be manufactured of high strength steel, meeting the minimum mechanical properties of ASTM A1011 HSLAS, Grade 50, Class 1. Each splice plate shall be attached with four ribbed neck carriage bolts with serrated flange locknuts. Hardware shall be zinc plated in accordance with ASTM B633 SC1 for pre-galvanized cable trays, or Chromium Zinc in accordance with ASTM F-1136-88 for hot-dip galvanized cable trays.

3. Splice plates shall be furnished with straight sections and fittings.

G. Cable Tray Supports: Shall be placed so that the support spans do not exceed 10-foot maximum span. Supports shall be constructed from 12 gauge steel formed shape channel members 1-5/8 inch by 1-5/8 inch with necessary hardware such as Trapeze Support Kits provided by the cable tray manufacturer. Cable trays installed adjacent to walls shall be supported on wall mounted brackets.

H. Center hung supports shall be manufactured of 12 gauge, 1-5/8 inch by 1-5/8 inch steel strut with a pipe welded at the middle of the support to provide eccentric loading stability. Support shall

withstand 700 pounds in a 60 percent vs. 40 percent eccentric loading condition with a safety factor of 3.

I. Trapeze hangers and center-hung supports shall be supported by 1/2 inch (minimum) diameter rods.

J. Barrier Strips: Shall be placed as specified on drawings and be fastened into the tray with self-drilling screws.

K. Accessories - special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of but are not limited to; section splice plates, expansion plates, blind-end plates, specially designed ladder dropouts, barriers, etc.

L. Loading Capacities: Cable tray system shall be capable of carrying a uniformly distributed load of 100 lbs./ft. on a 10 foot support span with a safety factor of 1.5 when supported as a simple span and tested per NEMA VE1 Section 5.2.

2.04 WIRE BASKET SECTIONS AND COMPONENTS

A. General: Provide wire basket of types and sizes indicated; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

B. Materials and Finishes: Material and finish Specifications for each wire basket type are as follows:

1. Electro-Galvanized Zinc: Support accessories and miscellaneous hardware shall be coated in accordance with ASTM B633 SC3. All threaded components shall be coated in accordance with ASTM B633 SC1.

2.05 TYPE OF WIRE BASKET SUPPORT SYSTEM

A. All straight section longitudinal wires shall be straight (with no bends).

B. Wire basket shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All wire ends along wire basket sides (flanges) shall be rounded during manufacturing for safety of cables and installers.

C. Wire basket sizes shall conform to the following nominal criteria:

1. Straight sections shall be furnished in standard 118 inch lengths.

2. Wire basket shall have a 2 inch usable loading depth, width as shown on the Construction Documents.

D. All fittings shall be field formed as needed.

E. All splicing assemblies shall be factory fabricated to match cable tray assembly.

F. Wire basket supports shall be center support hangers, trapeze hangers or wall brackets.

G. Trapeze hangers or center support hangers shall be supported by 1/4-inch or 3/8-inch diameter rods.

H. Special accessories shall be furnished as required to protect, support and install a wire basket support system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cable tray and wire basket as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.

B. Coordinate cable tray and wire basket with other electrical Work as necessary to properly interface installation of wire basket runway with other Work.

C. Provide sufficient space encompassing cable tray and wire basket to permit access for installing and maintaining cables.

D. Provide adequate support to carry all present and future loads, times a safety factor of four.

3.02 TESTING

A. Test cable tray and wire basket support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.

END OF SECTION 26 05 36

SECTION 26 05 44
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 07 90 00 "Joint Sealers" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Advance Products & Systems, Inc.

b. BWM Company.

c. CALPICO, Inc.

d. Flexicraft Industries.

e. Metraflex Company (The).

f. Pipeline Seal and Insulator, Inc.

g. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 90 00 "Joint Sealers."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 48.16
SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Seismic and Wind-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include:

1. Control panels.

2. Luminaires.

3. Motor control centers.

4. Panelboards.

5. Transformers.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed:
    a. Ultimate: 120 mph
    b. Nominal: 93 mph
2. Building Classification Category: III.
3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by maximum area of component projected on vertical plane normal to wind direction and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
    a. Component Importance Factor: 1.5.
    b. Component Response Modification Factor: 6.
    c. Component Amplification Factor: 2.5.
2. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.604.
3. Design Spectral Response Acceleration at 1.0-Second Period: 0.389.

2.02 RESTRAINT CHANNEL BRACINGS

A. Manufactures: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.

4. Unistrut; Part of Atkore International

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.03 RESTRAINT CABLES

A. Manufactures: Subject to compliance with requirements, provide products by one of the following:

1. CADDY; a brand of nVent
2. Kinetics Noise Control, Inc.
3. Vibration & Seismic Technologies, LLC.
4. Vibration Mountings & Controls, Inc.
5. Gripple, Inc.

B. Restraint Cables: ASTM A603 galvanized or ASTM A492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.04 SEISMIC-RESTRAINT ACCESSORIES

A. Manufactures: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Gripple, Inc.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.05 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.06 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:

1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Engineer.

5. Test to 90 percent of rated proof load of device.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48.16

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.
9. Receptacle labels.

1.03 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.04 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3 inches (75 mm) high letters on 20 inches (500 mm) centers.

D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4 inches (100 mm) wide black stripes on 10 inches (250 mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size. Utilize same label mediums as identified in Part 2.1 above.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.04 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.05 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.06 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

2.07 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.

B. Accessible Junction Boxes within Buildings: Identify each exposed or accessible junction and pull box with spray paint and with permanent marker indicating voltage and contained circuits. Example: "480 V, H1-26." Apply spray paint to identify the system type as follows:

1. Emergency: Orange.
2. Communications: Green.
3. Mechanical/Electrical Supervisory System: Blue.
4. Security Systems: Yellow.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less:

a. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

b. Apply Colors as Follows:

208Y / 120 Volts	Phase	480 / 277 Volts
Black	A	Brown

Red		B	Purple
Blue		C	Yellow
White		Neutral	Grey
Green	Ground	Green	

D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting:

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    a. Power transfer switches.
    b. Controls with external control power connections.

J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction

signs with approved legend where instructions are needed for system or equipment operation.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch (10 mm) high letters for emergency instructions at equipment used for power transfer.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Unless otherwise indicated, provide a single line of text with 1/2-inch (13 mm) high letters on 1-1/2-inch (38 mm) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

    b. Outdoor Equipment: Stenciled legend 4 inches (100 mm) high.

    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.

    b. Enclosures and electrical cabinets.

    c. Access doors and panels for concealed electrical items.

    d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

    e. Emergency system boxes and enclosures.

    f. Enclosed switches.

    g. Enclosed circuit breakers.

    h. Enclosed controllers.

    i. Variable-speed controllers.

    j. Push-button stations.

    k. Power transfer equipment.

l. Contactors.

m. Power-generating units.

n. Monitoring and control equipment.

M. Receptacle Circuit Labels: Identify all 120 VAC and 208 VAC power receptacle cover plates with serving panel and circuit number designation. Utilize clear self-adhesive label with black letters. Example: "L3 - 25."

END OF SECTION 26 05 53

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE
COORDINATION AND ARC FLASH STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes computer-based, fault-current, overcurrent protective device coordination studies and Arc Flash Studies. Protective devices shall be set based on results of the protective device coordination study. Arc Flash labels shall be applied based on results of the Arc Flash Study.

B. This Section applies to all new normal power and emergency power gear and any existing gear that is affected by increase/decrease in fault current, increase/decrease in require Arc Flash PPE or change in overcurrent settings.

1.03 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Prepare a preliminary report in electronic pdf format of the coordination portion of the study with the electrical gear Shop Drawings. Gear Shop Drawings will not be approved until the preliminary coordination report has been evaluated with the proposed gear.

E. Prepare a Final Study Report in electronic pdf format with tabs as follows:

1. Title that includes the project description, project location address, date, engineer responsible for the report and professional stamp and signature.

2. Introduction and general information relative to the study, notation of any unique information about this project, program used to prepare the study, and general summary.

3. Analysis and Recommendations for the short circuit study, overcurrent study and Arc Flash Study (if applicable). Recommendations for the coordination study must reference a TCC curve that graphically displays the overcurrent devices involved with the recommendation. Each recommendation shall include a short description of reasoning for the recommendation.

4. Calculations for the Short Circuit Study. Include various scenarios from ATS or other switching configurations.
5. Calculations for the Arc Flash study of each piece of switchgear, switchboard, panelboard, transformers, enclosed circuit breakers and disconnects based on AIC values indicated on the construction documents power riser diagram. Arc Flash calculation results shall indicate the energy in joules/second, flash hazard level, flash hazard boundary, required PPE and approach boundaries.
6. Time Current Curves displayed in color. The TCC display sheets shall be numbered and shall be named for ease of finding on the one-line diagram. Example: 1 - L2A to MDP.
7. Overcurrent Device Settings. Display table of overcurrent devices and the settings of each device that were determined in the coordination study.
8. Resource Data. Include back up data that was gathered and used for the study.
9. One-line diagram from the coordination program used indicating each overcurrent device. Tag.

1.04 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Arc Flash Calculations, Personal Protective Equipment (PPE) specifications and hazard level designations shall comply with 2017 NFPA 70 and 2018 NFPA 70E.

F. Design of labels and applications of the signs shall comply with ANSI Z535.4 1998.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide products by the following:

1. SKM Systems Analysis, Inc.

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.

2.03 ARC FLASH LABELS

A. Arc Flash self adhesive labels shall be made of vinyl for each panelboard, transformer, enclosed circuit breaker and enclosed disconnect. Each Arc Flash label shall indicated the following:

1. Arc Flash Energy.
2. Flash Hazard Level.
3. Flash Hazard Boundaries.
4. Approach Boundaries.
5. Required PPE.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 POWER SYSTEM DATA

A. Gather and tabulate the following input data in the resource section of the Study Report to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Data sheets and documented information as follows:
    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios, primary protective device, magnetic inrush current and overload capability.
    c. Motor horsepower, full-load current, locked rotor current, code letter designation, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator KVA size, power factor, Voltage and the following parameters:
        i. ANSI Per unit source impedances, transient and steady state parameters of xd, xd', Td", Td', Tdc, Ra (stator resistance). Include X/R ratios.
        ii. Generator Decrement curve information including Xd" Sat, Xd' Sat and Xd Sat reactances; Td" and Td' time constants; Ta armature short circuit time constant.
        iii. Field current at the given load and field current at no load.
        iv. Generator decrement curve data sheet and any protective overload curve data sheets that are part of the supplied protection with the unit.
    e. Utility company 3-phase potential bolted contribution with associated X/R ratio, Utility company Single-Line-to-Ground potential bolted fault contribution and associated X/R ratio.
    f. Ratings, types, and settings of utility company's overcurrent protective devices.
    g. Special overcurrent protective device settings or types stipulated by utility company.
    h. Time-current-characteristic curves of all devices indicated to be coordinated.
    i. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    j. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    k. Panelboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.
    l. Circuit-breaker and fuse-current ratings and types.
    m. Busway ampacity and impedances.

n. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and actual length.

3.03 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a Bolted Single-Line-to-Ground Fault and Bolted Three phase fault and shall include possible motor contributions, transformer phase shift and Generator contributions. For ATS or switching schemes, determine values with the various schemes. Calculations shall be determined for the following pieces of equipment:

1. Motor-control center.
2. Distribution panelboard.
3. Branch circuit panelboard.
4. Enclosed Circuit breaker or switch.
5. Bus of each Generator.

B. Calculate momentary and interrupting duties on the basis of maximum available fault current.

C. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 (Red Book), IEEE 241 (Gray Book), and IEEE 242 (Buff Book).

1. Transformers:
   a. ANSI C57.12.22 "Standard for Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High-Voltage, 34 500 GrdY/19 920 Volts and Below; Low Voltage, 480 Volts and Below."
   b. IEEE C57.12.00 "Standard for General Requirements for Liquid-Immersed Distribution Power and Regulating Transformers."
   c. IEEE C57.96 "Guide for Loading Dry-Type Distribution and Power Transformers."
2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
3. Low-Voltage Fuses: IEEE C37.46.

D. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram and in report format.
2. Evaluate equipment with the calculated fault currents and report in the summary/recommendations portion of the Study report. Ensure that short circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault

currents. Evaluate adequacy of the equipment grounding conductors and grounding electrode conductors at maximum ground fault currents.

3.04 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.

2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.

3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 (Red Book), IEEE 241 (Gray Book), and IEEE 242 (Buff Book) recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.

b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. Include the following in the Study Report:

1. Settings Selected for Overcurrent Protective Devices in table format indicated in the "settings" tab of the study report:

a. Device tag.

b. Relay manufacturer, type, current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker manufacturer, type, sensor rating; and long-time, short-time, and instantaneous settings.

d. Fuse-current rating and type and manufacturer.

e. Ground-fault relay manufacturer, type, pickup and time-delay settings.

2. Coordination Curves in the "Time Current Curves" tab of the report: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information with maximum of 5 devices per Time current curve display:

   a. Device tag that indicates the device label, device model type and device settings.

   b. Voltage and current ratio for curves.

   c. Damage points for each transformer.

   d. No damage, melting, and clearing curves for fuses.

   e. Clearing curves for breakers.

   f. Cable damage curves.

   g. Transformer inrush points.

   h. Maximum fault-current cutoff point.

   i. Generator decrement curve and overload curve.

   j. Arcing fault for worst case incident energy.

3. Evaluate coordination of all devices and report in the "Analysis and Recommendations" tab. Note any items that do not coordinate, resulting recommendations, or other statements.

3.05 ARC FLASH STUDY

A. Provide Arc Flash calculations for the following pieces of equipment:

   1. Motor-control center.

   2. Distribution panelboard.

   3. Branch circuit panelboard.

   4. Enclosed circuit breaker or switch.

   5. Bus of each generator.

B. For Arc Flash calculations, determine energy in joules/second utilizing AIC values from the Fault Study and Coordination Study. Calculate the following and include in the "Arc Flash Study Report" tab:

   1. Flash Hazard Level.

   2. Flash Hazard Boundaries.

3. Approach Boundaries.

4. Required PPE.

C. Install Self Adhesive Arc Flash labeling for each panelboard, transformer, enclosed circuit breakers and disconnects.

3.06 FIELD OVERCURRENT DEVICE SETTINGS

A. After submittal approval and before gear is energized, set adjustable overcurrent devices in accordance with the "settings" tab of the Study Report.

3.07 TRAINING

A. Training is not included. Owners have the option of providing their own training to Owner's maintenance personnel about Fault Studies, Coordination and Arc Flash hazards indicated on equipment; the types of PPE required and qualified verse non-qualified maintenance personnel.

END OF SECTION 26 05 73

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

2. Buck-boost transformers.

1.03 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.05 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ACME Electric Corporation; Power Distribution Products Division.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. General Electric Company.
4. Siemens Energy & Automation, Inc.
5. Square D; Schneider Electric.
6. Hammond Power Solutions.

2.02 GENERAL TRANSFORMER REQUIREMENTS

A. DOE 2016 Compliant.

B. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

C. Cores: Grain-oriented, non-aging silicon steel.

D. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.03 DISTRIBUTION TRANSFORMERS

A. DOE 2016 compliant.

B. Comply with NEMA ST 20, and list and label as complying with UL 1561.

C. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Seismic Controls for Electrical Systems."

D. Cores: One leg per phase.

E. Enclosure: As indicated on Drawings, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

F. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Standard.

G. Taps for Transformers Smaller than 3 kVA: One 5 percent tap above normal full capacity.

H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

J. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

2. Include special terminal for grounding the shield.

3. Shield Effectiveness:

a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.

b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.

c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

L. Wall Brackets: Manufacturer's standard brackets.

M. Low-Sound-Level Requirements: NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.04 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section 260553 "Identification for Electrical Systems."

2.05 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Seismic Controls for Electrical Systems."

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

3.05 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 24 13
SWITCHBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Utility metering
3. Enclosures
4. Disconnecting and overcurrent protective devices.
5. Control power.
6. Accessory components and features.
7. Identification.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.04 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, surge suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.

6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
4. Settings of each adjustable overcurrent device.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards.

C. Handle and prepare switchboards for installation according to NECA 400 and NEMA PB 2.1.

1.07 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F.

b. Altitude: Not exceeding 6600 feet.

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet.

1.08 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.09 WARRANTY

A. Special Warranty for SPD Only: Manufacturer's standard form in which manufacturer agrees to repair or replace devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric.
3. Siemens.
4. Square D.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted circuit breaker.
2. Branch Devices: Panel mounted circuit breaker.
3. Sections front and rear aligned.

C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

D. Barriers: Between adjacent switchboard sections.

E. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

F. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

G. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
3. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

H. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

2.02 UTILITY METERING

A. Provide utility metering section. Pull section and metering compartment shall comply with EUSERC and Flathead Electric Cooperative requirements.

B. Compartment shall be barriered from the rest of the section, have a hinged lockable front cover, removable bus links with provisions for mounting current transformers, and when required, provisions for mounting voltage transformers. Current and voltage transformers shall be supplied and installed by the utility company.

C. Provide service entrance label and provide necessary applicable service entrance features per NEC and local code requirements.

2.03 ENCLOSURES

A. Outdoor NEMA 3R Enclosure

1. Outdoor enclosure shall be non-walk-in and meet applicable NEMA 3R UL requirements

2. Enclosure shall have sloping roof downward toward rear

3. The enclosure shall be provided with bolt-on rear covers for each section

4. Doors shall have provisions for padlocking

5. Ventilating openings shall be provided complete with replaceable fiber glass air filters

6. Provide thermostatically controlled space heaters, supplied from control power transformer in switchboard, for each structure to prevent the accumulation of moisture.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Main Devices

1. Main device shall be individually mounted, molded case circuit breaker with digital, true RMS sensing trip unit. Provide device as specified in appropriate article below.

2. Main device shall be equipped with Arc Flash Energy-reducing maintenance switching and local status indicator.

3. Where indicated on the Drawings, main device shall be 100% rated.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. Breaker type shall be thermal magnetic, unless indicated otherwise in Construction Documents Schedules or as required by manufacturer.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time delay adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response (except emergency circuits).
4. Molded-Case Circuit-Breaker (MCCB) Standard Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
5. Molded-Case Circuit Breaker Special Features and Accessories: (Only where indicated in Construction Documents Schedules or notes.)
    a. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    b. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    c. Communication Capability: Functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
    d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    e. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

C. Breakers with 1200 amp frame or larger shall be equipment with an Arc Flash Energy-reducing maintenance switching with local status indicator.

2.05 CONTROL POWER

A. Control-Power Transformers:

1. Dry type, mounted in separate compartments for units larger than 3 kVA.
2. Provided with primary and secondary protection and sized as required for proper operation of specified equipment, including space heater.

B. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.06 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400 and NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install switchboards and accessories according to NECA 400 and NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Comply with NECA 1.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

B. Switchboard will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges per the Project Engineer's instruction.

END OF SECTION 26 24 13

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Distribution panelboards.
2. General lighting and appliance branch-circuit panelboards.
3. Lighting control panelboards.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.04 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    a. Enclosure types and details for types other than NEMA 250, Type 1.
    b. Bus configuration, current, and voltage ratings.
    c. Short-circuit current rating of panelboards and overcurrent protective devices.
    d. UL listing for series rating of installed devices.
    e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

D. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.05 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.06 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton Corporation; Cutler-Hammer Products.

b. General Electric Co.; Electrical Distribution & Protection Div.

c. Siemens Energy & Automation, Inc.

d. Square D.

2.02 MANUFACTURED UNITS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets as indicated on the Construction Documents.

1. NEMA rating as indicated on Construction Documents Panel Schedules and Risers.
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Standard Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
5. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
6. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
7. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

C. Phase and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
3. Neutral Bus: Neutral bus rated minimum 100 percent of phase bus and UL listed as suitable for nonlinear loads.
4. Split Bus: Vertical buses divided into individual vertical sections.

D. Conductor Connectors: Suitable for use with conductor material.
1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Mechanical type.
3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

E. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

F. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.03 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.04 DISTRIBUTION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

B. Main Overcurrent Protective Devices: Circuit breaker with electronic (static) trip.

C. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
3. Circuit breaker sizes 50 A to 100 A shall have a minimum of an adjustable long time and instantaneous feature.
4. Circuit breaker sizes larger than 100 A shall be electronic (static) trip.

D. Breakers with 1200 amp frame or larger shall be equipment with an Arc Flash Energy-reducing maintenance switching with local status indicator.

2.05 GENERAL LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Main Overcurrent and Sub-feed Protective Devices. Sizes 50 A to 100 A shall have minimum of an adjustable long time and instantaneous feature. Sizes larger than 100 A shall be electronic (static) type.

B. Branch Overcurrent Protective Devices: Thermal Magnetic type, bolt-on circuit breakers, replaceable without disturbing adjacent units. Coordinate paragraph below with Drawings.

C. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.06 LOAD CENTERS

A. Not allowed, unless specifically specified elsewhere in the Specifications or Construction Documents.

2.07 OVERCURRENT PROTECTIVE DEVICES

A. See Section 2.4 and 2.5 for applications.

B. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic (static) trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I2t response.

4. Molded-Case Circuit-Breaker Standard Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
    a. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
5. Molded-Case Circuit Breaker Special Features and Accessories: (Only where indicated in Construction Documents Schedules or notes.)
    a. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity, 5-mA trip for breakers serving GFCI receptacle circuits.
    b. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

C. Breakers with 1200 amp frame or larger shall be equipment with an Arc Flash Energy-reducing maintenance switching with local status indicator.

2.08 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. When applicable, comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."

C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.
    1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1 inch (27 GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1 inch (27 GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 24 16

SECTION 26 24 19
LOW VOLTAGE MOTOR CONTROL CENTER

PART 1 - GENERAL

1.01 SCOPE

A. This section includes the requirements for 600V-class low voltage motor control centers (MCCs) for use on alternating current power systems.

B. The MCCs shall be furnished and installed as specified in this section and as shown on the Contract Drawings.

1.02 RELATED SECTIONS

A. Section 262816 "Enclosed Switches and Circuit Breakers."

B. Section 262913 "Enclosed Controllers."

C. Section 264313 "Surge Protective Devices for Low Voltage Electrical Power Circuits."

1.03 REFERENCES

A. The MCC shall meet or exceed the requirements within the following standards for MCCs.

1. NEMA ICS 18 - Industrial Control and Systems: Motor Control Centers

2. UL 845 - UL Standard for Safety for Motor Control Centers
NOTE: UL 845 is a harmonized standard consisting of:

a. Underwriters Laboratories Inc. (UL) UL 845.

b. Canadian Standards Association (CSA) C22.2 No. 254-05.

c. Association of Standardization and Certification (ANCE) NMX-J-353-ANCE-2006.

3. NFPA 70 - National Electrical Code.

B. The MCC shall be designed, manufactured, and tested in facilities registered to ISO 9001.

1.04 DESIGN REQUIREMENTS

A. Provide MCC based on applicable NEMA and UL standards and in accordance with the detailed Contract Specifications and Drawings.

B. The manufacturer of the MCC shall also be the manufacturer of the across-the-line motor starters, across-the-line contactors, solid-state reduced voltage starters, and variable frequency drives. The use of third-party supply and assembly for these components in the motor control center is not acceptable and will be rejected.

C. The contractor shall confirm motor full-load amperage ratings and provide those ratings to the MCC manufacturer to achieve proper sizing of the motor branch circuit and overload protection.

1.05 PRE-MANUFACTURE SUBMITTALS

A. Refer to Section 013300 for submittal procedures.

B. Manufacturer Drawings.

1. MCC elevations showing dimensional information including details such as, but not limited to, the following:

a. MCC height (less any removable lifting angles or eyes).

b. MCC width.

c. MCC depth.

d. Location of shipping splits.

2. Structure Descriptions Showing the Following:

a. Bus ratings.

b. Enclosure ratings.

c. Short-circuit withstand ratings.

d. Other information as required for approval.

3. Conduit locations.

4. Required bus splices.

5. Unit descriptions including information such as, starter sizes, circuit breaker frame sizes, circuit-breaker continuous ampere ratings, and pilot devices.

6. Nameplate information.

7. Schematic wiring diagrams.

8. Manufacturer drawings shall be provided in PDF format.

9. Manufacturer drawings do not need to be stamped if a drawing schedule is provided that lists the drawing numbers, version levels, and status of drawings (such as, preliminary, approval, and final).

C. Product Data.

1. Data sheets and publications on all major components including, but not limited to, the following:

a. Motor starters.

b. Overload relays.

c. Circuit breaker and fuse information including time current characteristics.

d. Control power transformers.

e. Pilot devices.

f. Relays.

D. Specification Response.

1. All clarifications and exceptions must be clearly identified.

E. Installation Instructions.

1. Provide a copy of the manufacturer's installation instructions that includes the following:

a. Receiving, handling, and storage instructions.

b. General description for reading nameplate data, serial numbers, UL markings, and short circuit ratings.

c. Installation procedures including splicing procedures.

d. Conduit and cable installation.

e. Installing and removing plug-in units.

f. Operation of operator handles and unit interlocks.

g. Checklist before energizing.

h. Procedure for energizing equipment.

i. Maintenance procedures.

1.06 FINAL SUBMITTALS

A. Refer to Section 013300 for the procedure on submittal of final documentation.

B. The contractor shall provide certification that the MCC has been installed in accordance with the manufacturer's instructions and with local codes and standards that govern MCC installations.

C. The contractor shall provide certification that all circuit breaker settings have been adjusted per field requirements.

D. The contractor shall provide certification that all power fuses have been selected and installed per field requirements.

E. The contractor shall provide certification that all solid-state motor overload settings have been adjusted per installed motor characteristics.

F. The contractor shall provide certification that all settings for solid state devices such as reduced voltage solid-state controllers and variable frequency drives have been adjusted per the specific application requirements.

G. The contractor shall provide certification that any timing devices have been properly adjusted.

H. Final Drawings.

1. The manufacturer shall provide final drawings reflecting the "As-Shipped" state of the MCC documents previously submitted.
2. Manufacturer Drawings shall be provided in PDF format.
3. Manufacturer Drawings do not need to be stamped if a drawing schedule is provided that lists the drawing numbers, version levels, and status of drawings (such as, Preliminary, Approval, Final).
4. The contractor shall be responsible for making any changes to the "as-shipped" Drawings from the manufacturer to reflect any field modifications.

I. Test reports indicating manufacturer's standard testing was performed.

J. Maintenance Data.

1. MCC installation instructions.
2. Installation/operation instructions for major components such as, automatic transfer switch and circuit breakers.
3. MCC spare parts listing and pricing.

1.07 QUALITY ASSURANCE

A. The manufacturer of the MCC shall have a minimum of 35-years experience in the manufacturing and assembly of NEMA Low Voltage motor control centers.

B. The manufacturer shall have ISO 9001 registered facilities for the design, manufacture, and testing of MCCs.

C. MCC sections and individual MCC units shall be designed and manufactured in accordance with UL 845 requirements.

D. MCC sections and individual MCC units shall be UL listed, where possible.

1.08 REGULATORY REQUIREMENTS

A. Contractor shall ensure that the installation conforms to the requirements of the latest edition of the NFPA 70 "National Electrical Code" and/or other applicable installation standards.

1.09 DELIVERY, STORAGE, AND HANDLING

A. The contractor shall coordinate the shipping splits with the MCC manufacturer for entry into the building.

B. Shipping splits shall be noted on the MCC manufacturer drawings.

C. The contractor shall store the MCCs in a clean, dry, and heated space.

D. The contractor shall protect the units from dirt, water, construction debris, and traffic.

E. During storage the contractor shall connect internal space heaters (if specified) with temporary power.

F. MCCs are to be shipped with external lifting angles at the top and running continuously for each shipping split. Lifting eyelets are not acceptable.

1.10 ENVIRONMENTAL REQUIREMENTS

A. The MCC enclosure rating shall be appropriate for the environment where the MCC is to be located.

1.11 FIELD MEASUREMENTS

A. The contractor shall verify all field measurements prior to the fabrication of the MCC.

1.12 WARRANTY

A. The manufacturer shall provide their standard parts warranty for 12 months from the date of invoice.

B. The manufacturer shall confirm this warranty as part of the submittal.

1.13 SPARE MATERIALS

A. The contractor shall review the manufacturer's recommended spare parts list and discuss it with the Owner to determine requirements for spare parts.

B. The contractor is to provide the quotation for spare parts to the Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. MCCs shall be CENTERLINE® 2100 as manufactured by Allen-Bradley.

2.02 RATINGS

A. The MCC shall be rated for the system voltage as indicated on the Contract Drawings.

B. The MCC horizontal and vertical power bus bracing shall be rated to meet or exceed the available fault current as shown on the contract drawings, but shall not be less than 42,000 A rms symmetrical.

C. All MCC units shall have a full rated short-circuit rating that meets or exceeds the available fault current as shown on the contract drawings. The use of series short-circuit ratings shall not be permitted.

D. All circuit breakers used in the motor control center shall have full-rated short-circuit interrupting ratings based on the applied MCC voltage. Slash rated short-circuit interrupting ratings for circuit breakers are not acceptable .

2.03 ENCLOSURE

A. The MCC enclosure shall be NEMA Type 1 with gasket around perimeter of doors.

B. Each section shall be equipped with two full-metal side sheets to isolate each vertical section and to help reduce the likelihood of fault propagation between sections.

C. All interior and exterior surfaces shall be painted ANSI 49 medium-light gray. The vertical wireways and unit back plates shall be painted high-visibility gloss white.

D. All unpainted parts shall be plated for corrosion resistance.

E. Removable closing plates on each end of the MCC shall cover all horizontal bus and horizontal wireway openings.

2.04 STRUCTURE

A. The MCC shall be of dead front construction and shall consist of one or more vertical sections bolted together to form a rigid, free-standing assembly. The systems shall be designed to allow for the addition of future sections at either end and to permit the interchanging of units.

B. Vertical sections shall be rigid, free-standing structures.

1. Vertical sections shall have internal mounting angles running continuously within the shipping block. An external mounting channel that is required to maintain structure integrity is not acceptable.

2. Vertical sections shall be 90 inches high, 20 inches deep and 20 inches wide, except where larger dimensions are required or indicated on the Drawings.

3. Vertical sections shall be provided with a removable steel lifting angle on all shipping blocks. The angle shall run the length of the shipping block.

4. Each standard section shall be capable of being subdivided into 12 usable, unit spaces.

C. Horizontal wireways.

1. Horizontal wireways shall be located at the top and bottom of the MCC.

2. Horizontal wireways shall be 6 inches in height and extend the full depth of the vertical section to allow maximum flexibility in locating conduit for MCC feeds and loads.

a. Pull-boxes to extend the height of the top horizontal wireway by 12 inches shall be provided, if specified on the Contract Drawings.

3. Horizontal wireways shall be continuous across the length of the MCC, except where access needs to be denied due to electrical isolation requirements.

4. The horizontal wireways shall be isolated from the power bus.

5. The horizontal wireways shall have removable covers held in place by captive screws.

D. Provide a full height vertical wireway, independent of the plug-in units, in each standard vertical section.

1. The vertical wireway shall be isolated from the vertical and horizontal buses.

2. The vertical wireway shall be covered with a hinged and secured door.

3. Wireway tie bars shall be provided.

4. Isolation between the wireway and units shall be provided.

2.05 BUS BARS

A. Horizontal Power Bus.

1. The horizontal bus shall be rated as shown on the Drawings.
2. The horizontal bus material shall be copper with tin plating.
3. The horizontal bus shall be supported, braced and isolated from the vertical bus with a high strength, non-conductive, non-tracking, glass polyester material.
4. For standard sections, the horizontal bus shall be continuous within each shipping block and shall be braced within each section.
5. Horizontal bus splices shall have at least two bolts on each side.

B. Vertical Bus.

1. The vertical power bus shall have a minimum effective rating of 600 A. If a center horizontal bus construction is utilized, then the rating shall be 300 A above and below the horizontal bus for an effective rating of 600 A. If a top or bottom mounted horizontal bus is utilized, then the full bus must be rated for 600 A.
2. The vertical bus material shall be copper with tin plating.
3. The vertical bus shall attach to the horizontal bus with at least two bolts.
4. The vertical bus shall be continuously braced by a high strength, non-conductive, non-tracking, glass-filled polyester material and isolated from the unit spaces by a non-conductive, polycarbonate molded cover.
5. The vertical bus shall be isolated from the horizontal power bus except where necessary to connect the vertical power bus to the horizontal power bus.
6. Automatic shutters shall cover plug-in stab openings when units are removed.

C. Ground Bus. Provide a ground bus system consisting of a horizontal ground bus connected to vertical ground buses mounted in each section.

1. Provide a tin-plated copper 0.25 by 2 inches horizontal ground bus mounted in the bottom of the MCC unless otherwise specified in the Drawings.
2. Provide a pressure-type mechanical lug mounted on the ground bus in the incoming line section.
3. Provide a unit ground stab on all unit inserts. The ground stab shall establish unit insert grounding to the vertical ground bus before the plug-in power stabs engage the power bus. The grounding shall be maintained until after the plug-in power stabs are disengaged.

D. Neutral Bus:

1. Provide a fully rated horizontal neutral bus and neutral connection plates in sections.

2.06 UNIT INFORMATION

A. NEMA Size 5 FVNR starters and below shall be provided as plug-in units.

B. Plug-in units:

1. Plug-in units shall consist of a unit assembly, unit support pan, and unit door assembly.

2. Units shall be supplied with removable doors. The unit doors shall be fastened to the structure so that the doors can be closed when the unit is removed.

3. A unit support pan shall be provided for support and guiding units. Unit support pans shall remain in the structure when units are removed to provide isolation between units.

4. A service position shall be provided for plug-in units that allows for the unit to be supported, but disengaged from the bus. The unit shall be capable of being padlocked in the service position. This position is to be used to isolate a unit from the bus to allow service to be performed on the connected load equipment.

C. Power Stabs:

1. Unit stabs for engaging the power bus shall be tin-plated copper and provided with stainless back-up springs to provide and maintain a high pressure 4-point connection to the vertical bus.

2. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed on the rear of the unit. A separate isolated pathway shall be provided for each phase to minimize the possibility of unit fault conditions reaching the power bus system.

3. Power cable termination at the plug-in stab shall be a maintenance-free crimp type connection.

D. Withdrawable Power Stabs:

1. Plug-in units shall have the capacity of withdrawing the power stabs, allowing the primary voltage to be disconnected with the unit door closed.

2. The withdrawable assembly shall accept a standard 1/4 inch hex-style drive socket.

   a. A complete power engagement shall occur when turning the mechanism 1/4 turn in clockwise direction.

   b. Complete power disengagement shall occur when turning the mechanism 1/4 turn in counter-clockwise direction.

3. The withdrawable stabs design shall include a set of stab assembly-mounted shutters.

   a. Shutters shall automatically open before the power stabs can extend and connect to the vertical bus.

   b. Shutters shall close as soon as the power stabs are disconnected from the vertical bus and are completely inside the stab housing.

4. The withdrawable stabs design shall include interlock mechanisms.

   a. A through-the-door mechanism shall allow the unit to be locked in the "Power Stabs Disconnected" position.

i. This mechanism shall be such that it can be padlocked to prevent the connection of the stabs to the vertical bus even when the unit is inserted into the vertical section.

ii. Unit door shall be capable of opening with the padlock and lockout engaged.

b. Unit disconnect handle must be in the OFF position (load side of the disconnect device removed from line power) before the stabs can be disconnected from the vertical bus.

i. Mechanism shall also allow the removal of the unit from the vertical section but only after the disconnect handle has been turned OFF and the power stabs have been disconnected from the vertical bus.

ii. Unit stabs have to be disconnected (withdrawn) before the unit can be re-inserted into the vertical section.

5. The withdrawable stabs design shall include feedback mechanisms that are verifiable with the unit door closed.

a. A two-position indication system shall be provided (Power Stabs Connected/Disconnected) and shall be visible from the door.

i. Connected with Red Indication–Primary voltage stabs fully engaged and connected to the vertical bus.

ii. Disconnected with Green Indication–Primary voltage stabs fully disconnected from the vertical bus.

b. A set of test points shall be located on the front of the unit for identification of:

i. Power stabs position: a positive continuity check between these probes shall verify that all three power stabs have been disconnected from the vertical bus and completely withdrawn inside the stabs housing.

ii. Stab-mounted shutters position: a positive continuity check between these probes shall verify that the shutters are closed, meaning that all three power stabs have been disconnected and withdrawn inside the stab housing.

6. Withdrawable power stabs with door closed mechanism shall not increase the original unit height design so total space in the motor control center is optimized.

7. A remote operating device shall be supplied to allow the connection and disconnection of the power stabs with the door closed.

a. The minimum distance shall be not less than three times the minimum default value recommended by the NFPA 70E (Arc Flash Protection Boundary–Annex D).

E. Disconnect Handle.

1. Plug-in units shall be provided with a heavy-duty, non-conductive, industrial duty, flange mounted handle mechanism for control of each disconnect switch or circuit breaker.

2. Use of rotary operators is not acceptable.
3. Disconnect handles may pivot in the vertical or horizontal plane.
4. On-off condition shall be indicated by the handle position, red and green color indicators with the words ON and OFF, and the international symbols 1 and O along with a pictorial indication of the handle position.
5. Handles shall be capable of being locked in the OFF position with up to three padlocks.
6. Plug-in units shall be provided with interlocks per NEMA and UL requirements Interlocks shall be provided for the following:
    a. Prevention of unit insertion or withdrawal with the disconnect in the ON position.
    b. Prevention of the unit door from being opened when the disconnect is in the ON position.
        i. A feature for intentionally defeating this interlock by qualified personnel shall be provided
    c. Prevention of the disconnect switch from being moved to the ON position if the unit door is open
        i. A feature for intentionally defeating this interlock by qualified personnel shall be provided

F. Pilot Devices:
1. Where specified, units shall be furnished with pushbuttons, selector switches, or pilot lights as shown on the Contract Drawings.
2. Pilot devices shall be 30.5mm and rated NEMA Type 4/13 water tight/oil tight.

G. Terminal Blocks:
1. Control terminal blocks shall be provided on all contactor and starter units.
    a. Control terminal blocks shall be a pull-apart design on all plug-in units for easy removal of the unit from the structure.
2. Control terminal blocks on non-plug-in contactor and starter units shall be fixed type.
3. Power terminal blocks shall be provided on all contactor and starter units, rated NEMA size 3 (100 A) and below that utilize vertically operated disconnects.
    a. Power terminal blocks shall be pull-apart for NEMA size 1 and 2 (30 A and 60 A contactors).
    b. Power terminal blocks for NEMA size 3 starters (100 A contactors) shall be non-pull-apart.
4. Terminal blocks shall not be located adjacent to or inside the vertical wireway.

H. Doors:

1. Each unit shall be provided with a removable door mounted on removable pin-type hinges.
2. The unit doors shall be capable of being opened at least 110 degrees.
3. The unit doors shall be removable from any location in the MCC without disturbing any other unit doors.
4. The unit door shall be fastened to the structure so it can be closed to cover the unit space when the unit is removed.
5. The unit doors shall be held closed with quarter-turn latches.

2.07 METERING COMPARTMENT

A. MCCs shall include a plug-in metering unit.

B. Units shall include the following:

1. Fusible disconnect with fuses.
    a. The disconnect must be operable with the unit door closed.
2. Fused control circuit transformer.
3. Current transformers shipped loose to be installed by the contractor onto incoming power conductors.
4. Solid-state power monitor with door mounted display.

C. Power Monitor:

1. Power monitors shall be capable of displaying the following:
    a. Line current for all three phases with plus or minus 0.2 percent full-scale accuracy.
    b. Average three phase current with plus or minus 0.2 percent full-scale accuracy.
    c. Line-to-neutral and line-to-line voltage with plus or minus 0.2 percent of full-scale accuracy.
    d. Current and voltage unbalance.
    e. Real, reactive, apparent, and true power with plus or minus 0.4 percent full-scale accuracy.
    f. KWh, KVARh, and kVAHnet.
    g. True RMS to the 45th harmonic.
    h. Frequency at plus or minus 0.5 percent.
    i. Power factor at plus or minus 0.4 percent.
2. Power monitors shall include min/max logs and trend logs with up to 45,867 data points.

3. Power monitors shall be capable of performing distortion analysis with THD, Crest Factor (I, V) and Distortion power factor.
4. The power monitor shall include an EtherNet/IP communication port as standard.
5. Power monitors shall include two form-C relays.
6. Power monitors shall be Allen-Bradley PowerMonitor™ 5000 unit or approved equal.

2.08 DISCONNECTS

A. Main Lug Compartment:

1. Provide a main incoming-line lug compartment complete with main lugs to accommodate the incoming power conductors as indicated on the Contract Drawings. Main lugs shall be provided by MCC Manufacturer.

B. Feeder Disconnects:

1. Unless indicated otherwise, disconnecting means for feeders shall be circuit breakers with thermal-magnetic trip units for 250 A and smaller frames; provide an electronic trip unit for frames larger than 250 A.
2. Interrupting capacity rating shall meet or exceed the available fault current as shown on the contract drawings. Interrupting capacity based on a slash rating is not acceptable.
3. Minimum frame size shall be 125 A.
4. Provide one normally open and one normally closed circuit breaker auxiliary contact which follows the position of the circuit breaker main contacts for indication of "On" or "Off/Tripped."

2.09 COMBINATION NEMA ACROSS THE LINE STARTERS

A. Starters shall meet applicable NEMA and UL requirements.

B. Starters shall be minimum NEMA Size 1.

1. Fractional NEMA sizes are not acceptable.

C. The motor starter shall be Allen-Bradley Bulletin 500 or 300 or approved equal.

D. Starters shall be provided with a 3-pole solid state overload relay that includes the following features:

1. Selectable trip classes of 10, 15, 20, or 30.
2. Set for class 20 unless otherwise indicated on the Contract Drawings.
3. Overload protection.
4. Phase loss protection.
5. Trip current adjustment range of 5:1.
6. Visual trip status indication.

7. Test/Reset button.
8. Bipolar latching relay with one normally open and one normally closed contact, rated NEMA B600 for use in motor contactor control circuits.
9. Thermal memory circuit to model the heating and cooling effects of motor on and off periods.
10. Ground Fault protection with a selectable trip value between 20 mA and 5 A.
11. The overload relay shall be Allen-Bradley 193-EE or 592-EE ‘E1 Plus’ or approved equal.

E. In addition to the hold-in contact, starters shall be provided with one normally open and one normally closed auxiliary contact. The starter shall be capable of accommodating up to six contacts in addition to the hold-in contact.

F. Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.

G. Overload relays shall have a reset button located on the outside of the unit door.

H. Provide a door mounted selector switch for Hand-Off-Auto operation. The Hand mode shall provide local control at the MCC unit door. In the Auto mode, control shall be provided through a remote contact.

I. Provide door mounted 120V AC push-to-test pilot lights with LED lamps for indication of the following status:

1. Run: Red.
2. Stop: Green.
3. Fail: Amber.

2.10 MOTOR STARTER UNITS

A. Electro-mechanical NEMA starters:

1. Disconnecting means for the across the line starters shall be motor circuit protectors.
2. Unit short circuit rating shall be greater than or equal to the available fault current as shown on the Contract Drawings.
3. Units shall be supplied based upon the rules/requirements set forth in the UL 845, NEMA ICS-18, and NFPA 70.
4. Contractor shall field adjust the units based upon the particular motor application.
5. Minimum MCP frame size shall be 125 A.
6. Provide one normally open and one normally closed circuit breaker auxiliary contact that follows the position of the circuit breaker main contacts for indication of "On" or "Off/Tripped."

2.11 VARIABLE FREQUENCY DRIVES

A. Variable frequency drives shall be Allen-Bradley PowerFlex 753, or approved equal.

B. Features:

1. Ratings:

a. Voltage:

i. Capable of accepting nominal plant power of 480V AC at 60Hz.

ii. The supply input voltage tolerance shall be ± 10 percent of nominal line voltage.

b. Displacement Power Factor:

i. Six-pulse VFD shall be capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of 0.95 or better at rated load and nominal line voltage, over the entire speed range.

c. Efficiency:

i. A minimum of 96.5 percent (+/- 1 percent) at 100 percent speed and 100 percent motor load at nominal line voltage.

ii. Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.

d. Operating ambient temperature range without derating: 0 deg C to 40 deg C (32 deg F to 104 deg F).

e. Operating relative humidity range shall be 5 percent to 95 percent non-condensing.

f. Operating elevation shall be up to 1000 Meters (3,300 ft) without derating.

2. Sizing:

a. VFD Systems shall be sized for Normal Duty loads and shall provide 110 percent overload capability for up to one minute and 150 percent for up to 3 seconds.

3. Auto Reset/Run:

a. For faults other than those caused by a loss of power or any other non-critical fault, the drive system shall provide a means to automatically clear the fault and resume operation.

4. Ride-Through:

a. The VFD system shall attempt to ride through power dips up to 20 percent of nominal. The duration of ride-through shall be inversely proportional to load. For outages greater than 20 percent, the drive shall stop the motor and issue a power loss alarm signal to a process controller, which may be forwarded to an external alarm signaling device.

5. Run on Power Up:

a. The VFD system shall provide circuitry to allow for remote restart of equipment after a power outage. Unless indicated in the contact drawings, faults due to power outages shall be remotely resettable. The VFD system shall indicate a loss of power to a process controller, which may be forwarded to an external alarm signaling device. Upon indication of power restoration the process controller will attempt to clear any faults and issue a run command, if desired.

6. Communications:
   a. VFD shall be capable of communicating on multiple networks.
   b. VFD shall be capable of supporting the following network options:
      i. DeviceNet.
      ii. EtherNet/IP.
      iii. ControlNet Coax.
      iv. ControlNet Fiber.
      v. Interbus.
      vi. CANopen.
      vii. Modbus/TCP.
      viii. Modbus RTU.
      ix. Profibus DP.
      x. RS-485 DF1.
      xi. RS-485 HVAC.
      xii. Remote I/O.
7. Door Mounted Human Interface Module (HIM):
   a. VFD shall provide a door-mounted HIM with integral LCD display, operating keys and programming keys.
   b. Door-mounted HIM, shall maintain the NEMA rating of the MCC enclosure.
   c. The HIM shall have the following features:
      i. A seven (7) line by twenty-one (21) character backlit LCD display with graphics capability.
      ii. Shall indicate drive operating conditions, adjustments and fault indications.
      iii. Shall be configured to display in the following three distinct zones:
         - The top zone shall display the status of direction, drive condition, fault / alarm conditions and Auto / Manual mode.
         - The middle zone shall display drive output frequency.

- The bottom zone shall be configurable as a display for either programming menus / information or as a two-line user display for two additional values utilizing scaled units.

iv. Shall provide digital speed control.

v. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.

C. Branch Circuit Protection:

1. Provide input fusing, motor circuit protector (MCP), or inverse time circuit breaker as indicated on the Drawings.

D. Control Power Transformer:

1. Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.

2. The transformer shall be rated for 125 percent of the VFD power requirements.

E. Harmonic Mitigation Techniques:

1. Drive Input Line Reactor:

a. Provide a drive input line reactor mounted within the MCC which shall meet shall meet the following specifications:

i. The construction shall be iron core with an impedance of 3 percent.

ii. The winding shall be copper or aluminum wound.

iii. The insulation shall be Class H with a 115 deg C rise over 50 deg C ambient.

iv. The unit shall be rated for system voltage, ampacity, and frequency.

F. Auxiliary Relays:

1. Provide relays for Drive Alarm, Drive Fault, Drive Run, and System Status Faults (as required).

2. The relays shall be Allen-Bradley 700-HC (2 N.O. & 2 N.C.). The relay contacts shall be rated for 115V AC/30V DC, 5.0 amp resistive, 2.5 amp inductive.

G. Control Interface:

1. The control terminals shall be rated for 115V AC.

2. The control interface shall provide input terminals for access to VFD functions that include start, stop, external fault, speed select, and enable, as required.

H. Hand/Off/Auto Selector Switch:

1. Provide a door-mounted "Hand/Off/Auto" selector switch.

2. The "Hand/Off/Auto" selector switch shall start the drive in the "Hand" mode and stop the drive in the "Off" mode.

3. In the "Auto" mode the drive shall be started and stopped from a remote "RUN" contact.
4. In all modes, Auxiliary and Enable inputs to the drive control interface board must be present before the drive will start.
5. When a HIM is present, the stop function shall always be available to stop the drive regardless of the selected mode ("Hand" or "Auto"). The HIM will be non-functional (except for the display and programming) when the switch is in "Off" mode. The HIM shall stop the drive if the switch is in the "Auto" mode with the remote start contact initiated.
6. The drive speed reference shall be controlled from the HIM when in "Hand" mode (factory default setting).
7. The drive speed reference shall be controlled by a remote 4-20 mA input when in "Auto" mode.

I. Pilot Lights:

1. Provide door-mounted 120V AC push-to-test LED pilot lights for indication of the following status:
   a. Run: Red.
   b. Drive Fault: Amber.
   c. Control Power On: White.
   d. Motor Fault: Amber.

J. Provide one isolated, configurable analog input and output.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Contractor shall install MCC in accordance with manufacturer’s instructions.

B. Contractor shall tighten accessible bus connections and mechanical fasteners to the manufacturer’s torque requirements.

C. Contractor shall select and install fuses in fusible switches based upon field requirements.

D. Contractor shall adjust circuit breaker settings based upon field requirements.

E. Contractor shall adjust solid state overloads to match the installed motor characteristics.

3.02 MANUFACTURER’S SERVICES

A. Manufacturer of the MCC shall be capable of providing the programming for the programmable logic controller and the operator interface if provided within the MCC.

B. Manufacturer of the MCC shall be capable of providing start-up services as part of the supply of the MCC.

3.03 TRAINING

A. A course outline shall be submitted as part of the MCC submittals.

B. The manufacturer shall offer off-site training on the concepts, knowledge and tools necessary to design, specify, install, troubleshoot, and use a networked MCC.

END OF SECTION 26 24 19

SECTION 26 27 13
ELECTRICITY METERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes equipment for utility company's electricity metering.

1.03 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences, both automatic and manual. Include the following:

1. Electricity-metering equipment.

B. Shop Drawings for Electricity-Metering Equipment:

1. Dimensioned plans and sections or elevation layouts.

2. Wiring Diagrams: Power, signal, and control wiring specific to this Project. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

3. Mounting and anchoring devices recommended by manufacturer to resist seismic forces specified in Division 26 Section "Seismic Controls for Electrical Systems."

C. Manufacturer Seismic Qualification Certification for Electricity-Metering Equipment: Submit certification that equipment components and their mounting and anchorage provisions have been designed to remain in place without separation of any parts or loosening of factory-made connections when subjected to the seismic forces defined in Division 26 Section "Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculations.

2. Detailed description of equipment mounting and anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For electricity-metering equipment to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center as specified in NECA 400.

1.06 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Owner's written permission.

1.07 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power and communication services.

2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.01 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

B. Meter Sockets: Comply with requirements of electrical power utility company.

1. Housing: NEMA 250, Type 3R enclosure.

a. Structural strength of the housing, its anchorage and component attachment provisions, and anchorage devices recommended for anchoring the housing in place shall be adequate to prevent separation of equipment and its components from their installed positions during a seismic event as defined in Division 26 Section "Seismic Controls for Electrical Systems."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

END OF SECTION 26 27 13

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. General use receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. SPD receptacles, 125 V, 20 A.
4. Hazardous (classified) location receptacles.
5. Twist-locking receptacles.
6. Pendant cord-connector devices.
7. Cord and plug sets.
8. Toggle switches, 120/277 V, 20 A.
9. Wall plates.

1.03 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.01 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Emergency Electrical System: Red.

3. SPD Devices: Blue.

4. Isolated-Ground Receptacles: Orange.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL USE RECEPTACLES, 125 V, 20 A

A. Industrial Grade.

B. Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with UL 498 and FS W-C-596.

C. Isolated-Ground Duplex Receptacles, 125 V, 20 A:

1. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

D. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

E. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

F. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.03 GFCI RECEPTACLES, 125 V, 20 A

A. Industrial Grade.

B. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

C. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

D. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.04 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Hazardous (Classified) Locations Receptacles:

1. See Construction Documents for device specification.
2. Standards: Comply with NEMA FB 11 and UL 1203.

2.05 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L5-20R.
2. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 2-pole, 3-wire:

1. Configuration: NEMA WD 6, Configuration L6-R.
2. Standards: Comply with UL 498.

C. Twist-Lock, Single Receptacles, 277 V, 2-pole, 3-wire:

1. Configuration: NEMA WD 6, Configuration L7-R.

2. Standards: Comply with UL 498.

2.06 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.

B. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.

C. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

D. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

E. Standards: Comply with FS W-C-596.

2.07 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.08 TOGGLE SWITCHES, 120/277 V, 20 A

A. Industrial Grade.

B. Single-Pole Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

C. Two-Pole Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

D. Three-Way Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

E. Four-Way Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

F. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A:

1. Description: Illuminated when switch is on.

2. Standards: Comply with UL 20 and FS W-S-896.

2.09 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Feed-through GFCI receptacles for protection of downstream receptacles is not allowed.

3.03 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use clear label with black lettering on the face of the plate, and durable wire markers or tags inside the outlet box.

3.04 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches, switchboards, controllers and motor-control centers.

2. Spare-fuse cabinets.

1.03 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

2. Let-through current curves for fuses with current-limiting characteristics.

3. Time-current curves, coordination charts and tables, and related data.

4. Fuse size for elevator feeders and elevator disconnect switches.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a. Let-through current curves for fuses with current-limiting characteristics.

b. Time-current curves, coordination charts and tables, and related data.

c. Ambient temperature adjustment information.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

1.05 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than one of each type and size.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussman, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

2.03 SPARE-FUSE CABINET (only if indicated on the Construction Documents)

A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.

3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Feeders: Class RK1, time delay.

B. Motor Branch Circuits: Class RK5, time delay.

C. Other Branch Circuits: Class RK1, time delay.

3.03 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.04 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 26 28 13

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers.
4. Molded-case switches.
5. Enclosures.

1.03 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. HD: Heavy duty.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.04 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.
4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces

defined in Division 26 Section "Seismic Controls for Electrical Systems" Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Manufacturer's field service report.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Source Limitations: Obtain disconnect switches and enclosed circuit breakers from one manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.07 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed. Package materials with protective covering for storage and identify with labels describing contents.

1. Spares: For the following:

a. Fuses for Fusible Switches: 10 percent.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Eaton Corporation; Cutler-Hammer.
2. General Electric Company.
3. Siemens.
4. Square D.

2.02 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Nonfusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.03 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. For breakers 50 A to 100 A, provide breaker with adjustable long time and instantaneous trip. For breakers larger than 100 A, provide electronic (static) type.

B. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic (static) trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and shall have the following field-adjustable settings:
    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I2t response.
4. Molded-Case Circuit-Breaker Standard Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
    a. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
5. Molded-Case Circuit Breaker Special Features and Accessories: (Only where indicated in Construction Documents Schedules or notes.)
    a. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity, 5-mA trip for breakers serving GFCI receptacle circuits.
    b. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    c. Key Interlock Kit: Externally mounted to prohibit circuit breaker operation; key shall be removable only when circuit breaker is in off position.

2.04 ENCLOSURES

A. Flush or surface mounted and NEMA rating as indicated on Construction Documents.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section 260529 "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

3.03 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Test mounting and anchorage devices according to requirements in Division 26 Section "Seismic Controls for Electrical Systems."

2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.06 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.07 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 28 16

SECTION 262913
ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.

1.03 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current rating of integrated unit.

d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.

e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed controllers, accessories, and components will withstand seismic forces defined in Division 26 Section "Seismic Controls for Electrical Systems" Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.06 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every 5 installed, but no fewer than one set of 3 of each type and rating.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Cutler-Hammer Products.

2. General Electrical Company; GE Industrial Systems.

3. Allen-Bradley Co.

4. Siemens/Furnas Controls.

5. Square D.

2.02 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 20 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with a control power source of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

2. Overload Relay (Single Phase Only): Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

3. Adjustable Overload Relay (Three Phase Only): Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.03 ENCLOSURES

A. Description: Surface-mounting cabinets and NEMA rating as indicated on Construction Documents, Schedules, and Risers.

2.04 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Control Relays: Auxiliary and adjustable time-delay relays.

C. Phase-Failure and Undervoltage Relays (5 HP or Larger): Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

D. Current-Sensing, Phase-Failure Relays for Bypass Controllers (5 HP or Larger): Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.05 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.02 INSTALLATION

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Install freestanding equipment on concrete bases.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."

D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.03 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

3.04 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.05 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.

2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.06 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.07 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.08 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

END OF SECTION 26 29 13

SECTION 26 29 23
VARIABLE-FREQUENCY MOTOR CONTROLLER

PART 1 - GENERAL

1.01 SUMMARY

A. The Variable Frequency Drive (VFD) system shall contain all components required to meet the performance, protection, safety and certification criteria of this specification.

1.02 RELATED SECTIONS

A. Section 26 05 00 – Common Work Results for Electrical

B. Section 26 05 53 – Identification for Electrical Systems

C. Section 26 43 13 – Surge Protective Devices for Low Voltage Electrical Power Circuits

1.03 REFERENCES

A. National Fire Protection Association - NFPA 70 - US National Electrical Code.

B. National Electrical Manufacturers Association - NEMA 250 - Enclosures for Electrical Equipment.

C. Underwriters Laboratory Inc. – UL 508.

D. Canadian Standards Association International – CAN/CSA-C22.2 No. 14-05.

E. International Electrical Code - IEC 146.

F. Institute of Electrical and Electronics Engineers, Inc. - IEEE 519 - IEEE Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00

B. Shop Drawings - Approval

1. Elevation Drawings: Include dimensional information and conduit routing locations.

2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.

3. Wiring Diagrams:

a. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.

b. Control Diagram: Include disconnect devices, pilot devices, etc.

4. Major components list.

C. Product Data Sheets

1. VFD and Operator Interface publications.

2. Data sheets and publications on all major components including but not limited to the following:
    a. Contactors
    b. Circuit breaker and fuse (power and control)
    c. Control power transformers
    d. Pilot devices
    e. Relays/Timers

D. Test procedures shall be per the manufacturer's standards.

1.05 CLOSEOUT SUBMITTALS (OPERATION AND MAINTENANCE MANUALS)

A. Submit under provisions of Section 01 33 00

B. Shop Drawings – Final as shipped

1. Elevation Drawings: Include dimensional information and conduit routing locations.
2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.
3. Wiring Diagrams:
    a. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.
    b. Control Diagram: Include disconnect devices, pilot devices, etc.
4. Major components list.

C. Product Data Sheets

1. VFD and Operator Interface publications.
2. Data sheets and publications on all major components including but not limited to the following:
    a. Contactors
    b. Circuit breaker and fuse (power and control)
    c. Control power transformers
    d. Pilot devices
    e. Relays/Timers

D. Test procedures shall be per the manufacturer's standards.

E. Operation and Maintenance Data

1. Service and Contact information
2. VFD and Operator Interface User Manuals
3. Troubleshooting / Service Manuals

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers:

a. The VFD and all associated optional equipment shall be UL listed or recognized and shall have a UL label attached on the inside of the enclosure cabinet.

2. Suppliers:

a. All inspection and testing procedures shall be developed and controlled under the guidelines of the Supplier's quality system and must be registered to ISO 9001 and regularly reviewed and audited by a third party registrar.

b. The VFD shall be factory pre-wired, assembled and tested as a complete package.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall coordinate the shipping of equipment with the manufacturer.

B. Contractor shall store the equipment in a clean and dry space at an ambient temperature range of -25 °C to 55 °C (-13 °F to 130 °F).

C. The contractor shall protect the units from dirt, water, construction debris and traffic.

1.08 WARRANTY

A. The manufacturer shall provide their standard parts warranty for eighteen (18) months from the date of shipment or twelve (12) months from the date of being energized, whichever occurs first.

B. This warranty applies to variable frequency drive systems.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Allen-Bradley – PowerFlex 753 VFD, or ***pre-approved*** equal. The City's intent is to utilize AB drives in order to be consistent with other drives implemented in its utility infrastructure projects.

2.02 VARIABLE FREQUENCY DRIVE UNIT

A. Features

1. Certifications

a. Listed to UL508C and CAN/CSA-C22.2 No. 14-05

b. In conformity with EMC Directive (2004/108/EC) and Low Voltage Directive (2006/95/EC). Standards applied; EN 61800-3:2004, EN 61800-5-1:2007

c. Electric Power Research Institute. Certified compliant with standards SEMI F47 and IEC 61000-4-34

2. Hardware
    a. Utilize diode bridge or SCR bridge on the input rectifier.
    b. Utilize DC bus inductor on all six-pulse VFDs only.
    c. Utilize switching logic power supply operating from the DC bus.
    d. Incorporate phase to phase and phase to ground MOV protection on the AC input line.
    e. Microprocessor based inverter logic shall be isolated from power circuits.
    f. Utilize latest generation IGBT inverter section.
    g. Battery receptacle for Lithium battery power to the Real Time Clock.
    h. Additional DPI port for handheld and remote HIM options.
    i. Dedicated Digital Input for hardware enable.
    j. Conformal coated printed circuit boards.
    k. Optional onboard 24V DC Auxiliary Control Power Supply.
3. Control Logic
    a. Ability to operate with motor disconnected.
    b. Provide a controlled shut down, when properly protected, with no component failure in the event of an output phase to phase or phase to ground short circuit. Provide annunciation of the fault condition.
    c. Provide multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold, Fast Braking, and Current Limit Stop.
    d. Provide multiple acceleration and deceleration rates.
    e. Adjustable output frequency up to 650Hz.
4. DeviceLogix Control
    a. Ability to control outputs and manage status information locally within the VFD.
    b. Ability to function stand-alone or complimentary to supervisory control.
    c. Ability to speed reaction time by processing in the VFD.
    d. Ability to provide scaling, selector switches, or other data manipulations not already built into the VFD.
    e. Ability to read inputs/write outputs and exclusively control the VFD.
    f. Ability to provide an option for decision making if communication is lost with main controller.
    g. Ability to control other VFDs via a peer-to-peer EtherNet/IP network.
    h. Ability to write programs off-line.

5. Motor Control Modes
    a. Selectable Sensorless Vector, Flux Vector, V/Hz, and Adjustable Voltage Control modes selectable through programming.
    b. The drive shall be supplied with a Start-up and Auto-tune mode.
    c. The V/Hz mode shall be programmable for fan curve or full custom patterns.
    d. Capable of Open Loop V/Hz.
6. Current Limit
    a. Programmable current limit from 20 to 160% of rated output current.
    b. Current limit shall be active for all drive states: accelerating, constant speed and decelerating.
    c. The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.
7. Acceleration / Deceleration
    a. Accel/Decel settings shall provide separate adjustments to allow either setting to be adjusted from 0 to 3600 seconds.
    b. A second set of remotely selectable accel/decel settings shall be accessible through digital inputs.
8. Speed Profiles
    a. Programming capability shall allow the user to produce speed profiles with linear acceleration/deceleration or "S Curve" profiles that provide changing accel/decel rates.
    b. S Curve profiles shall be adjustable.
9. Adjustments
    a. A digital interface can be used for all set-up, operation and adjustment settings.
    b. All adjustments shall be stored in nonvolatile memory (EEPROM).
    c. No potentiometer adjustments shall be required.
    d. EEPROM memory for factory default values shall be provided.
    e. Software must be available for trending and diagnostics, as well as online and offline programming functionality.
10. Process PID Control
    a. The drive shall incorporate an internal process PI regulator with proportional and integral gain adjustments as well as error inversion and output clamping functions.

b. The feedback shall be configurable for normal or square root functions. If the feedback indicates that the process is moving away from the set-point, the regulator shall adjust the drive output until the feedback equals the reference.

c. Process control shall be capable of being enabled or disabled with a hardwire input. Transitioning in and out of process control shall be capable of being tuned for faster response by preloading the integrator.

d. Protection shall be provided for a loss of feedback or reference signal.

11. Skip Frequencies

a. Three adjustable set points that lock out continuous operation at frequencies which may produce mechanical resonance shall be provided.

b. The set points shall have a bandwidth adjustable from Maximum Reverse Speed to Maximum Forward Speed.

12. Fault Reset/Run

a. The drive shall provide up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart.

b. The automatic mode shall not be applicable to a ground fault, shorted output faults and other internal microprocessor faults.

c. The time between restarts shall be adjustable from 0.5 seconds to 30 seconds.

13. Run on Power Up

a. A user programmable restart function shall be provided to allow restart of the equipment after restoration of power after long duration power outages. Restart time dependent on presence of incoming signal.

14. Fault Memory

a. The last 32 fault codes shall be stored and time stamped in a fault buffer.

b. Information about the drive’s condition at the time of the last fault such as operating frequency, output current, dc bus voltage and twenty-seven other status conditions shall be stored.

c. A power-up marker shall be provided at each power-up time to aid in analyzing fault data.

d. The last 32 alarm codes shall be stored and time stamped for additional troubleshooting reference.

15. Overload Protection

a. The drive shall provide internal class 10 adjustable overload protection.

b. Overload protection shall be speed sensitive and adjustable.

c. A viewable parameter shall store the overload usage.

16. Auto Economizer

a. An auto economizer feature shall be available to automatically reduce the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage shall be reduced to minimize flux current in a lightly loaded motor thus reducing kW usage.

b. When the load increases, the drive shall automatically return to normal operation.

17. Terminal Blocks

    a. Separate terminal blocks shall be provided for control and power wiring.

    b. I/O terminal blocks shall be removable with wiring in place.

18. Flying Start

    a. The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed. This feature is disabled by default.

19. Inputs and Outputs

    a. The Input / Output option modules shall consist of both analog and digital I/O.

    b. No jumpers or switches shall be required to configure digital inputs and outputs.

    c. All digital input and output functions shall be fully programmable.

    d. The control terminal blocks shall be rated for 115V AC.

    e. Inputs shall be optically isolated from the drive control logic.

    f. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed, and enable.

    g. The VFD shall be capable of supporting up to 7 analog inputs, 7 analog outputs, 21 digital inputs, 7 relay outputs, 7 transistor outputs, and 3 positive temperature coefficient (PTC) inputs.

    h. The Input / Output option modules shall have the following features:

        i. Analog Inputs:

            - Quantity two (2) differentially isolated, ±10V (bi-polar), 88k ohm input impedance, 11 bit plus sign.

            - Analog inputs shall be user programmable for a variety of uses including frequency command and process loop input. Analog inputs shall be user programmable for function scaling (including invert), offset, signal loss detect and square root.

        ii. Analog Outputs:

            - Quantity two (2) ±10V (bi-polar) / 11 bit & sign, 2 k ☐ minimum load
              20 mA, 11 bit plus sign, 400 ☐ maximum load.

- The analog output shall be user programmable to be proportional to one of fourteen process parameters including output frequency, output current, encoder feedback, output power.
- Programming shall be available to select either absolute or signed values of these parameters.

iii. Digital Inputs:

- Quantity of six (6) digital inputs rated 24V DC/115V AC.
- All inputs shall be individually programmable for multiple functions including: Start, Run, Stop, Auxiliary Fault, Speed Select, Jog and Process PI functions.

iv. Digital Outputs:

- At least one (1) relay output (N.O. or N.C.).
- For 240V AC or 24V DC, N.O. contact output ratings shall be 2 amp max., general purpose (inductive)/resistive. N.C. contact output ratings shall be 2 amp max., resistive only.
- Relays shall be programmable to multiple conditions including: Fault, Alarm, At Speed, Drive Ready and PI Excess Error.
- Timers shall be available for each output to control the amount of time, after the occurring event, that the output relay actually changes state.
- At least one (1) transistor output.
- For 24V DC, transistor output rating shall be 1 amp max, Resistive.

20. Reference Signals
    a. The drive shall be capable of using the following input reference signals:
        i. Analog inputs
        ii. Preset speeds
        iii. Remote potentiometer
        iv. Digital MOP
        v. Human Interface Module
        vi. Communication modules
21. Loss of Reference
    a. The drive shall be capable of sensing reference loss conditions.
    b. In the event of loss of the reference signal, the drive shall be user programmable to the following:
        i. Fault the drive and coast to stop.

ii. Issue a minor fault - allows the drive to continue running while some types of faults are present.

iii. Alarm and maintain last reference.

c. When using a communications network to control the drive, the communications adapter shall have these configurable responses to network disruptions and controller idle (fault or program) conditions:

i. Fault

ii. Stop

iii. Zero Data

iv. Hold Last State

v. Send Fault Configuration

22. Metering

a. At a minimum, the following parameters shall be accessible through the Human Interface Module, if installed:

i. Output Current in Amps

ii. Output Voltage in Volts

iii. Output Power in kW

iv. Elapsed MWh

v. DC Bus Voltage

vi. Frequency

vii. Heatsink Temperature

viii. Last eight (32) faults

ix. Elapsed Run Time

x. IGBT Temperature

23. Faults

a. At a minimum, the following faults shall be accessible through the Human Interface Module:

i. Power Loss

ii. Undervoltage

iii. Overvoltage

iv. Motor Overload

v. Heat Sink Over-temperature

vi. Maximum Retries

vii. Phase to Phase and Phase to Ground Faults

24. Predictive Diagnostics
    a. At a minimum, the following predictive diagnostic features shall be provided:
        i. Relay Output Life Cycles based on load type and amps.
        ii. Hours of Fan Life based on load and ambient temperature.
        iii. Motor Bearing life based on expected hours of use.
        iv. Motor Lubrication schedule based on hours of use.
        v. Machine Bearing life based on expected hours of use.
25. Real-Time Clock
    a. Shall be capable of providing time stamped events.
    b. Shall have the ability to be set locally or via a remote controller.
    c. Shall provide the ability to be programmable for month, day, year and local time zones in HH:MM:SS.

2.03 VFD PACKAGED SYSTEM

A. Features
1. Ratings
    a. Voltage
        i. Capable of accepting nominal plant power of 480V AC at 60Hz.
        ii. The supply input voltage tolerance shall be ± 10% of nominal line voltage.
    b. Displacement Power Factor
        i. Six-pulse VFD shall be capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of 0.95 or better at rated load and nominal line voltage, over the entire speed range.
    c. Efficiency
        i. A minimum of 96.5% (+/- 1%) at 100% speed and 100% motor load at nominal line voltage.
        ii. Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.
    d. Operating ambient temperature range without derating: 0 °C to 40 °C (32 °F to 104 °F)
    e. Operating relative humidity range shall be 5% to 95% non-condensing.
    f. Operating elevation shall be up to 1000 Meters (3,300 ft) without derating.
2. Sizing

a. VFD Systems shall be sized for Heavy Duty loads and shall provide 150 percent overload capability for up to one minute and 180 percent for up to 3 seconds.

3. Auto Reset/Run

   a. For faults other than those caused by a loss of power or any other non-critical fault, the drive system shall provide a means to automatically clear the fault and resume operation.

4. Ride-Through

   a. The VFD system shall attempt to ride through power dips up to 20% of nominal. The duration of ride-through shall be inversely proportional to load. For outages greater than 20%, the drive shall stop the motor and issue a power loss alarm signal to a process controller, which may be forwarded to an external alarm signaling device.

5. Run on Power Up

   a. The VFD system shall provide circuitry to allow for remote restart of equipment after a power outage. Unless indicated in the contact drawings, faults due to power outages shall be remotely resettable. The VFD system shall indicate a loss of power to a process controller, which may be forwarded to an external alarm signaling device. Upon indication of power restoration the process controller will attempt to clear any faults and issue a run command, if desired.

6. Communications

   a. VFD shall be capable of communicating on multiple networks.

   b. VFD shall be capable of supporting the following network options:

      i. DeviceNet

      ii. EtherNet/IP

      iii. ControlNet Coax

      iv. ControlNet Fiber

      v. Interbus

      vi. CANopen

      vii. Modbus/TCP

      viii. Modbus RTU

      ix. Profibus DP

      x. RS-485 DF1

      xi. RS-485 HVAC

      xii. Remote I/O

7. Enclosure Door Mounted Human Interface Module (HIM)

a. VFD shall provide a HIM with integral LCD display, operating keys and programming keys.

b. An enclosure door-mounted HIM, shall maintain the NEMA rating of the enclosure.

c. An optional VFD-mounted HIM, rated NEMA/UL Type 1, may be provided and shall be capable of connecting via a separate cable for use as a handheld terminal.

d. The HIM shall have the following features:

i. A seven (7) line by twenty-one (21) character backlit LCD display with graphics capability.

ii. Shall indicate drive operating conditions, adjustments and fault indications.

iii. Shall be configured to display in the following three distinct zones:

- The top zone shall display the status of direction, drive condition, fault / alarm conditions and Auto / Manual mode.
- The middle zone shall display drive output frequency.
- The bottom zone shall be configurable as a display for either programming menus / information or as a two-line user display for two additional values utilizing scaled units.

iv. Shall provide digital speed control.

v. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.

B. Enclosure

1. Shall be rated NEMA/UL Type 12
2. Shall be painted per the manufacturer’s standard.
3. Shall provide entry and exit locations for power cables.
4. Shall contain a label for UL508.
5. The drive system nameplate shall be marked with system Short Circuit Current Rating (SCCR).

C. Drive Enclosure Input Disconnect

1. Provide an enclosure door interlocked disconnect with thermal magnet circuit breaker.
2. Operator Handles

a. Provide flanged-mounted, externally operated main disconnect handle.

b. Handles shall be lockable with up to three lockout / tagout padlock positions.

c. Handles shall be interlocked to prevent the enclosure door from being opened when the disconnect is in the ON position.

D. Branch Circuit Protection

1. Input inverse time circuit breaker shall be provided.

E. Control Power Transformer

1. Provide a control power transformer mounted and wired inside of the drive system enclosure.
2. The transformer shall be rated for 125% of the VFD power requirements.

F. Harmonic Mitigation Techniques

1. Drive Input Line Reactor
   a. Provide a drive input line reactor mounted within the drive system enclosure for drives that are less than 100 horsepower.
   b. The line reactor shall meet the following specifications:
      i. The construction shall be iron core with an impedance of 3 percent
      ii. The winding shall be copper or aluminum wound.
      iii. The insulation shall be Class H with a 115 °C rise over 50 °C ambient.
      iv. The unit shall be rated for system voltage, ampacity, and frequency.

G. Auxiliary Relays

1. Provide relays for Drive Alarm, Drive Fault, Drive Run, and System Status Faults (as required).
2. The relays shall be Allen-Bradley 700-HC (2 N.O. & 2 N.C.). The relay contacts shall be rated for 115V AC/30V DC, 5.0 amp resistive, 2.5 amp inductive.

H. Control Interface

1. The control terminals shall be rated for 115V AC.
2. The control interface shall provide input terminals for access to VFD functions that include start, stop, external fault, speed select, and enable, as required.

I. Hand/Off/Auto Selector Switch

1. Provide a "Hand/Off/Auto" selector switch, mounted on the enclosure door.
2. The "Hand/Off/Auto" selector switch shall start the drive in the “Hand” mode and stop the drive in the “Off” mode.
3. In the “Auto” mode the drive shall be started and stopped from a remote “RUN” contact.
4. In all modes, Auxiliary and Enable inputs to the drive control interface board must be present before the drive will start.

5. When a HIM is present, the stop function shall always be available to stop the drive regardless of the selected mode (“Hand” or “Auto”). The HIM will be non-functional (except for the display and programming) when the switch is in “Off” mode. The HIM shall stop the drive if the switch is in the “Auto” mode with the remote start contact initiated.
6. The drive speed reference shall be controlled from the HIM when in “Hand” mode (factory default setting).
7. The drive speed reference shall be controlled by a remote 4-20 mA input when in “Auto” mode.
8. The device shall be an Allen-Bradley Bulletin 800T (30mm), NEMA Type 4/13, mounted on the drive system enclosure door.

J. Drive Disable Mushroom Push Button

1. Provide a maintained mushroom style push button, mounted on the enclosure door that when pushed, will open the drive enable input.
2. The device shall be an Allen-Bradley Bulletin 800T (30mm), NEMA Type 4/13, mounted on the drive system enclosure door.

K. Pilot Lights

1. Provide LED pilot lights, mounted on the enclosure door, for indication of the following status:
    a. Run: Red
    b. Drive Fault: Amber
    c. Control Power On: White
    d. Motor Fault: Amber
2. The device shall be an Allen-Bradley Bulletin 800T (30mm), NEMA Type 4/13, mounted on the drive system enclosure door.

L. Motor Run Time Meter

1. Provide a digital, non-resettable, door-mounted elapsed time meter.
2. The meter shall be electrically interlocked with the Drive Run relay and Bypass contactor to indicate actual motor operating hours.

PART 3 - EXECUTION

3.01 EXAMINATION

1. Verify that location is ready to receive equipment.
2. Verify that the building environment can be maintained within the service conditions required by the manufacturer of the VFD.

3.02 INSTALLATION

A. Installation shall be in compliance with all manufacturer requirements, instructions and drawings.

3.03 START-UP SERVICE

A. At a minimum, the start-up service shall include:
   1. Perform pre-Power Check
   2. Megger Motor Resistances: Phase-to-Phase and Phase-to-Ground
   3. Verify system grounding per manufacturer's specifications
   4. Verify power and signal grounds
   5. Check connections
   6. Check environment

B. Drive Power-up and Commissioning:
   1. Measure Incoming Power Phase-to-Phase and Phase-to-Ground
   2. Measure DC Bus Voltage
   3. Measure AC Current Unloaded and Loaded
   4. Measure Output Voltage Phase-to-Phase and Phase-to-Ground
   5. Verify input reference signal

C. All measurements shall be recorded.

D. Drive shall be tuned for system operation.

E. Drive parameter listing shall be provided.

3.04 TRAINING

A. Manufacturer to provide a quantity of 2, 4-hour sessions of on-site instruction.

B. The instruction shall include the operational and maintenance requirements of the variable frequency drive.

C. The basis of the training shall be the variable frequency drive, the engineered drawings and the user manual. At a minimum, the training shall:
   1. Review the engineered drawings identifying the components shown on the drawings.
   2. Review starting / stopping and speed control options for the controller.
   3. Review operation of the Human Interface Module for programming and monitoring of the variable frequency drive.
   4. Review the maintenance requirements of the variable frequency drive.
   5. Review safety concerns with operating the variable frequency drive.

END OF SECTION 26 29 23

SECTION 26 43 13
SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

1. ANSI/IEEE C62.41.1 - 2002: IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits.
2. ANSI/IEEE C62.41.2 - 2002: IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
3. ANSI/IEEE C62.45 2002: Recommended practice on surge testing for equipment connected to low-voltage (1000 V and less) AC Power Circuits.
4. ANSI/UL 1283: Electromagnetic interference filters.
5. ANSI'UL 1449 3rd Edition: Surge protective devices.
6. NFPA 70: National Electrical Code (NEC).

1.02 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment. The SPD shall be identified as a Type 1 or Type 2 SPD, complying with new revisions to ANSI/UL 1449 and NEC Article 285.

B. Related Sections:

1. Division 26 Section "Common Work Results for Electrical" general requirements that are common to more than one section of Division 26.
2. Division 26 Section "Panelboards" for factory-installed SPDs. Note: SPDs installed internal to the distribution equipment shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified to their respective UL standards.

1.03 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. VPR: Voltage Protection Rating.

C. SPD: Surge Protective Device.

D. I(n): Nominal Discharge Current.

E. SCCR: Short circuit current rating.

F. MCOV: Maximum continuous operating voltage.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Qualification Data: For qualified testing agency.

C. Test Data: Certified documentation shall be provided of the product's ANSI/UL 1449 Edition 3 Listing, SPD Type designation, Voltage Protection Rating (VPR), Nominal Discharge Current (In), and Short Circuit Current Rating SCCR).

D. Field quality-control reports.

E. Installation, Operation and Maintenance Manuals: Provide one copy of the installation, start-up, operation and maintenance data for each unit supplied.

1. Two weeks prior to final inspection, submit four copies of the following to the Engineer:

a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested.

b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.

F. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: SPDs must be tested by and carry the UL mark.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.1, C62.412 and test devices according to IEEE C62.45.

D. Comply with UL 1283 and UL 1449.

E. Comply with NFPA 70.

1.06 PROJECT CONDITIONS

A. Service Conditions: Rate SPD devices for continuous operation under the installed conditions.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period ten years from date of Substantial Completion.
2. Products with warranties that exclude temporary over voltages, abnormally high number of surges, direct or indirect lightning strikes shall not be used.

1.08 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: One of each size and type installed.

1.09 MANUFACTURER'S QUALIFICATIONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Current Technology Inc.; Danaher Power Solutions.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. Erico Products, Inc.
4. General Electric Company; GE Consumer and Industrial - Electrical Distribution.
5. Siemens Energy and Automation, Inc.
6. Square D; a brand of Schneider Electric.

PART 2 - PRODUCTS

2.01 SURGE PROTECTION DEVICES

A. General Requirements:

1. Fabrication using bolted compression lugs for internal wiring.
2. Redundant suppression circuits.
3. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
4. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
5. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
6. SPD shall be listed to UL 1449 Edition 3 as a Type 1 or Type 2 product.
7. The UL 1449 Edition 3 Nominal Discharge Current shall be 20 kA. Products with less than a 20 kA nominal discharge current listing shall not be accepted.
8. MCOV shall be greater than 115 percent of nominal operating voltage.

9. SPD shall have a UL 1449 Edition 3 listed short circuit current rating of 200 SCCR.
10. SPD shall protect all modes via L-N, L-G and N-G modes of protection. For Delta Systems L-L and L-G protection modes shall be provided, with the ability of configure L-L and L-G for ungrounded systems.
11. The /SPD shall have the following status indications:
    a. LED indication for each line or phase.
    b. LED indication for overall status.
    c. Fault indication for each mode.
12. SPD shall have an audible alarm with silencing switch to indicate when protection has failed.
13. SPD shall have a six digit, non-resettable surge counter.
14. SPD shall have an integrated disconnect for safe field service.
15. SPD shall have modular, field replaceable components.

B. Main Service Panels:
1. SPD shall have a 240 kA per phase surge rating.
2. SPD UL 1449 Edition 3 listed Voltage Protection Rating (VPR) shall not exceed the following:
    a. 120/240V or 120/208; L-N, L-G, N-G = 800V, L-L 1200V.
    b. 240V Delta or 277/480V; L-N, L-G, N-G =1200V, L-L= 2000V.
    c. or 347/600V; L-N, L-G, N-G = 1500V, L-L=2500V.
3. At least -40 dB at 100 kHz EMI/RFI shall be provided.

C. Branch Panels:
1. SPD shall have a 120 kA per phase surge rating.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install SPDs at switchboard, switchgear, or panelboard on load side, with ground lead bonded to service entrance ground.

B. Install SPDs for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
1. Provide a circuit breaker, sized by manufacturer, as a dedicated disconnecting means for SPD unless otherwise shown on Drawings.

3.02 FIELD QUALITY CONTROL

A. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

2. After installing SPD but before electrical circuitry has been energized, test for compliance with requirements.

3. Complete startup checks according to manufacturer's written instructions.

D. SPDs will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.03 STARTUP SERVICE

A. Do not energize or connect switchgear, switchboards, or panelboards to their sources until SPDs are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

END OF SECTION 26 43 13

SECTION 26 51 19
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Include compliance of LED Luminaries with IES LM-79 and IES LM-80.
7. Include plans, elevations, sections, and mounting and attachment details.
8. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
9. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

B. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Modules: For each type, provide 1 percent of the total quantity installed. Furnish at least one of each type.

2. LED Drivers: For each type, provide 1 percent of the total quantity installed. Furnish at least one of each type.

3. Diffusers and Lenses: For each type, provide 2 percent of the total quantity installed. Furnish at least one of each type.

4. Globes and Guards: For each type, provide 2 percent of the total quantity installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

D. Provide luminaires from a single manufacturer for each luminaire type.

E. Each luminaire type shall be binned within a four-step MacAdam Ellipse to ensure color consistency among luminaires.

F. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

G. Each luminaire type shall be binned within a two-step MacAdam Ellipse to ensure color consistency among luminaires.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. Recessed Fixtures: Comply with NEMA LE 4.

D. Bulb shape complying with ANSI C79.1.

E. Lamp base complying with ANSI C81.61.

F. Compliance with ANSI C78.377 "Specifications for the Chromaticity of Solid State Lighting Products".

G. Compliance with UL 8750 "Safety Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products".

H. Compliance with LM-79 "Electrical and Photometric Measurements of Solid-State Lighting Products" and LM-80 "Measuring Lumen Maintenance of LED Light Sources".

I. CRI of minimum 80 or as specified on the construction documents.

J. Minimum allowable efficacy of 60 lumens per watt for downlights, 90 lumens per watt minimum for other LED fixtures or as specified on the construction documents schedules.

K. Rated lamp life of 50,000 minimum hours or as specified on the construction documents schedules, whichever is more stringent.

L. RoHS or equivalent compliance.

M. Fully serviceable and upgradeable LED light engine.

N. LED Driver/Power Supply:

1. Integral high efficiency driver with power supply of 120V-277V input at 60HZ.
2. Power factor greater than 0.9 at full load.
3. THD at < 20 percent.
4. Drive current at 1000ma maximum.
5. Class 2 power supply.
6. Dimming utilizing 0-10V dimming control.
7. The Driver shall provide continuous flicker free dimming from 100 percent to 10 percent.
8. Capable of being serviced from above or through the aperture.
9. Protected from overload and short circuit conditions.

2.03 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.04 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.05 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

G. Aircraft Cable Support: Use cable, anchorages, and intermediate support recommended by fixture manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.03 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls or attached to a minimum 20 gauge backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

G. Surface mounted lighting fixtures shall be attached to the ceiling system with positive clamping devices that completely surround the supporting members. Safety wires shall be attached between the clamping device and the adjacent ceiling hanger or to the structure above. In no case shall the fixture exceed the design carrying capacity of the supporting members.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. All lighting fixtures shall be positively attached to the suspended ceiling system by mechanical means as specified in the National Electrical Code, Section 410-36(b) unless independently supported. The attachment device, a minimum of two per fixture, shall have a capacity of 100 percent of the lighting fixture weight acting in any direction.

2. Pendant-hung lighting fixtures shall be supported directly from the structure above using No. 9-gauge wire or an approved alternate support without using the ceiling suspension system for direct support.

3. For seismic design classifications of C, D, E and F and all Hospital work, lighting fixtures weighing between 10 and 56 pounds shall have, in addition to the requirements outlined above, two No. 12 gauge hangers connected from the fixture housing to the structure above. These wires may be slack.

4. Lighting fixtures weighing 56 pounds or more shall be supported directly from the structure above by approved hangers.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

END OF SECTION 26 51 19

SECTION 26 52 19
EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing laboratory providing photometric data for luminaires.

B. Product Certificates: For each type of luminaire.

C. Manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Sample Warranty: For manufacturer's warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps, LED Modules and Drivers: 1 percent of each type and rating installed. Furnish at least one of each type.

2. Diffusers and Lenses: 2 percent of each type and rating installed. Furnish at least one of each type.

3. Globes and Guards: 2 percent of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.

b. Faulty operation of luminaires and accessories.

c. Deterioration of metals, metal finishes and color retention, and other materials beyond normal weathering.

d. Led Modules or Driver failure.

2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.02 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for fluorescent luminaires.

F. Lamp Base: Comply with ANSI C81.61.

G. Bulb Shape: Complying with ANSI C79.1.

H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.

1. Emergency Connection: Operate fluorescent two lamp(s) or LED module(s) continuously upon loss of normal power (see Construction Document schedules for lumen output). Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.

2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

3. Nightlight Connection: Operate lamp continuously.

4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

5. Battery: Sealed, maintenance-free, nickel-cadmium type.

6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

7. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

I. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Emergency Connection: Emergency Connection: Operate fluorescent two lamp(s) or LED module(s) continuously upon loss of normal power (see Construction Document Schedules for lumen output). Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast/driver.

2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type.
6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.03 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs; 70,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed

infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.04 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.05 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.06 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls or attached to a minimum 20 gauge backing plate attached to wall structural members.

2. Do not attach luminaires directly to gypsum board.

G. Surface mounted lighting fixtures shall be attached to the ceiling system with positive clamping devices that completely surround the supporting members. Safety wires shall be attached between the clamping device and the adjacent ceiling hanger or to the structure above. In no case shall the fixture exceed the design carrying capacity of the supporting members.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

2. Luminaire will be considered defective if it does not pass operation tests and inspections.

3. Prepare test and inspection reports.

3.05 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.

2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

END OF SECTION 26 52 19

SECTION 26 56 13
LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.
2. Luminaire-lowering devices.

B. Related Sections include the following:

1. Division 26 "LED Exterior Lighting."
2. Division 26 "LED Interior Lighting."

1.03 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete lighting fixture.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.04 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.

1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
2. Include finishes for lighting poles and luminaire-supporting devices.
3. Anchor bolts.
4. Manufactured pole foundations.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of poles and pole accessories.

4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

1.05 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Qualification Data: For Installer.

C. Seismic Qualification Certificates: For accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Sample Warranty: Manufacturer's standard warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles and luminaire-lowering devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 1 “General Requirements,” include pole inspection and repair procedures.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

1.08 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with ASCE 7-10.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.

3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Parking Lot Area Pole Structural, load and Wind Characteristics: Comply with ASCE 7-10.

D. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

E. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.02 STEEL POLES

A. Source Limitations: Obtain poles from single manufacturer or producer.

B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

C. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.

1. Shape: As specified on Construction Document Fixture Schedules.

2. Brackets, Arms and mounting provisions as specified on the Construction Document Fixture Schedules.

D. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.

E. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless steel bolts.

2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

F. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

G. Fasteners: Size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.

2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

H. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

I. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

J. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.

K. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.

2. Powder Coat: Comply with AAMA 2604.

a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.

2.03 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6061-T6, with access handhole in in pole wall.

1. Shape: As specified on Construction Document Fixture Schedules.

2. Brackets, Arms and mounting provisions as specified on the Construction Document Fixture Schedules.

B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

C. Grounding and Bonding Lugs: Bolted 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

D. Fasteners: Size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.

2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

E. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

F. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.

2. Powder coat shall comply with AAMA 2604.

a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.

2.04 POLE ACCESSORIES

A. Duplex Receptacle (if indicated on the Construction Documents): Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Comply with requirements in Section 262726 "Wiring Devices."

1. Recessed 24 inches (300 mm) above finished grade.

a. NEMA 250, Type 3R, nonmetallic polycarbonate plastic or reinforced fiberglass, enclosure with cover; color to match pole.

b. Lockable hasp and latch complying with OSHA lockout and tag-out requirements.

B. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

C. Decorative accessories, supplied by decorative pole manufacturer, include the following:

1. As specified on the Construction Documents Fixture Schedule.

2.05 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi (380,000 kPa).

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2.06 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete,

reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete." See Construction Documents pole base details for specific design requirements.

B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.03 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.

1. Fire Hydrants and Water Piping: 60 inches (1520 mm).
2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet (3 m).
3. Trees: 15 feet (5 m) from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2-inch (13 mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6 inch (150 mm) wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch (25 mm) below top of concrete slab.

F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.04 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch (0.254-mm) thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.05 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.06 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 26 56 13

SECTION 26 56 19
LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires (including wall mounted) that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays or sensors.

B. Related Requirements:

1. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Include compliance of LED Luminaries with IES LM-79 and IES LM-80.
6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.

8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
9. Include plans, elevations, sections, and mounting and attachment details.
10. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
11. Include diagrams for power, signal, and control wiring.

B. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports and seismic restraints.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing laboratory providing photometric data for luminaires.

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay or sensors.

D. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires, photoelectric relays and related controls to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types and related controls used on Project; use manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Modules: For each type, provide 1 percent of the total quantity installed. Furnish at least one of each type.

2. LED Drivers: For each type, provide 1 percent of the total quantity installed. Furnish at least one of each type.
3. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures, including luminaire support components.
    b. Faulty operation of luminaires and accessories.
    c. Deterioration of metals, metal finishes and color retention, and other materials beyond normal weathering.
    d. LED Modules or Driver failure.
2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Compliance with UL 8750 "Safety Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products."

E. Compliance with LM-79 “Electrical and Photometric Measurements of Solid-State Lighting Products” and LM-80 "Measuring Lumen Maintenance of LED Light Sources."

F. UL Listed for wet locations. Light engines are IP66 rated; luminaire is IP65 rated. Rated for minus 40 deg C minimum ambient.

G. CRI of 70 minimum. CCT as indicated on Luminaire schedule.

H. L70 lamp life of 50,000 hours minimum.

I. Dimmable: Only as indicated on the drawing lighting schedules.

J. Minimum allowable efficacy of 60 lumens per watt for CCT of 3000K, 80 lumens per watt minimum for CCT of 4100K, and 90 lumens per watt minimum for CCT of 5000K.

K. Internal driver, unless otherwise indicated on Construction Drawings.

L. In-line Fusing: On the primary for each luminaire.

M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

N. Source Limitations: Obtain luminaires from single source from a single manufacturer.

O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

P. LED Driver/Power Supply:

1. Integral high efficiency driver with power supply of 120V-277V input at 60HZ.

2. Power factor greater than 0.9 at full load.

3. THD at < 20 percent.
4. Drive current at 1000 ma maximum.
5. Class 1 power supply.
6. Capable of being serviced from above or through the aperture.
7. Protected from overload and short circuit conditions.

2.03 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage and coating.

c. CCT and CRI for all luminaires.

2.04 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.

2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

2.05 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, attached to a minimum 1/8 inch (3 mm) backing plate attached to wall structural members.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.04 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.05 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch (0.254-mm) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.06 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.07 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Verify operation of photoelectric controls.

C. Luminaire will be considered defective if it does not pass tests and inspections.

END OF SECTION 26 56 19

DIVISION 27

COMMUNICATIONS

SECTION 27 11 16
COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. 19-inch equipment racks.
2. 19-inch freestanding and wall-mounted equipment cabinets.
3. Open Rack equipment racks.
4. Power strips.
5. Grounding.
6. Labeling.

B. Related Requirements:

1. Section 26 05 26 "Grounding and Bonding for Electrical Systems."
2. Section 26 05 33 "Raceways and Boxes for Electrical Systems."
3. Section 27 15 13 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
4. Section 27 15 23 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.

1.03 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. BICSI: Building Industry Consulting Service International.

C. LAN: Local area network.

D. RCDD: Registered communications distribution designer.

E. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

F. TGB: Telecommunications grounding bus bar.

G. TMGB: Telecommunications main grounding bus bar.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.

2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.

B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.

3. Grounding: Indicate location of TGB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Experienced installers, certified by the manufacturer, with at least five years experience installing Category 6 cabling systems and fiber optic systems in accordance with TIA-568 standards.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. UL listed.

C. RoHS compliant.

D. Compliant with requirements of the Payment Card Industry Data Security Standard.

2.02 19-INCH EQUIPMENT RACKS

A. Description: Two- and four- post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72-inches between rails.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Chatsworth.
2. Middle Atlantic Products, Inc.
3. Hoffman.
4. Or approved equal.

C. General Requirements:

1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Material: Extruded steel.
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. Color: Black.

D. Floor-Mounted Racks:

1. Overall Height: 84 inches or as indicated on Drawings where specifically noted.
2. Overall Depth: 23 inches.
3. Upright Depth: 3 inches.
4. Two-Post Load Rating: 200 lb.
5. Four-Post Load Rating: 1000 lb.
6. Number of Rack Units per Rack: 45 or as indicated on Drawings where specifically noted.
7. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug.

8. Base shall have a minimum of four mounting holes for permanent attachment to floor.
9. Top shall have provisions for attaching to cable tray or ceiling.
10. Self-leveling.

E. Wall-Mounted Racks:

1. Height: As indicated on Drawings.
2. Load Rating: 150 lb.
3. Wall Attachment: Four mounting holes.
4. Equipment Access: Integral swing.

F. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.
5. Provide horizontal managers equal to Middle Atlantic Products, Inc. HCM series (2 RMS for each 48 port patch panel, 1 RMS for each 24 port patch panel, 1 RMS minimum for each 24 port switch, 2 RMS for each 48 port switch).
6. Rack-mounted Shelf: Include heavy-duty, double-side, 26 inch deep, 200 lb capacity shelf for each piece of equipment in the rack that does not have rack mounting capability.

2.03 GROUNDING

A. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Rack and Cabinet TGBs: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-606-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted TGB: Terminal block, with stainless-steel or copper-plated hardware for attachment to cabinet.
2. Rack-Mounted Horizontal TGB: Designed for mounting in 19-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical TGB: 36 inches long, with stainless-steel or copper-plated hardware for attachment to rack.

2.04 LABELING

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

C. Comply with BICSI ITSIMM for installation of communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.

1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.

2. Record agreements reached in meetings and distribute them to other participants.

3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.

4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.02 GROUNDING

A. Comply with NECA/BICSI 607.

B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection."

C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2-inches of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.

1. Bond the shield of shielded cable to patch panel, and bond patch panel to TGB or TMGB.

3.03 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B.

B. Label colors for equipment identification shall comply with TIA-606-B.

END OF SECTION 27 11 16

SECTION 27 15 13
COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cable management system.
4. Cabling identification products.
5. Grounding provisions for twisted pair cable.
6. Source quality control requirements for twisted pair cable.

B. Related Requirements:

1. Section 27 11 16 "Communications Racks, Frames, and Enclosures."

1.03 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. Jack: Also commonly called an "outlet," it is the fixed, female connector.

I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

J. RCDD: Registered Communications Distribution Designer.

K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

M. S/FTP: Overall braid screened cable with foil screened twisted pair.

N. S/UTP: Overall braid screened cable with unscreened twisted pairs.

O. UTP: Unscreened (unshielded) twisted pair.

1.04 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.

2. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration Drawings and printouts.

4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

a. Telecommunications rooms plans and elevations.

b. Telecommunications pathways.

c. Telecommunications system access points.

d. Telecommunications grounding system.

e. Telecommunications conductor drop locations.

f. Typical telecommunications details.

g. Mechanical, electrical, and plumbing systems.

C. Twisted pair cable testing plan.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On USB media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Five years experience installing Category 6 cabling systems in accordance with TIA-568 standards.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Cables: Provide products by one of the following manufacturers or approved equal.

1. Commscope.
2. General Cable.
3. Hitachi.
4. Hubbell.
5. Mohawk.
6. OCC.
7. Panduit.
8. Systimax.
9. Siemon.

B. Hardware: Provide products by one of the following manufacturers or approved equal.

1. Commscope.
2. Hubbell.
3. ICC.
4. OCC.
5. Ortronics.
6. Panduit.
7. Systimax.
8. Siemon.

2.02 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-C.

2.03 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CMP complying with UL 1685 (use in return air plenum spaces).
2. Communications, Non-plenum: Type CMR complying with UL 1666 (use in non-plenum spaces).

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. RoHS compliant.

2.04 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Riser or plenum. Use plenum rate in return air plenum spaces.

F. Jacket: Blue thermoplastic.

2.05 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.

D. Connecting Blocks:

1. 110-style IDC for Category 6.
2. 110-style IDC for Category 6a.
3. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. Universal T568A and T568B wiring labels.

b. Labeling areas adjacent to conductors.

c. Replaceable connectors.

d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.

3. Number of Jacks per Field: One for each four-pair cable indicated.

G. Patch Cords: Factory-made, four-pair cables in appropriate heights and lengths; terminated with an eight-position modular plug at each end. Provide for each patch panel port (used or unused).

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

H. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.

2. Standard: Comply with TIA-568-C.2.

3. Marked to indicate transmission performance.

I. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.

2. Designed to snap-in to a patch panel or faceplate.

3. Standard: Comply with TIA-568-C.2.

4. Marked to indicate transmission performance.

J. Faceplate:

1. Four port, vertical single gang faceplates designed to mount to single gang wall boxes.

2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 26 27 26 "Wiring Devices."

3. Metal Faceplate: Steel, complying with requirements (only in unfinished areas) in Section 26 27 26 "Wiring Devices."

4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.06 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.07 GROUNDING

A. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.08 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA-568-C.1.

C. Factory test twisted pair cables according to TIA-568-C.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.02 INSTALLATION OF PATHWAYS

A. Comply with Section 26 05 29 "Hangers and Supports for Electrical Systems."

B. Comply with Section 26 05 36 "Cable Trays for Communications Systems."

C. Drawings indicate general arrangement of pathways and fittings.

3.03 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.

2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.

5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

6. Consolidation points may be used only for making a direct connection to equipment outlets:

   a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

   b. Locate consolidation points for twisted-pair cables at least 49 feet from communications equipment room.

7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

8. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.

9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual , Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.

11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

12. In the communications equipment room, install a 10-foot long service loop on each end of cable.

13. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.04 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.05 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-C and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. C

1. Administration Class: Class 3.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications

Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 27 15 13

SECTION 27 15 23
COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Retain or delete this article in all Sections of Project Manual.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

C. Section 27 11 16 "Communications Racks, Frames, and Enclosures."

1.02 SUMMARY

A. Section Includes:

1. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM4).

2. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS2).

3. Optical fiber cable connecting hardware, patch panels, and cross-connects.

4. Grounding.

5. Cabling identification products.

1.03 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. RCDD: Registered Communications Distribution Designer.

1.04 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

A. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1" in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration Drawings and printouts.

4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

a. Telecommunications rooms plans and elevations.

b. Telecommunications pathways.

c. Telecommunications system access points.

d. Telecommunications grounding system.

e. Telecommunications conductor drop locations.

f. Typical telecommunications details.

g. Mechanical, electrical, and plumbing systems.

C. Fiber optic cable testing plan.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On USB media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

B. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:

1. Five years' experience installing fiber optic systems for similar project type in accordance with TIA-568 standards.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end.

2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications equipment and service suppliers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide products by one of the following manufacturers or approved equal:

1. Panduit.

2. Corning.

3. General Cable.

4. Hubbell.

5. Leviton.

6. OCC.

7. Commscope.
8. Siemon.

2.02 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-C.

2.03 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM4)

A. Description: Multimode, 50/125-micrometer, 2-fiber, nonconductive, tight buffer, optical fiber cable.

B. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAD for detailed specifications.

C. Conductive cable shall be steel armored type.

D. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

E. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

F. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.

G. Jacket:

1. Jacket Color: Aqua.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

H. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2.04 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

A. Description: Single mode, 9/125-micrometer, 2 fibers, tight buffered, nonconductive optical fiber cable.

B. Conductive cable shall be steel armored type.

C. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

D. Jacket:

1. Jacket Color: Yellow.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

E. Standards:

1. Comply with TIA-492CAAB for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with ICEA S-104-696 for mechanical properties.

F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2.05 OPTICAL FIBER CABLE HARDWARE

A. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, single-fiber cables in 36-inch lengths.

D. Connector Type: Type LC complying with TIA-604-10-B connectors.

E. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

F. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

G. Faceplate:

1. Two-port, vertical single-gang faceplates designed to mount to single-gang wall boxes.

2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 26 27 26 "Wiring Devices."

3. Metal Faceplate: Steel (only in unfinished spaces), complying with requirements in Section 26 27 26 "Wiring Devices."

4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

2.06 GROUNDING

A. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with TIA-607-C.

2.07 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.08 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

C. Factory test preterminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF OPTICAL FIBER HORIZONTAL CABLES

A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot-long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

3.03 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.04 GROUNDING

A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-C and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.05 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B.

1. Administration Class: Class 3.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, horizontal pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

4. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting

hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

i. Horizontal and Multimode Horizontal Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.

ii. Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

F. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

G. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

H. End-to-end cabling will be considered defective if it does not pass tests and inspections.

I. Prepare test and inspection reports.

END OF SECTION 27 15 23

DIVISION 31

EARTHWORK

SECTION 31 00 00
EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This work is the excavation, trenching and backfilling for the placement of structures, utilities, equipment and appurtenances, handling and storing materials for fill and backfill, bracing, shoring, trench protection, subgrade preparation, final grading, site dressing and cleanup.

B. To the extent possible, reuse existing topsoil and other materials excavated from the site.

1.02 REFERENCES

A. The most recent publication of all the following form a part of this specification:

AASHTO T99	Moisture-Density Relations fo Soils and Soil-Aggregate Mixtures Using 5-lb Rammer and 12" Drop
ASTM D698	Moisture-Density Relations fo Soils and Soil-Aggregate Mixtures Using 5-lb Rammer and 12" Drop
AASHTO T191 ASTM D1556	Density of soil in-place by the sand-cone method
AASHTO T310 ASTM D6938	In-Place density and water content of soil and soil aggregate by Nuclear Method (Shallow Depth)
AASHTO T11 ASTM C117	Materials finer than 0.075 mm (No. 200) sieve in mineral aggregates by washing
AASHTO T27 ASTM C136	Sieve analysis of fine and coarse aggregate
AASHTO T89	Determining the liquid limit of soils
AASHTO T90	Determining the plastic limit and plasticity index of soils
ASTM D4318	Test method for liquid limit, plastic limit and plasticity index of soils

1.03 RELATED DOCUMENTS

A. The following documents and specification sections apply directly to this Section:

1. Division 01 Section “Payment Procedures" for a schedule of unit prices;
2. Division 01 Temporary Facilities and Controls;
3. Division 02 - Existing Conditions Site Clearing;

4. Division 02 - Existing Conditions Dewatering;
5. Division 31 – Site Clearing, Geotextiles;
6. Division 32 - Exterior Improvements;
7. Division 33 - Utilities;
8. Division 40 – Process Interconnections

1.04 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

B. Base Course: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade before installing structure.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Select Subgrade: Satisfactory soil imported from off-site for use between membrane liner and imported dike material.

F. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by Engineer. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, manholes, lagoon inlets, valve pits, lift stations, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

1.05 SUBMITTALS

A. Product Data: For the following:

1. Drainage fabric (if applicable);
2. Separation fabric (if applicable);
3. Stabilization fabric (if applicable).

B. Samples: For the following:

1. 30 lb samples, sealed in airtight containers, of each proposed soil material from on-site or borrow sources.

2. 1 ft x 1ft samples of drainage fabric.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill;

2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill;

3. Liquid limit, plastic limit and plasticity of soils in accordance with AASHTO T89 and T90, respectively.

1.06 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than 48 hours in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Engineer's written permission.

3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GM, GC, ML, SC, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, clayey soils, and other deleterious matter. For **select subgrade** beneath membrane liner, the material shall be the same except it shall be free of rock or gravel larger than ½ inches in any dimension.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GP, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 4 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed recycled concrete, and natural or crushed sand.

F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed recycled concrete, and natural or crushed sand.

G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed recycled concrete, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1 ½ inch sieve and not more than 12 percent passing a #200 sieve.

H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand having a maximum ¾ inch size and must be free draining and nonplastic.

I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel having 100% passing the 1 ½ inch sieve and 0 to 10% passing the No. 10 sieve.

J. Select Subgrade: Satisfactory soil materials, with no rocks larger than 2" in any dimension.

2.02 ACCESSORIES

A. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.02 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.03 EXPLOSIVES

A. Blasting is not anticipated to be necessary for this project and will not be allowed.

3.04 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, notify geotechnical enginner and replace with satisfactory soil materials. No additional payment will be made for remedial action due to unsuitable soils.

2. Meet OSHA requirements for excavations (including work performed in pre-existing excavated openings) and excavated material stockpiles. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

3.05 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Pile Foundations: Stop excavations from 6 inches to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended for bearing surface.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.07 APPROVAL OF SUBGRADE

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. No additional payment will be made for remedial action due to unsuitable soils.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.

E. Subgrade and contact surface for membrane liner must be smooth and completely free of any protrusions that may penetrate the liner after installation. Subgrade must be approved by Engineer and Liner Manufacturer representative prior to installation of the liner.

3.08 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.09 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Inspecting and testing underground utilities.
3. Removing concrete formwork.
4. Removing trash and debris.
5. Removing temporary shoring and bracing, and sheeting.
6. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.

4. Under footings and foundations, use engineered fill.

3.12 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 4 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 4 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 92 percent.

3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

3.14 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cutout soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1 inch.

3.15 FIELD QUALITY CONTROL

A. Testing: The Engineer will perform field quality-control testing. The Contractor may also engage the services of a qualified testing firm to perform field quality-control testing to verify the Engineer's testing results, at no additional cost to the OWNER.

B. Allow Engineer to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.

D. Engineer and Contractor's independent firm (if applicable) will test compaction of soils in place according to ASTM D 2922. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 square feet or less of paved area or building slab, but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.

3. Utility Structures: At each compacted backfill layer, at least one test for every 100 square feet or less, but no fewer than one test per structure.

E. When Engineer's testing reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained. Contractor shall be responsible for the cost of repeat testing conducted by the Engineer.

3.16 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 00 00

SECTION 31 05 13
SOILS FOR EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Subsoil materials.
2. Topsoil materials.

B. Related Sections include:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 SUBMITTALS FOR REVIEW

A. See Section 01 33 00 - Submittals: Procedures for submittals.

B. Samples: In accordance with Section 01 40 00.

1.03 QUALITY ASSURANCE

A. Section 01 40 00 - Quality Control: Field Samples.

B. Material Source: Provide materials from the same source throughout the Work. Change of source requires Engineer approval.

PART 2 - PRODUCTS

2.01 SUBSOIL MATERIALS

A. Subsoil: Uncontaminated excavated onsite material or imported borrow material. Graded free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.

1. Type A: See MPWSS, latest edition. Existing (Native) soil shall be considered a Type A.
2. Type B: See MPWSS, latest edition.
3. Type C: Non-used; All frozen material, vegetation, trash, rocks, and concrete and bituminous chunks having a dimension exceeding 3 inches.

2.02 TOPSOIL MATERIALS

A. Topsoil: Uncontaminated excavated onsite material or imported borrow material; Graded free of roots, rocks larger than ¾ inches, subsoil, debris, large weeds, and foreign matter.

1. Imported or Re-used; Friable loam. Acidity range (pH) of 5.5 to 7.5 containing a minimum of 4 percent and a maximum of 25 percent organic matter. Conforming to

ASTM D2487 Group Symbol OL and OH.

2.03 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Control: Testing and analysis of soil material.

B. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698, ASTM D2922, and ASTM D3017.

C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D2487.

D. Provide materials of each type from same source throughout the Work.

E. Contractor to obtain and pay for services of soil classification technician from an independent geotechnical laboratory to monitor soils installed.

END OF SECTION 31 05 13

SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This work includes the identification, preparation, removal, stockpiling, salvage and disposal of existing surface materials at the project site which are impacted by or interfere with construction of the improvements.

1.02 RELATED DOCUMENTS

A. The following documents and specification sections apply directly to this Section:

1. Drawings and Special Provisions of the Contract;
2. General and Supplementary Conditions;
3. Division 01 - General Requirements;
4. Division 02 - Existing Conditions;
5. Division 31 - Earthwork;
6. Division 33 - Utilities.

1.03 SUMMARY

A. This Section includes, but not limited to, the following:

1. Protecting existing trees and vegetation to remain.
2. Removing trees and other vegetation as necessary.
3. Clearing and grubbing.
4. Topsoil stripping.
5. Removing above-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place.
7. Disconnecting and removing site utilities.

1.04 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

1.05 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain Owner’s property, cleared materials shall become Contractor’s property and shall be removed from the site.

1.06 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 "Excavation and Embankment."

1. Obtain approved borrow soils materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Locate and clearly flag trees and vegetation to remain or to be relocated.

D. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TREE PROTECTION

A. Do not store construction materials, debris, or excavated material within drip line of remaining trees.

B. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.

C. Do not excavate within drip line of trees, unless otherwise indicated.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.

1. Replace trees that cannot be repaired and restored to full-growth status, as determined by a qualified arborist.

3.03 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Owner will arrange to shut off any publicly-owned utilities indicated to be removed.
2. Contractor shall arrange to shut off any privately-owned utilities with utility companies.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

3.04 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within drip line of remaining trees.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground unless otherwise specified in the Specifications.

3.05 TOPSOIL STRIPPING

A. Remove weeds, debris and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.

1. Stockpile surplus topsoil and allow for re-spreading deeper topsoil.

3.06 SITE GRADING

A. Rough-grade the site to provide positive drainage away from all construction elements and away from the site in such a manner that no damage to adjacent property will result from runoff.

1. Project site shall be graded sufficiently smooth to provide access to all elements of construction.

3.07 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.08 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 10 00

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Protection of features not designated for removal.
2. Site removals.
3. Disposal of waste materials.

B. Related Sections include:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 1 – General Requirement Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 REGULATORY REQUIREMENTS

A. Conform to applicable codes and regulations for proper disposal of debris.

B. Conform to applicable codes for worker safety.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Construction Fencing: Construction fencing shall be orange plastic mesh, heavy duty, snow fencing fastened to metal or wood posts.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that existing plant life designated to remain is tagged or identified.

B. Beginning work of this Section means acceptance of existing conditions.

C. Identify and furnish an area for storing or placing removed material prior to the commencement of Work in this Section.

3.02 PROTECTION

A. Locate, identify, and protect utilities that remain from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping.

C. Protect bench marks, survey control points, and existing structures from damage.

D. Prevent surface water and subsurface or groundwater from entering excavations, from

ponding on prepared subgrades and from flooding site and surrounding area.

E. Contractor shall repair or replace, to original condition or better, existing structures and improvements, flora, and landscaping damaged or injured during construction operations. Contractor shall understand the sensitive nature of working on or near developed property and shall endeavor to limit injury or damage both inside the limits of construction and outside the limits of construction.

F. Protect existing trees and other vegetation indicated to remain from unnecessary cutting, breaking, skinning of roots, skinning and bruising of bark, smothering of trees, by stockpiling construction materials or excavated materials within the drip line, excess foot of vehicular traffic, or parking of vehicles within drip line.

G. Protect wetlands, rivers, streams, and other waters of the state from all construction activities and contamination by erosion and runoff.

H. Protect areas that have been finish graded from subsequent construction operations, traffic, and erosion. Remove, provide new, and compact as required, material contaminated by erosion and runoff

3.03 WORK BY OTHERS

A. Sod in areas to be disturbed will be removed by others prior to commencement of earthwork activities.

3.04 CLEARING

A. Clear areas required for access to site and execution of Work.

3.05 GRUBBING

A. Shall conform to Montana Department of Transportation (MDT) Standard Specifications for Road and Bridge Construction (2014 edition). Section 201.03.1 shall be followed except as specified below and absolutely no burning will be allowed.

1. Grubbing operations may be completed by removal of stump section or by grinding
2. Remove stumps, logs, roots, and other organic matter located within proposed pavements and structures to the depth indicated:
    a. Gravel or paved surface: 48” below surface grade.
    b. Grass areas: 12” below surface grade
    c. Other structures or utilities: 36” below existing ground or finish grade, whichever is lower.

B. Depressions resulting from grubbing operations shall be backfilled in accordance with other sections in Division 31.

3.06 DISPOSAL OF WASTE MATERIALS

A. Remove all clearing and grubbing debris from the site in accordance with the Contract Documents and all permits and regulations. Burning shall not be allowed on Owner’s property.

END OF SECTION 31 11 00

SECTION 31 11 10
REMOVAL OF EXISTING PAVEMENT, CONCRETE CURB, SIDEWALK, DRIVEWAY, AND/OR STRUCTURES
(Reference MPWSS Section 02112)

All applicable portions of MPW Standard Specification Section 02112 shall apply with the following additions, deletions, and/or modifications.

PART 3 - EXECUTION

Delete the last sentence of 3.1.C and add the following:

Edges on all concrete and asphalt shall be straight lines and vertical cuts made with a saw. Concrete shall be cut with a saw to a depth of 4 inches minimum. Section deeper than 4 inches may be broken after cutting. Resulting face shall not be flatter than a 1:1 from vertical. Construction methods will not disturb the remaining concrete slabs.

All slabs to remain shall be replaced, if disturbed, at no cost to the owner.

Exercise care in removal of existing tree roots that conflict with the work. Tree roots shall be removed by saw-cutting the roots to a neat line at the extent of the excavation. Remove only the minimum amount of roots necessary in order to complete the work.

PART 4 - MEASUREMENT AND PAYMENT

DELETE: Entire Section and refer to Section 01 29 00

END OF SECTION 31 11 10

SECTION 31 14 13
SOIL STRIPPING AND STOCKPILING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Protection of features not designated for removal.
2. Topsoil Removal.
3. Stockpiling of Materials.
4. Stockpile Cleanup.
5. Estimated Excess Material Volumes.

B. Related Sections include:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 1 – General Requirement Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 DESCRIPTION

A. Limits of construction are shown on the Drawings. Excavation shall not be allowed outside of the limits of construction where shown on the Drawings.

B. Materials may be temporarily stockpiled on the site within the limits of construction or where shown on the Drawings.

C. Protect benchmarks and existing structures that are to remain from damage or displacement.

1.03 FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the Work are as indicated.

1.04 DEFINITIONS

A. Soil Testing Laboratory: Refers to a professional soils engineering firm with soil sampling and testing services that is independent from the Contractor.

B. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.

1.05 SITE CONDITIONS

A. Soil borings were taken for this project by Thomas, Dean & Hoskins, Inc. The Geotechnical Investigation Report and associated Addenda are included in Section 00 31 32 of this Project Manual.

B. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.

C. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.

D. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.

E. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.

F. Do not commence construction of structure foundation until soil test results are confirmed.

1.06 ADDITIONAL PAYMENT

A. All excavation, removal, and disposal of earth, peat, muck, and other materials; erosion control; sheeting, shoring, and bracing; fill and backfill, placement, compaction, grading, source quality testing; stockpiling; and all other work under this Section shall be considered incidental to the Project and no claim for additional compensation of extra work will be accepted.

B. No claim for additional payment will be accepted for excavation and fill for all or improvements required for removal of unsuitable material up to three (3) feet below bottom of proposed foundation or one (1) foot below bottom of noted geosynthetically reinforced structural fill or one (1) foot below minimum excavation limit or as noted on the Drawings, whichever results in the greater excavation and fill.

C. Excavation and fill required for removal of unsuitable material deeper than the above limits will be paid for on a time and materials basis if conditions found in the Geotechnical Report are found to differ from actual conditions experienced on site. No additional payment will be made for conditions reflected in the Geotechnical Report.

D. No claim for additional payment will be accepted for repairs made to subgrade due to weather related items.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 INSPECTION

A. Contractor shall verify which native materials are suitable for reuse at the site. Provide testing data as required and keep materials separated.

B. Notify Engineer of any unsuitable materials.

3.02 PROTECTION

A. Protect all existing structures, trees, plantings, turf, and other facilities which are not scheduled for removal.

3.03 TOPSOIL REMOVAL

A. All topsoil shall be stripped to full depth and stockpiled separately to be placed on top of finished grading and all disturbed areas not covered by structures or pavement. Remove all heavy growths of grass prior to stripping topsoil.

B. Separate all debris, large roots, and rocks greater than one (1) inch from the topsoil and remove from the site in accordance with all applicable Federal, State, and Local regulations to Contractor furnished site.

C. Where trees are to be left standing, stop topsoil stripping a sufficient distance (at least the drip line) from a tree to prevent damage to main root system.

3.04 STOCKPILING OF MATERIALS

A. Contractor may temporarily stockpile acceptable materials including topsoil, excess excavated, and delivered materials within the limits of construction where shown on the Drawings. Contractor shall obtain approval from Engineer before stockpiling excess materials.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

E. Apply appropriate erosion control measures to stockpile areas.

F. Avoid stockpiling in location of future levee or berm around the site.

G. Contractor shall remove all excess stockpiles from the site prior to substantial completion of the project.

3.05 STOCKPILE CLEANUP

A. Remove stockpile; leave area in a clean and neat condition. Grade site surface to prevent freestanding surface water.

B. Restore stockpile area in accordance with Section 32 90 00.

C. Temporary Stockpile Area:

1. Contractor shall place material from excavations onsite in the area designated on the plans.

END OF SECTION 31 14 13

SECTION 31 22 00
GRADING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements and procedures for site grading including, but not limited to, the following:

1. Rough Grading
2. Finish Grading
3. Topsoil Placement

B. Related Sections include:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 1 – General Requirement Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 DESCRIPTION

A. Contractor shall grade the site as shown on the Drawings. Contours and spot elevations indicate finished surface grades.

B. Construct uniform slopes between contours and spot elevations.

C. Limits of construction are shown on the Drawings as indicated by the fencing boundary. Excavation, placement of fill, or general grading shall not be allowed outside of the limits of construction where shown on the Drawings.

D. Materials may be temporarily stockpiled on the site within the limits of construction or where shown on the Drawings.

E. Topsoil removal and rough grading of the site shall be completed prior to structure erection.

F. Perform finish grading and topsoil placement after structure erection.

G. Protect benchmarks and existing structures that are to remain from damage or displacement.

H. All earthwork shall be performed in a manner and sequence that will provide drainage and proper erosion control at all times.

1.03 FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the Work are as indicated.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil: Type S4 as specified in Section 31 05 13.

B. Subsoil Fill: Type S1 or S2 as specified in Section 31 05 13.

C. Engineered Fill: Type A4 as specified in Section 32 05 16.

D. Aggregate Base and Surface Course: Type A3 and A2 respectively as specified in Section 32 05 16 and shown on drawings.

E. Provide source testing data in accordance with Section 01 40 00.

2.02 SOURCE QUALITY CONTRO

A. Conduct the following tests on each material proposed for use prior to start of soils work. Refer to Section 01 40 00 for source test requirements.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify structure and trench backfilling have been inspected.

B. Verify subgrade base has been contoured and compacted.

3.02 PROTECTION

A. Contractor shall conduct all grading operations within the limits of construction where shown on the Drawings, and within the designated grading limits as shown from contours and spot elevations.

B. Protect all existing structures, trees, plantings, turf, and other facilities which are not scheduled for removal

C. Provide proper erosion and sediment control for all grading operation.

D. Repair disturbed areas and compact to required density prior to further work.

E. Remove material contaminated by erosion and runoff, provide new material and compact.

3.03 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, and stones in excess of 2 inches in size. Remove subsoil contaminated with petroleum products.

C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.04 ROUGH GRADING

A. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth finish surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and

existing grades.

B. Grade surface of fill under structures and slabs to required density, free of voids, and to required elevations.

C. Rough grade areas adjacent to structure lines to drain away from structures and to prevent ponding or increase in soil lateral pressure on the structure.

3.05 FINISH GRADING

A. Contractor shall provide the degree of finish grading that will be normally obtainable through the use of suitable equipment operated under favorable conditions and by an experienced operator. Deviations from the required tolerance shall be corrected by the Contractor at no additional cost to the Owner.

3.06 TOPSOIL PLACEMENT

A. Place topsoil in areas where seeding and restoration is required to a nominal depth of 6 inches. Place topsoil during dry weather.

B. Use imported topsoil as a supplement to stockpiled topsoil only when a 6 inch depth is unable to be maintained.

C. Drag topsoiled areas to remove wheel tracks and provide a uniform texture and appearance.

D. Place fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade. Finish grades shall allow for proper drainage without ponding.

E. Remove roots, weeds, rocks, and foreign material while spreading.

F. Manually spread topsoil close to plant life and buildings to prevent damage.

G. Lightly compact placed topsoil.

H. Remove surplus subsoil and topsoil from site. Contractor shall pay for loading, hauling, and spreading of all excess topsoil materials removed from the site or placed and spread on-site by direction of Owner or Engineer.

I. Contractor shall pay for additional topsoil that is required at the site, including providing transporting and placing topsoil.

J. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.07 TOLERANCES

A. Top of Topsoil: Plus or minus 1 inch.

END OF SECTION 31 22 00

SECTION 31 22 10
GRAVEL ROADWAY, SHOULDERS AND PARKING LOTS

PART 1 - GENERAL

The work covered by this section of the specifications shall consist of furnishing, placing, watering, shaping and compacting gravel to provide a firm and stable roadway and parking lots or driveway. Existing gravel roadways, driveways and parking lots disturbed during construction shall be replaced with gravel as noted on the drawings. The typical section for gravel shall be as shown on the drawings. Minor surface repairs shall be made with crushed gravel surface course only at no cost to the Owner.

END OF SECTION 31 22 10

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Scarifying, compacting and shaping the earth subgrade.
2. Perform subgrade preparation on all areas to receive concrete pavement, bituminous pavement, aggregate base course, and/or aggregate surface course.

B. Related Sections:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections

PART 2 - PRODUCTS

2.01 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to approval of the Engineer.

B. Suitable Soil Materials: On-Site excavated material or imported material meeting subsoil classification S1, S2, or S3 as defined in Section 31 05 13, free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

PART 3 - EXECUTION

3.01 GENERAL

A. The contractor shall follow the recommendations as provided in the Geotechnical Report by Thomas, Dean & Hoskins, Inc. The Geotechnical Investigation Report and associated Addenda are included in Section 00 31 32 of this Project Manual.

B. Subgrade Preparation shall consist of producing a firm and stable subgrade prior to placement of the surface or base course.

3.02 SUBGRADE PREPARATION

A. The Contractor shall compact and shape the subgrade for its full width as may be necessary to produce, at the time the base course is placed, the required density in the upper 12-inches of the base and the required grade and cross-section.

B. If areas are encountered that cannot be compacted, sub-excavate unstable materials and replace with materials that can be compacted.

C. Contractor shall be responsible for drying the subgrade soil or applying water as may be necessary to obtain the required density. Contractor shall also be responsible for grading the Work area and providing drainage so that accumulating water will drain away from the subgrade.

D. The finished subgrade surface shall be smooth and uniform and shall not rut, shove, flex, or displace when any construction equipment is placed on it.

E. The required grade and cross-section for subgrades shall consist of a smooth subgrade surface that conforms to the prescribed elevations for the particular subgrade being prepared, prior to constructing an additional course thereon. The required grade and cross-section for rough graded surfaces shall consist of a smooth graded surface that conforms to the prescribed elevations for that particular rough grade being prepared. The prescribed elevation for any point on the subgrade or rough graded surfaces shall be as determined from the grades staked by the Engineer.

F. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations, vehicular traffic, or weather conditions.

G. Subgrade preparation shall apply to all mat foundations, pipe trenches, concrete slabs, paved and graveled areas, including roads, driveways, parking areas, and sidewalks.

H. Testing requirements for subgrade preparation shall be as follows:

1. Shall conform to requirements of Section 01 40 00.

3.03 SPECIAL REQUIREMENTS

A. Only hand-operated compaction equipment should be used within 5 feet of walls.

B. Final subgrade elevation improvements for mat foundations should be smoothed using a vibratory plate, care shall be taken to prevent pumping of subgrade.

3.04 TOLERANCES

A. Finish subgrade or rough graded surfaces shall not deviate by more than 1 inch from the required section and grade.

END OF SECTION 31 23 13

SECTION 31 23 16
EXCAVATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for Excavation.
2. Subgrade Preparation.
3. Common Excavation.
4. Structural Excavation.
5. Estimated Excavation Quantities.
6. Disposal.

B. Related Sections:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Montana Public Works Standard Specifications (MPWSS), latest edition.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00:

1. Test Results: Prior to start of work, submit written reports for each material sampled and tested. Include project identification, date of report, name of contractor, name of testing laboratory, source of material, manufacturer and brand name for manufactured products, specification requirements for each material, and corresponding test results.
    a. Tests must have been taken no more than 180 calendar days before Notice to Proceed.
2. Product Data: Information on manufactured products indicating compliance with requirements of this Section.

1.04 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

B. Structures: Existing and new construction, including slabs, buildings, tanks, and

structural elements and systems.

C. Acceptable Materials: Material that will provide for the indicated soil bearing capacity, soil densities, material requirements and that, in the opinion of soil testing laboratory, will not be subject to future decomposition, settlement, subsidence, expansion and are otherwise of the required soil type.

D. Unsuitable Materials: Material that will not provide for the indicated soil bearing capacity and soil densities and that in the opinion of the soil testing laboratory will be subject to future decomposition, settlement, subsidence, expansion, and are otherwise not of the required soil type.

E. Soil Testing Laboratory: Refers to professional soils engineering firm with soil sampling and testing services and that is independent from the Contractor. The soil testing laboratory's engineer shall be licensed in the State of Montana.

F. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, topsoil removal, excavation to grade, and scarification and compaction of subgrade.

1.05 SITE CONDITIONS

A. Soil borings were taken for this project by Thomas, Dean & Hoskins, Inc. The Geotechnical Investigation Report and associated Addenda are included in Section 00 31 32 of this Project Manual

B. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.

C. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.

D. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.

E. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.

F. Do not commence construction of structure foundation until soil test results are confirmed.

G. See Geotechnical Excavation Report by Thomas, Dean & Hoskins and associated Addenda, Inc. for recommended soil bearing capacities for footings and structures.

1.06 CONVENTIONAL QUALITY ASSURANCE

A. Source Quality Control Testing: Retain the services of an independent soil testing

laboratory for Source Quality Control sampling and testing.

B. Materials and installed work may require testing and retesting, as required by Engineer, at any time during progress of work.

C. Allow free access of testing laboratory to material stockpiles and facilities at all times.

D. Tests including retesting of rejected materials and installed work shall be at Contractor's own expense unless otherwise indicated.

E. See Section 01 40 00 for additional requirements.

1.07 SEQUENCING AND SCHEDULING

A. Additional excess material shall be stockpiled in accordance with Section 31 14 13.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Stockpile delivered materials and excavated materials at locations approved by Owner until required for backfill or fill. Place, grade, and shape stockpiles for drainage.

B. Store materials in manner that will not impose additional loading and soil pressure on excavation limits and structures.

1.09 PAYMENT

A. All earth rock, peat, muck and all other excavation, removal and disposal required; erosion control, sheeting, shoring and bracing; fill and backfill; placement compaction, grading, source quality control testing, and all other work required under this Section shall be considered incidental to the Project and no claim for compensation or extra work will be accepted.

B. No claim for additional payment will be accepted for excavation and fill for all structures required for removal of unsuitable material of up to three (3) feet below bottom of foundation or one (1) feet below noted structural fill or backfill or one foot below minimum excavation limit as noted on Drawings, whichever results in the greater excavation and fill.

C. Excavation and fill required for removal of unsuitable material deeper than the above limits will be paid for on a time and materials basis if conditions found in the Geotechnical Report are found to differ from actual conditions experienced on site. No additional payment will be made for conditions reflected in the Geotechnical Report.

D. No claim for additional payment will be accepted for repairs made to subgrade due to weather related problems.

1.10 FIELD MEASUREMENTS

A. Survey benchmarks, control points, and intended elevations for the Work are as shown on the Drawings or will be provided by the Engineer.

1.11 COORDINATION

A. Coordinate work under provisions of Section 01 31 13.

B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

C. Contractor shall excavate for structures, pipe, and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 - PRODUCTS

2.01 EXCAVATION MATERIALS

A. See Section 31 05 13 for materials specifications.

2.02 SOURCE QUALITY CONTROL

A. See Section 31 23 23 and Section 01 45 00 for material quality testing requirements.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine project site and conditions under which work of this Section is to be performed.

B. Contractor shall verify which native materials are suitable for reuse at the site. Provide testing data as required and keep materials separated.

C. Notify Engineer of any unsuitable materials.

D. Do not over excavate without authorization from Engineer.

3.02 PREPARATION

A. An OSHA approved competent person shall review the above mentioned soil classification in the field. Excavations shall comply with the requirements of OSHA 29 CFR, Part 2926, Subpart P, “Excavations and Trenches.” Excavation safety is the responsibility of the Contractor. All excavations greater than 20 feet in depth shall be designed by a registered Professional Engineer.

B. Protection

1. Locate existing utilities in areas of work. Protect utilities that are to remain.

2. Protect structures from damage and from damage caused by groundwater, surface water, flood or floatation forces, lateral movement, settlement, undermining, washout, and other undesirable conditions created by the work.

    a. Maintain drainage when drainage ways are obstructed by earthwork and related operations.

3. Protect areas beyond construction zone with erosion control system.

4. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when allowed by utility owner and then only after acceptable

temporary utility services have been provided.

a. Provide temporary services, complying with Federal, State and local laws and regulations, and as acceptable to Owner, during any interruptions.

5. Maintain full access to structure exits and entrances, fire hydrants, street crossings, sidewalks, and other points as designated by Owner to prevent significant interruption of accessibility.

6. Do not bring explosives on site or use in work.

7. Maintain excavations and stockpiles to prevent caving, heaving, slides, and increased soil pressures on adjacent and underlying structures.

8. Maintain existing site drainage ways or provide new paths of drainage for site as required to perform earthwork.

C. Dry subgrade: Add water, then mix to make moisture content uniform throughout.

D. Wet subgrade: Aerate material by blading, discing, harrowing, or other methods to hasten drying process.

E. Excavation support: Install and maintain, as specified in Section 31 41 00, Shoring, as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

3.03 PROTECTION

A. Locate existing utilities in areas of work. Protect utilities that are to remain.

B. Protect structures from damage and from damage caused by groundwater, surface water, flood or floatation forces, lateral movement, settlement, undermining, washout, and other undesirable conditions created by the work.

1. Maintain drainage when drainage ways are obstructed by earthwork and related operations.

C. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when allowed by utility owner and then only after acceptable temporary utility services have been provided.

1. Provide temporary services, complying with Federal, State and local laws and regulations, and as acceptable to Owner, during any interruptions.

D. Protect areas that have been finish graded from subsequent construction operations, traffic, and erosion.

1. Install erosion control protection along perimeter of unfinished areas.

E. Maintain full access to structure exits and entrances, fire hydrants, street crossings, sidewalks, and other points designated by Owner to prevent significant interruption of accessibility.

F. Do not bring explosives on site or use in work.

G. Maintain excavations and stockpiles to prevent caving, heaving, slides, and increased soil pressures on adjacent and underlying structures.

H. Repair disturbed areas and compact to required density prior to further work.

I. Remove material contaminated by erosion and runoff, provide new material and compact.

3.04 COMMON EXCAVATION

A. Excavate designated areas to the proposed subgrade elevations indicated on the Drawings.

B. Contractor shall advise Engineer immediately if any unsuitable materials are encountered during excavation. Unsuitable materials shall be reasonably separated form unsuitable materials and shall be considered surplus material at no additional cost to the Owner.

C. If Contractor encounters excess excavation materials which meet the requirements of common fill as specified herein, Contractor may use those materials as common fill. Contractor shall verify with soils testing laboratory suitability of the use of on-site material.

D. Excavating shall be done in accordance with Section 31 23 19.

3.05 STRUCTURAL EXCAVATION

A. Remove unsuitable materials in accordance to the depth recommended by soils testing laboratory beneath structures to obtain the design bearing capacity.

1. Do not bear any structure partially on bedrock and partially on more compressible soils. Remove bedrock materials and replace them with clean compacted sand or gravel in accordance to the Geotechnical Report. The minimum depth of compacted sand or gravel is 6-inches.

2. Do not bear any structure on wet sandy or clay material. Over-excavate a minimum of 3-feet below the bottom mat foundation for the Aeration Basins, and 2-feet below the mat foundation of the RSB building, and 2- feet below spread footings in the RSB building and replace with compacted granular fill (As Indicated on the Construction Drawings) compacted to the requirements in Section 01 40 00.

3. Dewater excavations for special inspector to observe and determine excavation limits.

4. When bottoms of excavations are approved by soils testing laboratory, but are slightly unstable only in relation to Contractor operations or convenience, Contractor may provide a compacted gravel course utilizing materials acceptable to the soil testing laboratory. Such work shall be considered for the Contractor’s convenience and at Contractor’s own expense.

B. Slope sides of excavations as required to provide stability and to comply with Federal, State and local laws and regulations. Shore and brace excavation when required by project conditions.

1. Utilize cofferdams, steel sheet piling, shoring, underpinning, and other systems required to prevent damage to existing structures, settlement, slope stability problems, and undermining.
2. Remove construction related protection systems after their need is complete, in a manner that will not loosen or damage soils, create slope stability problems, and otherwise damage existing and new structures.
    a. Leave construction-related protection systems in place when their removal would create potential for damage to the soil conditions or to structures.

C. Excavate to required elevations and dimensions within a tolerance of plus or minus 1 inch, and extending a sufficient distance as required to provide for the work, completion of the structures, observation, and testing.
1. When excavating for footings and foundations, do not disturb soil materials at and below excavation limits. Excavate by hand when necessary to prevent damage to soil materials that will remain.
2. Trim bottoms to required lines and grades to leave solid dense base of required bearing capacity.
3. Final removal limits shall be approved by soil testing laboratory prior to concrete placement.

D. Removal of materials beyond required subgrade elevations or dimensions without specific approval of soils testing laboratory as well as backfilling, compaction and remedial work recommended by soils testing laboratory at the over-excavated area shall be at Contractor's own expense.
1. Under structures and their components fill unauthorized excavation utilizing one of the following systems:
    a. Extend indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
    b. Install lean concrete fill to bring elevations to required position.
    c. Fill and compact unauthorized excavations with soil materials and to required density.
2. Elsewhere, backfill and compact unauthorized excavations as indicated for authorized excavations of same classification

E. Protect excavation bottoms from freezing. Remove frozen materials and provide unfrozen compacted materials prior to placement of materials on them.

F. Excavations of structures shall be widened a minimum of one foot horizontally beyond the outer edges of the building perimeter footings for each foot the excavations extend below bottom-of-footing elevations.

G. It is anticipated the excavation bottom for each structure will consist of sand soils, lean clay or a combination of both. These soils shall be maintained within the prescribed

moisture content range until successive layers are placed over them. Thus, if the placement of backfill and fill is slowed or delayed during dry or wet weather, re-conditioning of the placed backfill, fill and natural soils may be necessary.

H. Prior to the placement of engineered fill or construction of structures, any loosened granular materials shall be surface compacted using a vibratory plate compactor. In areas where groundwater is within 3 feet of the subgrade this requirement may be waived in the field by the Engineer if it is found the compaction is pumping up water or creating a temporary “quick” condition and the soils are otherwise suitable for support of the foundations. Areas that yield or pump during surface compaction may require additional subcutting.

3.06 DISPOSAL

A. Excess soil, if any exists, shall be stockpiled on the site. Contractor shall remove unsuitable material such as muck, organic matter, trash, and refuse from the site and dispose of said material according to applicable Federal, State, and local regulations. No additional payment will be provided for off-site disposal.

END OF SECTION 31 23 16

SECTION 31 23 21
FILL AND BACKFILL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements and procedures for site grading including, but not limited to, the following:

1. Filling, Backfilling, and Compacting.

B. Related Sections include, but are not limited to:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.

2. Division 1 – General Requirements Specification Sections.

3. Division 31 – Earthwork Specification Sections.

1.02 REFERENCES

A. Montana Public Works Standard Specifications (MPWSS) specifications are referenced for material requirements and specific construction requirements only.

1.03 DESCRIPTION

A. Limits of construction are shown on the Drawings. Placement of fill shall not be allowed outside the fence boundary where shown on the Drawings unless location is authorized by the Owner.

B. Materials may be temporarily stockpiled on the site within the limits of construction, or where shown on the Drawings.

C. Excess materials shall be stockpiled on site at locations authorized by Owner.

D. Protect benchmarks and existing structures that are to remain from damage or displacement.

1.04 DEFINITIONS

A. Suitable Material: Material that will provide the indicated required soil bearing capacity, soil densities, material requirements or, in the opinion of the soils testing laboratory, will not be subject to future decomposition, subsidence, settlement, or expansion.

B. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.

C. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D1557.

2. Apply corrections for oversize material to either as-compacted field dry density or

maximum dry density, as determined by the Engineer.

D. Optimum Moisture Content:

1. Determined in accordance with ASTM standard specified to determine maximum dry density for relative compaction.

2. Determine field moisture content on basis of fraction passing ¾-inch sieve.

E. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.

F. Complete Course: A course or layer that is ready for next layer or next phase of Work.

G. Lift: Loose (uncompacted) layer of material.

H. Well-Graded:

1. A mixture of particle sizes with not specific concentration or lack thereof of one or more sizes.

2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.

3. Use to define material type that, when compacted, produces a strong and relative incompressible soil mass free of detrimental voids.

I. Influence Area: Are within planes sloped downward and outward at 60-degree angle from horizontal measured from:

1. 1 foot outside outermost edge at base of foundations or slabs.

2. 1 foot outside outermost edge at surface of roadways or shoulder.

3. 0.5 foot outside exterior of spring line of pipes.

J. Borrow material: Material from required excavations or from designated borrow areas on or near Site.

K. Select Backfill Material: Materials available on-site that Engineer determines suitable for specific use.

L. Imported Material: Materials obtained from sources offsite, suitable for specified use.

1.05 SITE CONDITIONS

A. Soil borings were taken for this project by Thomas, Dean & Hoskins, Inc. The Geotechnical Investigation Report and associated Addenda are included in Section 00 31 32 of this Project Manual.

B. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form

considered a part of this Contract.

C. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.

D. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.

E. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.

F. Do not commence construction of structure foundation until soil test results are confirmed.

1.06 SEQUENCING AND SCHEDULING

A. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03 30 00, Cast-In-Place Concrete. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.

B. Backfill around water holding structures only after completion of satisfactory leakage tests as specified in Section 03 30 00.

C. Construction of grade-supported slabs shall not occur immediately after below- grade walls are backfilled, so that post-compaction consolidation of the compacted backfills can be monitored to estimate how much the slabs could settle. Monitoring shall include the placement of grade stakes around the structure that shall be monitored weekly after construction. Results shall be reviewed by the Engineer to evaluate the rate at which post-construction settlements will occur. Settlement is estimated to be complete in less than 90 days.

1.07 PAYMENT

A. All excavation, removal, and disposal of earth, peat, muck, and other materials; erosion control; sheeting, shoring, and bracing; fill and backfill, placement, compaction, grading, source quality testing; stockpiling; and all other work under this Section shall be considered incidental to the Project and no claim for additional compensation of extra work will be accepted.

B. No claim for additional payment will be accepted for excavation and fill for all structures and improvements required for removal of unsuitable material up to two (2) feet below bottom of proposed piping invert elevation or one (1) foot below bottom of noted structural fill or one (1) foot below minimum excavation limit as noted on the Drawings, whichever results in the greater excavation and fill.

C. Excavation and fill required for removal of unsuitable material deeper than the above limits will be paid for on a time and materials basis if conditions found in the Geotechnical Report are found to differ from actual conditions experienced on site. No additional payment will be made for conditions reflected in the Geotechnical Report.

D. No claim for additional payment will be accepted for repairs made to subgrade due to weather related items.

1.08 FIELD MEASUREMENTS

A. Verify that survey benchmark, control point, and intended elevations for the Work are as shown on Drawings or will be provided by the Engineer.

1.09 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Control: Field inspection and testing.

B. Compaction testing will be performed in accordance with ASTM D698, and ASTM D2922.

C. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to Owner.

1.10 COORDINATION

A. Coordinate work under provisions of Section 01 31 13.

B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

C. Contractor shall excavate for piping and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Backfill around Structures: Backfill shall be as indicated on the Construction Drawings.

PART 3 - EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Notify utility company to locate utilities.

C. Protect plant life, lawns, and other features remaining as a portion of final landscaping.

D. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities that are to remain.

F. Contractor shall verify which native materials are suitable for reuse as granular foundation, bedding, encasement, and backfill material at the site. Provide testing data as required and keep materials separated.

G. Notify Engineer of any unsuitable materials or poor subgrade conditions.

H. Notify Engineer when structure or tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.

I. Dewater excavations during backfilling at no cost to Owner.

J. Dewater and dry saturated materials suitable for backfill at no cost to Owner.

K. Compact subgrade to density requirements for subsequent backfill materials.

L. Cut out soft areas of subgrade not capable of compaction in-place. Backfill with Type A or Type B fill and compact to density equal to or greater than requirements for subsequent fill material.

M. Identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.02 STOCKPILING OF MATERIALS

A. Stockpile according to Section 31 14 13.

3.03 FILLING, BACKFILLING, AND COMPACTING

A. The contractor shall follow the recommendations as provided in the Geotechnical Report by Thomas, Dean & Hoskins, Inc.

B. Surface compact excavations prior to installing fill material.

C. Proof roll subgrade areas, where noted with, as a minimum, a tandem axle dump truck loaded to at least 25 ton weight. Truck shall traverse the structure footprint to detect areas of loose or soft soils. Loose or soft soils shall be defined as soils exhibiting “excessive rutting” from the truck tires (approximately one (1) inch wheel rut depth.

D. Do not place material on muddy surfaces, frozen ground or on materials containing frost or ice.

E. Do not place fill required below structures until soil conditions encountered have been approved by special inspector.

F. Slope grade away from structures minimum 2 inches in 10 feet, unless noted otherwise.

G. Do not place material on or in water.

H. Do not proceed with backfilling of excavations until completion of the following:

1. Observation, testing, approval, and recording of locations of underground utilities.

2. Removal of concrete formwork.

3. Removal of shoring, bracing, other protection systems, and backfilling and compaction of voids left by their removals.

4. Removal of unsuitable materials, construction related debris, and excess materials.

5. Walls, including interior walls that brace exterior walls and intermediate floors and roof construction is installed, cured, and obtained required 28- day compressive strength.

6. When existing in-place soil materials are of density less than that specified, but the soil material is acceptable, perform removal, filling, discing of ground surface, moisture-conditioning to within acceptable limits of the optimum moisture content, and compact to provide specified density and bearing capacity as recommended by soils testing laboratory.

I. Placement and Compaction

1. Place materials in compacted layers of thickness required to obtain specified soil densities. Layers shall not exceed 8 inches in loose depth for cohesive and cohesionless soil material, respectively, compacted by heavy compaction equipment and not more than 8 inches in loose depth for cohesive and cohesionless soil materials, respectively, compacted by hand operated tampers unless soil density tests substantiate specified densities will be obtained when material is placed in thicker lifts.
2. Place material in lifts uniformly to the same approximate elevation, not exceeding the final grade height, in manner required to prevent creation of unbalanced soil lateral pressures, wedging action of materials and soil pressures that exceed the design lateral soil conditions and to prevent damage to the structure.
3. Moisten or aerate each layer to the extent required to obtain the optimum moisture content required for the indicated compaction density. Prevent free water from appearing on surface during or subsequent to compaction operations.
4. Remove and replace with acceptable material, or scarify and air dry otherwise acceptable soil material that is too wet to obtain specified soil density. Assist drying by discing, harrowing, or pulverizing, until moisture content is reduced to value required for compaction.
5. Compact each layer to the required density specified for each area classification. Hand tamp or utilize hand operated vibratory equipment when required to compact material placed immediately adjacent to walls within 5 feet.
6. Do not place additional layers until density of each layer in place complies with compaction requirements. Perform corrective work as required to obtain required density. Cost associated with correction work and retesting at failed test locations shall be at Contractor's expense.
7. At door stoops place sand cushion to cross-section indicated on Drawings.

3.04 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried below grade lines shown or established by the Engineer as follows:

1. Beneath Existing Footings: Concrete of strength equal to respective footing.
2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
3. Beneath Slabs on Grade: Aggregate fill.

4. Permanent Cut Slopes (Where overlying area is not to receive fill or backfill):
    a. Flat to Moderate Steep Slopes (3:1 or flatter): Common fill.
    b. Steep Slopes:
        i. Correct overexcavation by transitioning between overcut areas and designed slope adjoining areas, providing such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities or competed Work.
        ii. Backfilling overexcavated areas is prohibited, unless in Engineer's opinion, backfill will remain stable, and overexcavated material is replaced as compacted common fill.

3.05 PLACING FILL OVER GEOSYNTHETICS

A. General:
    1. Place fill over geosynthetics with sufficient care so as not to damage them.
    2. Place fill only by back dumping and spreading only.
    3. Dump fill only on previously placed fill.
    4. While operating equipment, avoid sharp turns, sudden starts and stops that could damage geosynthetics.
B. Hauling: Operate hauling equipment with a minimum 3 feet of covering.
C. Spreading:
    1. Spreading equipment shall be track mounted low ground pressure, D-3 or lighter.
    2. Operate spreading equipment on minimum of 12-inches of fill.
    3. Spread fill in same direction as unseamed overlaps to avoid separation.
    4. Limit distance material falls to maximum of 2 feet.
    5. Flatten wrinkles in direction of spreading.
    6. Maintain proper overlap of unseamed.
    7. Avoid overstressing material and seams.
D. Geosynthetics Damage:
    1. Mark punctures, tears, or other damage, so repairs can be made.
    2. Clear overlying fill as necessary to repair damage.

3.06 COMPACTION REQUIREMENTS

A. Compact materials as required in Section 01 40 00.
B. Contractor shall re-compact all areas represented by failed density tests at their own expense.

3.07 TOLERANCES

A. Finished Grade:

1. Plus or minus 1 inch, upon completion of settlement in ditches, berms, and lawn areas.

2. Plus or minus 1 inch upon completion of settlement in roadways and driveways.

B. All areas that receive fill or backfill shall be kept within settlement tolerances through the warranty period.

3.08 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 50 00.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.09 SETTLEMENT

A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the Supplementary Conditions.

B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer or Owner, or sooner if required by Engineer or Owner, depending on the critical nature of the settlement.

3.10 SCHEDULE

A. Beneath Landscaped Areas:

1. Type A or B, to a minimum of 6 inches and a maximum of 18 inches below finish grade, compacted as specified in Section 01 40 00.

B. Beneath Aeration Basin (BNR) and Return Sludge Building (RSB) Structures:

1. Material: As indicated on the Construction Drawings.

2. Compacted Thickness: Equal, continuous layers not exceeding 8 inches compacted thickness. In the upper 12 inches of soil below the structures place compacted lifts no greater than 8 inches.

3. Place Geogrid and Goetextile fabric as shown in the Drawings.

4. Compaction: As specified in Section 01 40 00.

C. Beneath Concrete Slabs on Grade and Adjacent to Concrete Structures and for all pipe installations:

1. Material: As indicated on the Construction Drawings, Type A or B material per Section 31 05 13 unless otherwise indicated as granular material per Section 32 05 16 placed in compliance with the Drawings.

2. Compacted Thickness: Equal, continuous layers not exceeding 8 inches compacted thickness. In the upper 12 inches of soil below the pavement place compacted lifts no greater than 8 inches.

3. Compaction: As specified in Section 01 40 00.

D. Fill to Correct Over-excavation:

1. Fill Type A, B as specified in Section 31 05 13, or granular material as specified in Section 32 05 16 as indicated on the Construction Drawings, flush to required elevation, compacted as specified in Section 01 40 00.

E. Sub-base Preparation:

1. As indicated on the Construction Drawings, Fill Type A or B as specified in Section 31 05 13, compacted in Section 01 40 00.

F. Beneath Asphalt:

1. Compact Subsoil as specified in Section 01 40 00.

2. As indicated on the Construction Drawings, Fill Type A or B as indicated on the Construction Drawings, compacted as specified in Section 01 40 00.

G. Topsoil Fill:

1. See Section 31 05 13.

END OF SECTION 31 23 21

SECTION 31 23 33
TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Excavating trenches for utilities.
2. Compacted bedding and fill of utilities to subgrade elevations.
3. Backfilling and compaction requirements for trenches.

B. Related Sections include, but are not limited to:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

B. Soil Testing Laboratory: Refers to a professional soils engineering firm with soil sampling and testing services that is independent from the Contractor.

C. Suitable Material: Material that will provide the indicated required soil bearing capacity, soil densities, material requirements or, in the opinion of the soils testing laboratory, will not be subject to future decomposition, subsidence, settlement, or expansion.

D. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.

1.03 SITE CONDITIONS

A. Soil borings were taken for this project by Thomas, Dean & Hoskins, Inc. The Geotechnical Evaluation Report and associated Addenda are included in the Project Manual.

B. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.

C. Contractor shall determine to Contractor’s own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.

D. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.

E. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.

F. Do not commence construction of structure foundation until soil test results are confirmed.

1.04 ADDITIONAL PAYMENT

A. All excavation, removal, and disposal of earth, peat, muck, and other materials; erosion control; sheeting, shoring, and bracing; fill and backfill, placement, compaction, grading, source quality testing; stockpiling; and all other work under this Section shall be considered incidental to the Project and no claim for additional compensation of extra work will be accepted.

B. No claim for additional payment will be accepted for excavation and fill for all structures and improvements required for removal of unsuitable material up to two (2) feet below bottom of proposed piping invert elevation or one (1) foot below bottom of noted structural fill or one (1) foot below minimum excavation limit as noted on the Drawings, whichever results in the greater excavation and fill.

C. Excavation and fill required for removal of unsuitable material deeper than the above limits will be paid for on a time and materials basis if conditions found in the Geotechnical Report are found to differ from actual conditions experienced on site. No additional payment will be made for conditions reflected in the Geotechnical Report.

D. No claim for additional payment will be accepted for repairs made to subgrade due to weather related items.

1.05 FIELD MEASUREMENTS

A. Verify that survey benchmark, control point, and intended elevations for the Work are as shown on Drawings.

1.06 COORDINATION

A. Coordinate work under provisions of Section 01 31 13.

B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

C. Contractor shall excavate for piping and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 - PRODUCTS

2.01 GENERAL

A. Granular materials provided for foundation, bedding, encasement, and backfill or other purposes shall consist of any natural or synthetic mineral aggregate such as sand, gravel, crushed rock, or slag that shall meet the meet the gradation requirements specified herein for each specific use.

B. Granular materials provided for foundation, bedding, encasement, or backfill use shall be classified by use in accordance with the following requirements.

2.02 GRANULAR FOUNDATION

A. Granular foundation shall be placed below the bottom of the pipe invert as replacement for unsuitable or unstable soils to provide better pipe support.

B. Granular foundation material shall be Type A5 aggregate material as specified in Section 32 05 16.

2.03 GRANULAR BEDDING

A. Granular bedding shall be placed below the pipe midpoint, prior to pipe installation to facilitate proper shaping and achieve uniform pipe support. Minimum depth as indicated on the Construction Drawings. Place approved bedding material 4-inches under the pipe, around the pipe, and to a depth of 6- inches over the pipe.

B. Granular bedding material shall meet the requirements of Section 32 05 16 and as indicated on the Construction Drawings.

2.04 GRANULAR ENCASEMENT

A. Granular encasement shall be placed below an elevation of six (6) inches above the top of the pipe, after pipe installation, for protection of the pipe.

B. Granular bedding material shall meet the requirements of Section 32 05 16 and as indicated on the Construction Drawings.

2.05 GRANULAR BACKFILL

A. Between pipe zone and subgrade elevation shall meet the requirements of Section 32 05 13 and as indicated on the Construction Drawings.

PART 3 - EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, maintain, and protect utilities that remain from damage.

C. Notify utility company to locate utilities.

D. Protect plant life, lawns, and other features remaining as a portion of final landscaping.

E. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

F. Maintain and protect above and below grade utilities that are to remain.

G. Contractor shall verify which native materials are suitable for reuse as granular foundation, bedding, encasement, and backfill material at the site. Provide testing data as required and keep materials separated.

H. Notify Engineer of any unsuitable materials.

I. Dewater trench and structure excavations at no cost to Owner.

3.02 EXCAVATING

A. Excavate topsoil in accordance with Section 31 14 13.

B. Excavate trench to alignment and grade as required to meet foundation and bedding requirements as specified. Trench shall be centered on pipe alignment and no more than 100 feet of trench should be excavated in advance of pipe laying operations.

C. The trench width may vary and depend on the depth of trench, the diameter of pipe to be laid, and the nature of the material to be excavated, but in any case shall be of ample width to allow the pipe to be laid and joined properly and the backfill to be placed and compacted properly. The minimum bottom width of unsheeted trench shall be 18 inches. The maximum clear width of trench at the top of the pipe shall be not more than 32 inches greater than the outside diameter of the pipe for pipes 30 inches diameter and larger, or 18 inches greater for pipe under 30 inches in diameter. Wider trench widths at the top of the pipe shall be subject to approval by Engineer. The width of the trench at the ground surface shall be kept to a minimum to prevent unnecessary disruption of service structures.

D. If the trench width at the pipe zone is excavated to a greater width than the maximum, the Engineer may require the Contractor to provide a higher class of bedding and/or higher strength pipe that that required by the Contract Documents in order to satisfy pipe design requirements. In such case, no additional compensation shall be made for the higher class bedding or higher strength pipe.

E. Trench excavation shall be made by open cut methods. Trench sides shall be as vertical as possible and the trench shall be braced, sheeted, and drained such that the work may be performed safely in accordance with OSHA requirements.

F. Sheeting, shoring, and bracing shall be put in place and maintained as required due to soil stability or site constraints. Shoring, sheeting, and bracing shall be provided to prevent disturbance or settlement of adjacent surfaces, structures, foundations, utilities and other properties. Any damage to the work under contract or to existing adjacent structures or other improvements caused by settlement, water or earth pressures, slides, cave-ins, or other causes due to lack of appropriate sheeting, shoring, or bracing shall be repaired at the Contractor’s expense at no delay.

G. Trench sheeting, shoring, and bracing shall be kept in place until pipe has been laid, tested for defects, and repaired if necessary, and the earth around the pipe is compacted. The sheeting, shoring, and bracing shall be removed in such a manner as not to remove the constructed pipe or adjacent structures or other improvements.

H. It shall be the Contractor’s responsibility for proper and adequate placement of sheeting,

shoring, and bracing in accordance with all applicable regulations and standards.

I. Whenever unsuitable or unstable soil for properly supporting the pipe or structures is encountered, a further depth and/or width shall be excavated and replaced with the foundation material specified herewith or other suitable foundation material and thoroughly compacted to assure a firm foundation for the pipe.

J. Stockpile excavated material in an orderly manner, at sufficient distance from the trench to avoid overloading, to prevent slides and cave-ins.

K. Contractor shall advise Engineer immediately if any unsuitable materials are encountered during excavation. Unsuitable materials shall be reasonably separated form unsuitable materials and shall be considered surplus material at no additional cost to the Owner.

L. If Contractor encounters excess excavation materials which meet the requirements of common fill, Contractor may use those materials as fill in common execution and fill areas. Excess surplus materials shall be stockpiled.

M. Excavate to and over-depth of a minimum of 6 inches below pipe in areas of bedrock or other extensive rock formations by jack hammer, blasting, or other approved method. Trench width shall be 1.25 times the outside diameter of the pipe.

N. Remove unsuitable materials in accordance to the depth recommended by the soils testing laboratory beneath structures to obtain desired soil bearing capacity. Contractor shall notify Engineer prior to any additional excavation that is needed. Additional excavation shall be subject to approval by the Engineer and subject to additional payment as noted above.

O. Removal of materials beyond required subgrade elevations or dimensions without specific approval from soils testing laboratory and Engineer as well as backfilling, compaction, and other work at the over excavated area shall be at the Contractor’s own expense.

P. Excavating and backfilling shall not be conducted in water. All excavations shall be maintained in a well drained condition at all times. Contractor shall provide and maintain temporary drainage facilities as required, and as approved by the Engineer, at no additional cost to the Owner.

Q. Do not interfere with 45 degree bearing splay of foundations. Underpin adjacent structures, as necessary, to prevent damage by excavation Work.

R. Hand trim for bell and spigot pipe joints. Remove loose matter.

S. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard, measured by volume.

T. In the event of shrinkage of excavated soils, resulting in shrinkage of backfill along trenches, Contractor shall provide, haul, place, and compact suitable soil type S1 or S2 from source at no cost to Owner.

U. Stockpile excavated material in an orderly manner, at sufficient distance from the trench to avoid overloading, to prevent slides and cave-ins. Remove excess material not being used from site.

3.03 PIPE FOUNDATION

A. Whenever unsuitable or unstable soil for properly supporting the pipe or structures is encountered, a further depth and/or width shall be excavated and replaced with the foundation material specified herewith or other suitable foundation material and thoroughly compacted to assure a firm foundation for the pipe.

B. Additional density testing may be required in unstable areas where unsuitable materials are found. Engineer shall determine stability of trench bottom.

C. Trench bottom shall be cut true and even so that the barrel of the pipe will have a bearing over the full length. Bell holes shall be excavated to ensure the pipe is resting for its entire length on the bottom of the trench and required bedding.

3.04 BACKFILLING

A. Pipe Zone

1. Should the materials available within the trench section be unsuitable or insufficient for this portion of the granular bedding, encasement and backfill materials as defined in this Specification, Contractor shall provide an approved material that meets the appropriate specifications.

2. Backfill materials shall be placed with care and deposited uniformly on both sides of pipe throughout the entire trench width in maximum 8-inch lifts. Mechanically compact material to required densities.

3. Flexible pipe shall be bedded in accordance with ASTM Specification D2321, “Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.” This shall include the placement of granular bedding and encasement materials from a point four (4) inches below the bottom of the pipe to a point six (6) inches above the top of the pipe compacted to required densities.

4. Placement and compaction of bedding, encasement, and backfill materials shall be consider incidental to the installation of the pipe.

B. Above Pipe Zone

1. Use suitable excavated materials from the site prior to importing of select granular borrow material. Any additional suitable select granular borrow material required to be imported shall be provided by the Contractor at no additional cost to the Owner. Contractor shall separate out all unsuitable materials. Excess surplus materials shall be removed from the Site.

2. Provide replacement backfill as required to establish required subgrade elevation. Use select granular borrow for replacement backfill.

3. Place backfill materials in uniform layers no more the 8 inches loose depth. Mechanically compact each layer of material to required densities.

4. Do not backfill unless approved compaction equipment is operating. The method of means of placement and type of compaction equipment used is at the discretion of

the Contractor, however, all portions of the trench backfill must meet the compaction requirements. Tests to determine the compacted density of the backfill may be ordered by the Engineer if the compaction does not appear to be adequate.

5. The intent of this specification is to compact the backfill enough to prevent large settlements above the pipe, but to use as little effort as possible to avoid disturbing the pipe and bedding at the pipe zone.

C. Backfill trenches to contours and elevations with unfrozen fill materials.

D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

E. Aggregate Fill: Place and compact materials in equal continuous layers not exceeding 8 inches loose depth.

F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches loose depth.

G. Employ a placement method that does not disturb or damage utilities in trench. Prevent floatation of pipe.

H. Maintain optimum moisture content of fill materials to attain required compaction density. Use vibratory or special compaction equipment when required.

I. Remove surplus fill materials from site.

J. Leave fill material stockpile areas completely free of excess fill materials. Contractor shall have the responsibility to load, haul, and spread all excess fill off-site.

3.05 COMPACTION REQUIREMENTS

A. Compact according to Section 01 40 00.

B. Contractor shall recompact all areas represented by failed density tests.

3.06 TOLERANCES

A. Top Surface of Backfilling:

1. Plus or minus 1 inch, upon completion of settlement in ditches, berms, and lawn areas.

2. Plus or minus 1 inch upon completion of settlement in roadways and driveways.

B. Trenches shall be kept within settlement tolerances through the warranty period.

3.07 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Control: Field inspection and testing.

B. Compaction testing will be performed in accordance with ASTM D698, and ASTM D2922.

C. If tests indicate Work does not meet specified requirements, remove Work, replace,

compact, and retest at no additional cost to Owner.

3.08 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 50 00.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.09 SCHEDULE

A. As Shown on the Construction Drawings in conformance with Geotechnical Report recommendations.

END OF SECTION 31 23 33

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. Prevention of sedimentation of waterways, wetlands, and storm and sanitary sewers due to construction activities.

B. Restoration of areas eroded due to insufficient preventative measures.

C. Related Sections include, but are not limited to:

1. Division 02 – Existing Conditions
2. Division 31 – Earthwork
3. Division 32 – Exterior Improvements
4. Division 33 – Utilities

1.02 REFERENCES

A. Montana General Permit No. MTR100000 (or its successor), Effective Date October 12, 2009 and Expiration Date January 1, 2013 - Authorization to Discharge under the National Pollutant Discharge Elimination System.

B. Montana Department of Transportation (MDT) Erosion and Sediment Control Field Manual – Latest Edition

C. Montana Department of Transportation (MDT) Standard Specifications for Road and Bridge Construction – Latest Edition

D. Montana General Permit No. MTG070000 (or its successor), Effective Date October 12, 2009 and Expiration Date January 1, 2013 – General Permit for Construction Dewatering.

E. ASTM D 4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2005.

F. ASTM D 4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2004).

G. ASTM D 4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2004.

H. ASTM D 4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 1991 (Reapproved 2003).

I. ASTM D 4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2004.

J. ASTM D 4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples, 2002.

1.03 SUBMITTALS

A. Provide product specification sheets for the following erosion control materials to demonstrate that the Contractor's proposed products meet the Contract Document requirements:

1. Fabric proposed for silt fence
2. Fiber Roll
3. Gradation tests for Construction Entrance stone material

PART 2 - PRODUCTS

2.01 SILT FENCE

A. As Shown on Drawings.

2.02 FIBER ROLLS

A. Prefabricated Rolls - As shown on Drawings.

2.03 CONSTRUCTION ENTRANCE

A. Materials As Shown on Drawings.

B. 3-6 inch Stone

1. Stone shall be angular and shall be comprised of hard, durable mineral materials that have been mechanically processed.
2. Stone shall not be from limestone/dolomite deposits that have thinly bedded strata or strata of a shale nature.
3. Stone gradation shall conform to the following:

SIEVE	PERCENT PASSING (by weight)
6-inch	100
3 ½-inch	50 – 100
3-inch	10 – 75
2-inch	0 – 10
3/8 inch	0 – 1

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. The Contractor shall develop a Storm Water Pollution Prevention Plan as required by the Montana Department of Environmental Quality that meets both the State's requirements and the minimum practices shown on the Drawings.

B. The Contractor shall complete and sign the Notice of Intent and submit to the Montana Department of Environmental Quality.

3.03 PERFORMANCE REQUIREMENTS

A. Contractor shall comply with all requirements of the Montana Department of Environmental Quality along with all Federal, State, and Local permits and regulations for erosion and sediment control.

1. If erosion or sedimentation occurs due to non-compliance with any of these permits, Contractor shall restore eroded areas at no cost to Owner.

2. If sedimentation beyond permitted thresholds occurs in regulated waterways or wetlands, Contractor shall at no additional cost to the Owner:

a. Contact the authorities having jurisdiction;

b. Remove deposited sediments to the satisfaction of the Owner and the authorities having jurisdiction;

c. Install or correct preventive measures to the satisfaction of the authorities having jurisdiction; and

d. Pay any fines or other additional requirements of the authorities having jurisdiction; and

e. Meet the Contract schedule for project completion.

B. Contractor shall not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

1. Obtain and pay for permits and provide security required by authority having jurisdiction.

C. Timing of erosion and sediment control practices: As Shown on the Drawings.

D. Erosion Control: Contractor shall reduce wind, water, and vehicular erosion of soil on project site due to construction activities for this project, consistent with approved permits and following these requirements:

1. Minimum erosion control measures as shown on the Drawings with additional practices implemented as required by the Contractor’s SWPPP.

2. Control movement of sediment and soil from temporary stockpiles of soil.

3. Prevent development of ruts due to equipment and vehicular traffic.

4. Provide good site housekeeping.

5. Inspect, repair, maintain, and replace erosion control practices consistent with approved permits and as shown on the Drawings.

E. Sediment Control: Contractor shall reduce sediment transport off- site due to construction activities for this project, consistent with approved permits and following these

requirements:

1. Minimum sediment control measures as shown on the Drawings with additional practices implemented as required by the Contractor's SWPPP.
2. Reduce windblown soil from leaving the project site.
3. Reduce tracking of mud onto public roads outside of the site.
4. Reduce mud and sediment from flowing onto sidewalks and pavements.
5. Inspect, repair, maintain, and replace sediment control practices consistent with approved permits and as shown on the Drawings.

3.04 CLOSE-OUT

A. Contractor shall file a Notice of Termination with the State following site stabilization that meets the requirements of the General Permit.

B. Contractor shall remove and clean up all temporary erosion and sediment control practices as shown on the Drawings. Site disturbance caused by removal of these practices shall be restored consistent with the surface restoration requirements shown on the Drawings. Costs for restoration shall be at Contractor's expense.

END OF SECTION 31 25 00

SECTION 31 35 26.16
GEOMEMBRANE CONTAINMENT BARRIER
BIOSOLIDS TREATMENT BASIN - POLYPROPYLENE LINER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections;

B. Division 1 Section “Payment Procedures" for a schedule of unit prices;

C. Division 31 Section "Earthwork" for site stripping, grubbing, removing topsoil, and protecting trees to remain;

D. Division 31 Section “Earthwork” for all site earthwork not covered in other areas;

E. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction;

F. Division 3 for installation of cast-in-place concrete mounting pads for the sludge mixing system and pipe penetration collars beneath the polypropylene liner;

G. Division 33 for installation of the insulated floating cover, baffle and anchoring system;

H. Division 46 for installation of the aeration diffusers;

I. Division 40 for installation of aeration piping.

1.02 SUMMARY

A. The Contractor, subcontractors and suppliers are required to be familiar with the site conditions under which this work is to be conducted and shall be responsible for and guarantee the performance of the polypropylene liner.

B. This Section includes the following:

1. Furnishing and installing a 45 mil thick scrim-reinforced polypropylene geomembrane liner in the Biosolids Treatment Basin as shown on the drawings, in these specifications and as directed by engineer. All work shall be done in strict accordance with the project drawings, these specifications and the Fabricator/Installer’s installation requirements and approved submittals.

1.03 SUBMITTALS

A. Submittals for the fabrication and installation of the polypropylene lining material shall be provided after the award of the contract. Factory fabrication shall not proceed until the submittals have been approved by the project engineer.

B. Manufacturer, Fabricator, Installer Qualifications. The following shall be the minimum information required:

1. Name.

2. Address.

3. Phone number and fax number.
4. Qualifications of individuals who will personally be assigned to the project.
5. Manufacturer - Number of years of manufacturing experience and approximate total square feet of liner installed.
6. Manufacturer – Number of square feet and location of the polypropylene installed, that is similar to that utilized for this job, in other hydraulic structures of similar application to this job.
7. Fabricator/Installer – Number of years of continuous experience and total square feet of various Geomembrane lining systems installed.
8. Fabricator/Installer – Square feet of polypropylene membrane fabricating and installing experience.
9. Fabricator/Installer – Authorization by the manufacturer of the liner to be a fabricator/installer of the liner.

C. Proposed polypropylene panel layout. The drawing shall show the entire area to be lined, the direction of factory seams, and size of panels. Except for special requirements due to configuration and/or terminating the geomembrane, maximum use of large size panels shall be made to reduce field seaming to a minimum.

D. Termination details of the geomembrane at the perimeter of lined areas, including anchors, vent interface, etc.

E. Geomembrane sealing details for areas around penetrations, support slabs and control structures.

F. Prior to installation of the PP panels, the Fabricator/Installer shall provide the Engineer with the following certification and test reports:

1. Written certification that the material meets all of the requirements of Table 1 in this Section.
2. Written certification that the rolled material from the manufacturer was inspected and tested prior to fabrication as required in this Section.
3. Written certification that the factory seams were inspected and tested in accordance with this Section.

G. Conformance testing results. No geomembrane material shall be installed until conformance testing is complete and results show that the delivered material meets the requirements of the Specifications. The conformance testing shall meet the minimum physical property characteristics of this Section. The test reports shall include the following test results:

1. Thickness (ASTM D751).
2. Breaking Strength (ASTM D7004)
3. Tear Strength (ASTM D5884).
4. Low Temperature (ASTM D2136)

5. Dimensional Stability (ASTM D1204)
6. Hydrostatic Resistance (ASTM D751)
7. Puncture Resistance (ASTM D4833)
8. Water Absorption (ASTM D471)
9. UV Resistance (ASTM G155)
10. Ply adhesion (ASTM D413).

H. Sample polypropylene manufacturer 20 year warranty.

I. All other certifications and test results required by this Section shall be submitted after the completion of the polypropylene installation and shall include:

1. Factory fabricated seams - Peel Strength (ASTM D882)
2. Factory fabricated seams – Shear Strength (ASTM D882)

J. Aggregate, gradation and other tests necessary to document the suitability of the liner subgrade, as may be required by Engineer.

1.04 MANUFACTURER AND FABRICATOR/INSTALLER QUALIFICATIONS:

A. The manufacturer of the polypropylene membrane material shall have a minimum of five years of manufacturing experience totaling more than 100,000,000 square feet.

B. The fabricator and installing contractor of the polypropylene membrane shall meet the following requirements:

1. Minimum of five years continuous experience totaling more than 10 million square feet of various Geomembrane lining systems.
2. Minimum of 1 million square feet of polypropylene membrane fabricating and installing experience.
3. Authorized by the manufacturer of the liner to be a fabricator/installer of the liner.

PART 2 - PRODUCTS

2.01 45 MIL SCRIM-REINFORCED POLYPROPYLENE

A. The material shall be a nominal 45 mil (ASTM D751) tick, scrim-reinforced, polypropylene as manufactured by EPI of Traverse City, MI or equal.

B. The polypropylene must have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes. The materials supplied under these specifications shall be first quality products manufactured specifically for the purpose of this work.

C. The manufacturer of the calendared rolls shall show the Engineer where a minimum of 5,000,000 square feet of the polypropylene to be utilized for this job has been installed in other hydraulic structures of similar application to this job.

D. Polypropylene sheeting shall be manufactured from a composition of high quality ingredients suitably compounded of 100% virgin polypropylene resin, and specifically compounded for use in hydraulic structures. Reprocessed or reground materials shall not be used. The use of water soluble formulation ingredients is prohibited.

E. The polypropylene membrane material shall consist of thoroughly mixed polypropylene compound. It shall be manufactured by the extrusion/calendaring process and shall be uniform in color, thickness, size and surface texture. The sheeting shall contain no undispersed materials, divots, deep gas checks and shall not exhibit cold flow.

F. The finished membrane shall consist of two (2) plies of polypropylene laminated over one (1) ply of reinforcing scrim. The reinforcing scrim shall be a 9 x 9 – 1000 denier polyester scrim to create an open-type weave that permits strike-through of the polypropylene.

G. The polypropylene shall fully encapsulate the scrim and shall extend a minimum of 1/8" beyond the reinforcing scrim roll edges. Exposed fabric along the longitudinal edges of the roll stock and evidence of delaminating shall not be permitted.

H. The composite material shall be flexible, durable, watertight product free of pinholes, blisters, holes and contaminants.

I. The material shall have the minimum physical property characteristics as shown in the following table:

TABLE 1

PROPERTY	TEST METHOD	VALUES
Thickness- (nominal) (mils)	ASTM D751/D5199	45
Thickness- (minimum) (mils)	ASTM D751/D5199	41
Weight per Unit Area (g/sf)	ASTM D5261	84
TENSILE PROPERTIES (min. ave.) •Grab Strength (lb/in) •Break Elongation (%)	ASTM D751 [2]	 225 22
Tear Resistance (min. ave.) (lb)	ASTM D5884 Method B Tongue Tear	100
Puncture Resistance (min/ave.) (lb)	FTMS 101C/Method 2031	85/120
Ply Adhesion (lb or FTB)	ASTM D413	20
Dimensional Stability (max) (%)	ASTM D1204	±1.0
Hydrostatic Resistance (psi)	ASTM D751 [2] Method A	325
Low Temp Brittleness	ASTM D2136	-40 C
Stress Crack Resistance (hrs)	ASTM D1693	5,000
UV Resistance	ASTM G155	Pass
Peel Strength (Factory Seams) lb/in	ASTM D882	20
Shear Strength (Factory Seams) lb/in	ASTM D882	200
Reinforcing Scrim	9 x 9, 1000 denier weft inserted polyester	

2.02 FACTORY FABRICATION

A. The fabricator shall be an experienced firm customarily engaged in factory-fabricating individual widths of scrim-reinforced polypropylene roll stock into large panels. The fabricator shall have experience in fabricating a minimum of 5,000,000 square feet of geomembrane by thermal fusion methods.

2.03 FACTORY RECEIVING INSPECTION

A. When polypropylene roll goods are received from the manufacturer, the roll numbers and production lot number(s) given on the packing list will be verified. The roll goods shall be unwound inspected on both sides, prior to seaming, for the following:

1. Unmixed or poorly disperse ingredients.
2. Exposed scrim.
3. Pin holes.
4. Presence of contaminants or foreign particles.
5. Rolls have not been visibly damaged during transit.
6. Straight edges.

B. All defects and impurities will be removed or repaired before the membrane is fabricated into panels.

C. In addition to the inspection of the roll goods, the statistically appropriate number of tests shall also be performed on all incoming material. These tests shall include the following:

1. Gauge (thickness) shall be measured according to ASTM D751 at the center and edge of the beginning and end of each role of material used in this work.

   A log shall be maintained showing the material type, roll number and lot number and specified thickness measurement.

2. Dimensional stability.
3. Minimum physical properties as specified in this Section.

D. The above test results are compared with the minimum requirements shown in Table 1. All rolls that do not pass any of the above inspections or tests will be marked "REJECTED" and returned to the polypropylene manufacturer.

2.04 FACTORY SEAMING

A. All factory seams shall be made by thermal fusion methods and:

1. All factory seams shall have a minimum scrim-to-scrim overlap of one and one half inches (1½") when fabricated.
2. All seams shall be made so that thermal fusion bond extends fully to the top edge of the sheet so that no loose edges are present on the top side of the sheet.

2.05 INSPECTION AND TESTING OF FACTORY SEAMS

A. Each fabricated panel shall be visually inspected for the following:

1. Exposed scrim.
2. Continuity of seams.
3. Surface imperfections.
4. Adequacy of any cross seams.
5. Confirm the total panel length.

6. Air lance tested per ASTM-D4545.

B. All exposed scrim edges shall be sealed with an approved polypropylene caulk or caped with a strip of unreinforced polypropylene.

C. Samples shall be taken from each factory seam welding unit used in this work at the beginning of every work shift and every four hours of production thereafter. Samples shall be 48 inch in size and shall not require patching of fabricated panels. Test specimens shall be cut at quarter points from each 48 inch seam sample (total of three places). The samples shall be tested for and meet the following requirements.

1. Bonded seam strength tests for polypropylene shall be conducted in accordance with ASTM-D882 as modified per NSF Standard 54. This test shall demonstrate a minimum of 80% of the specified directional shear strength according to Table 1.

2. Peel adhesion tests for polypropylene shall be conducted in accordance with ASTM-D882 as modified per NSF Standard 54. The test shall demonstrate the minimum specified directional shear strength according to Table 1.

3. A log shall be maintained showing the date, time, panel number and test results.

4. Failure of the material and/or seams to meet all requirements of these specifications maybe cause for rejection of the polypropylene material and/or seams as appropriate.

5. Fabricator shall provide all test results to the Owner and Engineer.

D. No defective seams or exposed scrim will be allowed. All indicated repairs shall be made by the geomembrane fabricator before the panels are packaged for shipment.

2.06 PACKAGING AND LABELING:

A. Each panel shall be packaged by rolling or accordion-folded and placed onto a sturdy wooden pallet designed to be moved by a forklift or similar equipment. All packaging shall be strong enough to prevent damage to the contents.

B. The following information shall be labeled on each fabricated panel:

1. Job number.

2. Thickness and manufacturer of the polypropylene.

3. Panel size.

4. Panel identification number.

5. Fabrication date.

6. Unique identifying markings indicating the proper direction of unrolling and/or unfolding to facilitate layout and positioning in the field.

C. The outside packaging of each palletized box shall be labeled with the following information:

1. Job number.

2. Thickness and manufacturer of the polypropylene.

3. Panel size(s).

4. Panel identification number(s).
5. Customer name and shipping address.

D. Panels that have been delivered to the job site shall be unloaded and stored in their original unopened containers. Each palletized carton should be stored in a safe, stable area. Pallets should be shrink wrapped in protective white reflective plastic sheeting if the material is to be stored for an extended period of time prior to installation. Whenever possible a space between the pallets should be provided.

E. Pallets shall not be stacked.

PART 3 - EXECUTION

3.01 CONFORMANCE TESTING

A. Conformance testing shall be conducted on the polypropylene to insure conformance with the specifications listed within Table 1 of this Section.

B. The Engineer will sample the polypropylene materials that have arrived on-site for conformance testing. The Contractor shall assist the Engineer with sampling. Conformance samples will be taken a minimum of each lot or every 100,000 square feet of material whichever results in more tests.

C. The Contractor shall be responsible for forwarding conformance samples to a certified, third party, testing laboratory for testing.

D. No polypropylene material shall be installed until conformance testing is complete on that material and results show that the delivered material meets the requirements of the specifications.

E. Material that fails to meet the requirements of the conformance testing shall be rejected and not utilized within the project. Rejected material will be replaced with material meeting the specifications at no additional cost to the Owner.

F. The Contractor shall pay for all costs associated with the conformance testing and retesting of new material, if necessary.

3.02 SUBGRADE PREPARATION

A. The lining installation shall not begin until after proper base has been prepared to accept the polypropylene membrane. A proper base will consist of compacted native material, 6” of compactable select native or import material with no sharp particles greater than 3/4" in its greatest dimension and liner venting/drainage system.

B. If groundwater is present within 12 inches below the surface to be lined, the Contractor shall dewater the area prior to and during installation of the liner. Dewatering will be required until the ponds have been filled with water to prevent blowout of the liner.

C. Immediately prior to the installation of the polypropylene geomembrane, a complete and detailed inspection of the embankments shall be performed by the Engineer, Contractor, and the Geomembrane installer to determine acceptance of the finished subgrade and elevations.

D. Any erosion or other damage to the subgrade which has occurred since placement shall be corrected by the Contractor.

3.03 PANEL PLACEMENT

A. The polypropylene lining shall be placed over the prepared surface as outlined in the engineer approved drawings, in a manner which minimizes handling.

B. The liner shall be installed in a relaxed condition, free of stress or tension. Stretching the liner to fit is not permissible.

C. Only those polypropylene sheets of lining material which can be anchored and seamed together the same day shall be unpackaged and placed into position.

D. The panels should not be unfolded under extreme cold or windy conditions.

E. In areas where high wind is prevalent, the lining installation should begin on the upwind side of the project and proceed downwind.

F. The leading edge of the liner shall be secured at all times with sandbags sufficient to hold it down during high winds.

G. The leading edges of the liner material left exposed after the day's work shall be anchored to prevent damage or displacement due to wind.

H. Materials, equipment or other items shall not be dragged across the surface of the polypropylene liner or be allowed to slide down slopes on the liner.

I. All parties walking or working oh the polypropylene liner shall wear soft soled shoes.

3.04 GAS VENTS

A. Gas vents shall be provided and spaced at a maximum of 80 foot on-center or more frequently as recommended by the Manufacturer or fabricator/installer in shop drawings and based on the conditions at the site. The gas vents shall be connected to and part of the overall sub-liner venting/drainage system.

B. Gas vents shall be located above the overflow elevation as indicated on the project drawings.

3.05 FIELD SEAMING

A. Lap joints shall be used to seal factory fabricated panels of polypropylene together in the field. The panels shall be positioned so that there is a nominal 6 inch seam overlap. The contact surfaces of the two sheets shall be wiped clean to remove all dirt, dust, moisture or other foreign materials.

B. Field seams must be made by thermal fusion.

1. Thermal fusion bonding-The welding machine shall be set to the pre-determined temperature and speed. A trial seam shall then be made and tested to verify these settings. The machine settings shall be adjusted accordingly. Throughout the seaming operation, occasional adjustments of temperature or speed as the result of changing ambient conditions may be necessary to maintain a consistent seam. A 1.5 inch nominal seam width is required for single track welds.

C. All field seaming or repair shall be conducted by a representative of the manufacturer having sufficient experience to ensure a high quality installation and satisfaction of the performance requirements of this job.

3.06 NON-DESTRUCTIVE SEAM STRENGTH TESTING

A. Upon completion of the liner installation, all seams shall be inspected for compliance with these specifications. The following inspections shall be performed by the fabricator/installer for all field seams:

1. Visual inspection.

2. Air lance test-ASTM-D4437.

B. All field seams, on completion of the work shall be tightly bonded. Any geomembrane surface showing injury due to scuffing, penetration by foreign object or distress from other causes shall be replaced or repaired.

C. All exposed scrim edges shall be sealed with an approved polypropylene caulk or caped with a strip of unreinforced polypropylene.

3.07 DESTRUCTIVE SEAM STRENGTH TESTING

A. A start-up seam shall be provided at the beginning of each day's or shift's seaming operation. The sample shall be made from the same sheet material, not cut from the seamed panels, and using the same seaming methods as will be used to fabricate the field seams. It shall be tested for bonded seam strength and peel adhesion.

1. Bonded seam strength tests for polypropylene shall be conducted in accordance with ASTM-D751 as modified per NSF Standard 54. This test shall demonstrate a minimum of 80% of the specified directional shear strength according to Table 1.

2. Peel adhesion tests for polypropylene shall be conducted in accordance with ASTM-D413 as modified per NSF Standard 54. The test shall demonstrate the minimum specified directional shear strength according to Table 1.

B. Each seaming crew and the materials they are using must be traceable and identifiable to their test seams. The samples shall be numbered, dated and identified as to the personnel making the seam, and location made by appropriate notes on a print of the panel layout for the project.

C. The completed field seam sample shall measure not less than 14

D. One sample per 750 feet of field seam or one per seaming crew per 4 hour period shall be tested for bonded seam strength and peel adhesion. The sample shall be made from excess material, and not cut out from the installed lining.

E. The fabricator/installer shall provide the test results to the Owner and Engineer.

F. If a test seam fails to meet the field seam design specification, then additional test seam samples will have to be made by the same seaming crew, using the same tools, equipment and seaming materials and retested.

3.08 JOINTS TO STRUCTURES

A. The polypropylene membrane shall be sealed to all concrete structures and other openings through the lining in accordance with details shown on the engineer approved shop drawings and manufacturers recommendations.

B. Factory and/or field fabricated boots specifically supplied by the liner manufacturer/installer shall be used to seal all pipes penetrating the liner in accordance with approved shop drawings and manufacturers recommendations. All joints shall be tightly bonded and stainless steel straps used to seal around the outside pipe diameter.

3.09 REPAIRS TO POLYPROPYLENE LINER

A. Any cuts, rips or tears in the polypropylene membrane shall be patched with a piece of the same membrane material. Patches should be cut with rounded corners and should overlap the damaged area a minimum of 4 inches. The entire surface of the patch shall be bonded to the polypropylene lining material.

B. Reinforced patches must be coated with an approved polypropylene edge caulk along all cut edges.

C. Patches can be applied with a hand held heat gun. The patch and damaged membrane area should be clean and dry. The heat gun should be inserted between the patch and the membrane liner heating the surfaces of each to a molten state. A steel roller should be immediately applied smoothing out any wrinkles. The entire perimeter of all patches shall pass the air lance test and be witnessed by the Owner's representative.

3.10 CLEANUP

A. Cleanup within the lining compound shall be an ongoing responsibility of the fabricator/installer. Particular care should be taken to ensure that no stones, scrap material, trash, tools or other unwanted items are trapped beneath the geomembrane liner.

3.11 POND LEAK TEST AND PERFORMANCE REQUIREMENTS

A. The Contractor, his subcontractors and suppliers are responsible for ensuring that the polypropylene liner is properly installed and capable of satisfying the following performance requirements:

1. Pond leakage shall be less than 6 inches per year at the pond operating depth in accordance with the Montana Department of Environmental Quality Design Standards.

2. The liner material shall be resistant to Ultraviolet deterioration, environmental weathering and wind effects for a period of 20 years.

B. A pond leak test shall be performed in all lagoon cells.

C. The Contractor shall fill the lagoon with water to the operating level of the lagoon cells. The Contractor shall be responsible for procuring all applicable permits associated with filling the lagoon with water.

D. The Contractor shall construct the ***pond leak test measuring device*** as shown in the plans. The device shall be filled with water and tested for leaks prior to installation in the lagoon. Any leaks found in the device shall be repaired by the Contractor. The Contractor shall then install the pond leak test measuring device in the lagoon.

E. The leakage test shall be conducted over a fourteen (14) day period. Upon initial installation, the Engineer and Contractor shall measure and concur upon the measurement and record the same initial water level reading. At the conclusion of the test (fourteen days from the initial reading) the Engineer and Contractor shall observe and record a final water level reading. For the leak test to pass, the water level in the pond leak test device can not vary by more than ¼" from the water level in the lagoon.

F. Should the leak test fail, the Contractor will be responsible for correcting deficiencies in the liner and conduct another leakage test at no cost to the Owner.

3.12 WARRANTY

A. The polypropylene geomembrane manufacturer shall confirm in writing, that the material to be furnished will be free of defects in materials and workmanship at the time of sale, and against deterioration due to the effects of ozone, ultraviolet or other normal weathering on a pro-rata basis for up to 20 years from the date of completed installation. The polypropylene geomembrane manufacturer shall furnish a sample warranty for review and approval prior to shipment.

END OF SECTION 31 35 26.16

SECTION 31 41 00
SHORING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Work related to sheeting, shoring, bracing, and excavation support systems needed to accomplish construction of buildings, tanks, facilities, utilities, and piping.

B. Related sections include, but are not limited to:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Section 03 30 00 – Cast-in-Place Concrete
3. Division 1 – General Requirement Specification Sections
4. Division 31 – Earthwork Specification Sections.

1.02 SUBMITTALS

A. Shop Drawings and Product Data: Submit, in accordance with Section 01 33 00. In general, include drawings and supporting calculations for shoring for Engineer review and approval.

B. Submittals shall include:

1. Excavation support plan.
2. Movement monitoring plan.
3. Trench excavation plan.
4. Movement measurement and data and reduced results indicating movement trends.
5. Documentation that shoring plan or system has been designed by a registered Professional Engineer if required.

C. Design calculations of bracing and shoring showing member stresses and connections due to imposed loads. Calculations shall be sealed by a qualified professional engineer.

1.03 QUALITY ASSURANCE

A. An OSHA approved competent person shall review the soil classification presented in the Geotechnical Report in the field. Excavations shall comply with the requirements of OSHA 29 CFR, Part 2926, Subpart P, “Excavations and Trenches.” Excavation safety is the responsibility of the Contractor. All excavations greater than 20 feet in depth shall be designed by a registered

Professional Engineer.

B. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, and local agencies.

C. Sheeting, shoring, and bracing shall not affect structural integrity of existing structures, utilities, or Work, and shall allow for sufficient clearances necessary to install associated appurtenances adjacent to new Work.

D. Sheeting, shoring, and bracing shall not penetrate walls or slabs of new Work unless approved by the Engineer.

E. Provide surveys to monitor movements of critical facilities.

1.04 REGULATORY REQUIREMENTS

A. Work outlined in this Section shall conform to OSHA regulations and all applicable codes and regulations for worker safety.

PART 2 - PRODUCTS

2.01 SHEETING, SHORING, AND BRACING

A. Type, design, detail, and installation of sheeting, shoring, and bracing shall be determined by and be the sole responsibility of the contractor.

PART 3 - EXECUTION

3.01 GENERAL

A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work. Shoring, sheeting, and bracing shall also be provided as necessary to protect workers and the public.

B. Sheeting, shoring, and bracing shall be installed to prevent solids from entering excavation below or through sheeting.

C. Open cut excavations are to be evaluated by a registered Engineer and protected against surface water intrusion.

3.02 EXCAVATION SUPPORT PLAN

A. Prepare an excavation support plan addressing the following topics:

1. Select and install shoring system such that no adverse impact occurs on existing structures, utilities, or facilities.

2. Details of shoring, bracing, sloping, or other provisions for worker protection from hazards of caving ground.

3. Design assumptions and calculations.

4. Methods and sequencing of installing excavation support.

5. Proposed locations of stockpiled excavated material.
6. Minimum lateral distance from the crest of slopes for vehicles and stockpiled excavated materials.
7. Anticipated difficulties and proposed resolutions.

3.03 MOVEMENT MONITORING PLAN

A. Prepare movement monitoring plan addressing following topics:
   1. Survey control.
   2. Location of monitoring points.
   3. Plots of data trends.
   4. Interval between surveys.
      a. Interval shall not be less than once per week during performance of work until the permanent structure is complete to the ground level and shall continue weekly for a period of four (4) weeks after completion of the work (or longer if movement persists).
   5. Remedial action and engineer notification plan should movement of existing structures occur during performance of the Work.

3.04 REMOVAL OF EXCAVATION SUPPORT

A. Remove excavation support in a manner that will maintain support as excavation is backfilled.

B. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.

C. Remove excavation support in a manner that does not leave voids in the backfill.

3.05 TRENCHES

A. Provide trench excavations exceeding four (4) feet in depth with adequate safety systems.

B. For trench excavation exceeding five (5) feet in depth, provide adequate safety systems meeting requirements of applicable state and local construction safety orders, and federal requirements.

END OF SECTION 31 41 00

SECTION 31 66 00
SPECIAL FOUNDATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies requirements for the construction of testing of ground improvements using Rigid Inclusions (RI) as identified in the Plans and Specifications for the Project, as well as quality control testing and performance testing. Rigid Inclusions are columns of grout or concrete used to reinforce the ground to increase bearing capacity and reduce settlement of the subject wastewater treatment plant structures. Rigid Inclusions are constructed with a drilling tool that displaces soil laterally, producing very little spoils. The intent of the Rigid Inclusions program specified herein is to aid in supporting the applied loads and control the settlement to less than the specified maximum values. The Contractor shall furnish all supervision, labor, material, equipment, and related services necessary to perform the work.

1.02 SCOPE OF WORK

A. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

B. In general, the scope of the work including the main tasks required to perform the work.

C. General Description: The work shall consist of designing, construction, monitoring, and testing of RIs as identified in this specification within the limits indicated in the Drawings. In particular, reference drawing numbers S2-2, S2-7, S3-2 thru S3-5, S4-3, S4-4, and S5-2 for design loading conditions. RIs work shall meet the acceptance criteria presented in the following sections of these specifications.

D. Overview of Tasks: In connection with the RI program, as shown on the drawings, the RI Contractor shall provide all labor, materials, and equipment to accomplish the following items of work:

1. Furnish and convey grout/concrete to RI locations.
2. Construction of RIs to the lines, grades, and criteria detailed on the approved RI Shop Drawings.
3. Load test a selected RI(s) to confirm design assumptions and demonstrate that they achieve the required load carrying capacity.
4. Monitor installation parameters utilizing a Data Acquisition System.
5. Trim RI tops to design elevations and backfill open hole with material designated by RI design engineer.
6. Complete QA/QC program.

E. Performance Responsibility: It shall be the RI Contractor’s responsibility to determine and implement the systems to ensure that specified criteria is achieved.

1. RI design shall be sealed by a Professional Engineer in the State of Montana, and compliance with the loads and performance specifications (provided by Structural Engineer of record) shall be the responsibility of the RI Contractor.
2. RI design shall provide details and construction requirements for the Load Transfer Platform.

F. Performance Criteria

1. Provide the specified bearing pressure/capacity of 3,000 pounds per square foot (psf).
2. Provide RI individual capacity to exceed concentrated loads indicated on Drawings.
3. Resist lateral seismic forces at base of structures as indicated on Drawings.
4. Layout individual RI's to avoid conflict with existing and new underground piping, while providing minimum clearances between RI's and piping to permit the General Contractor to excavate and place piping.
5. Limit total static settlement of the foundation to 1 inch during service conditions, as described in the drawings and geotechnical report.
6. Limit differential static settlement of the foundation to 3/4-inch during service conditions, as described in the drawings and geotechnical report.

1.03 STANDARDS AND REFERENCES

A. Applicable Standards: The most recent version of the following testing methods or standards shall/may be employed:

1. ASTM C31: Standard Practice for Making and Curing Cement Test Specimens in the Field.
2. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
3. ASTM C94: Standard Specification for Ready-Mixed Concrete.
4. ASTM C143: Standard Test Method for Slump of Hydraulic-Cement Concrete.
5. ASTM C150: Standard Specification for Portland Cement.
6. ASTM C172: Standard Practice for Sampling Freshly Mixed Concrete
7. ASTM C1064: Standard Test Method for Temperature of Freshly Mixed Hydraulic-CementConcrete
8. ASTM D1143: Standard Test Methods for Piles Under Static Axial Compressive Load
9. ASTM D1194: Standard Test Method for Bearing Capacity of Soil for Static Load and Spread Footings
10. ASTM D3689: Standard Test Methods for Deep Foundations Under Static Axial Tensile Load

11. ASTM D7383-19 – Axial Compressive Force Pulse (Rapid) testing of Deep Foundations (Statnamic Testing)

B. Reference Documents: Reference documents to be used by the RI Contractor shall include:

1. This specification,
2. Project Drawings, and
3. Project Geotechnical Report and subsequent cone penetrometer test (CPT) soundings.

1.04 DEFINITIONS

A. Rigid Inclusions (RIs): Ground improvement by the use of Rigid Inclusions typically uses grout elements to reinforce weak or compressible strata; resulting in increased bearing capacity and reduced settlement.

B. Displacement Tools: Auger or Pipe tools specially designed to displace soil laterally while advancing or retracting the tool. The displacement tool creates very little spoil.

C. Field Quality Control Representative (FQCR): The individual, generally titled Superintendent or Field Engineer, given specific inspection and testing tasks identified in this specification.

D. Test Rigid Inclusion: Test rigid inclusion is a rigid inclusion that is installed at non-production rigid inclusion locations. These rigid inclusions shall either be installed prior to production of rigid inclusion as verification load test, or during production installation to proof load test the rigid inclusions. Rigid inclusions installed prior to production rigid inclusion are to allow for selection, performance and evaluation of static load tests as well as developing of the installation criteria by the Engineer.

E. Load Transfer Pad: A load transfer pad will be constructed at the top of the rigid inclusions. The transfer pad shall consist of compacted granular fill with layers of high strength geotextile reinforcement as shown on the plans. The purpose of the pad is to transfer the majority of the superstructure loads to the rigid inclusions, thereby providing adequate support above and between the rigid inclusions.

1.05 APPROVED INSTALLERS

A. The Pier Installer company (the Installer) shall be approved by the Owner’s Engineer prior to bid opening. Without exception, no alternate installer will be accepted unless approved by the Owner’s Engineer at least two (2) weeks prior to bid opening and shall have the following minimum qualifications:

1. A minimum of 5 years of experience with the installation of Rigid Inclusion (RI) Pier systems of similar (or greater) size, and with similar soil conditions.
2. Successfully completed at least 50 projects with RI’s.
3. The RI Contractor’s job superintendent shall have a minimum of two years of method specific experience.

4. The project manager shall have at least three years of experience in RI construction, with at least the last two years in the full-time employment of the RI Contractor.
5. General Liability Coverage of at least $ 10 million.
6. Professional Liability Insurance of at least $ 3 million.
7. Bonding Capability commensurate with the project size.

1.06 ACTION SUBMITTALS

A. Bid Time Submittals: The following shall be submitted to the Owner's representative by the RI Contractor with the bid documents:

1. A list of at least five previously completed projects of similar scope and purpose for approval by the Owner's representative. The list shall include a description of the project, relative size, key RI contractor personnel, and contact person with phone number.

B. Pre-Field Work Submittals: The following shall be submitted to the Owner's representative by the RI Contractor at least two weeks prior to the start of the work:

1. Resumes of the management, supervisory, and key personnel for approval by the Owner's representative.
2. A ground improvement design based on information contained in the project geotechnical report, sealed by an engineer licensed in the state of Montana the work to be performed that demonstrates that the program achieves the specified performance criteria. Design calculations and working drawings shall show conformance with the RI design performance criteria. Calculations shall include an evaluation of vertical and horizontal displacements, as well as structural requirements for the RIs to resist loads at each structural foundation element. The working drawings shall include requirements for the materials, compaction, lateral extent and thickness of the load transfer pad.
3. Description of the equipment to be used and a detailed discussion of the RI installation procedure.
4. Proposed grout/concrete mix design and a description of the materials to be used.
5. Proposed RI reinforcing configuration and means, methods and sequence of installation.
6. Load Transfer Platform design: The RI Contractor's Design Engineer shall be responsible for design of the Load Transfer Platform in order to meet the Special Foundations load requirements, and the following shall represent a ***minimum level*** of design/construction :
    a. Extend excavation to a minimum depth of 2 feet below foundation elevation, extend excavation at a minimum of 1 horiz. to 1 vertical ratio beyond the perimeter of the structure. Excavation may need to be extended beyond building footprint at select locations to facilitate equipment access and/or dewatering

needs. Bottom of excavation may be sloped/graded to drain towards dewatering well points provided slope does not exceed 5%;

b. Dewater building excavation as necessary to attain a suitable working surface;

c. If moisture conditions allow, compact subgrade soils using static compactions methods. Compaction to be discontinued if pumping soils are observed. Perform proof rolling test to verify compaction.

d. Provide a non-woven, separation/stabilization geotextile meeting or exceeding the engineering properties of Propex Geotex 401. Place geotextile across the excavation footprint and up excavation sidewalls in accordance to Manufacturer's recommendations and have a minimum overlap of 1.5 feet at all joints. Provide structural geogrid meeting or exceeding the engineering properties of Propex Gridpro BXP11, Type 1. Place geogrid across the excavation footprint, on top of the geotextile, in accordance to Manufacturer's recommendations and have a minimum overlap of 1.5 feet at all joints.

e. Provide crushed drainage aggregate meeting the gradation listed in Table 1.06.1. Place and compact drainage aggregate (static compaction methods) across excavation footprint. Drainage aggregate intended to function as blanket drain and to have a compacted lift thickness in accordance with the RI Contractor's design parameters.

Table 1.06.1: Drainage Aggregate
(ASTM C33 #56 Aggregate

Sieve Size	Percent Passing
1½"	100
1"	90-100
¾"	40-85
½"	10-40
⅜"	0-15
No. 4	0-5

Alternative drainage aggregate gradations may be acceptable provided they are reviewed and approved by the RI Contractor's Design Engineer and the Owner's Engineer through the submittal process.

7. A ground improvement QA plan.
8. Work procedures and Quality Control criteria.
9. Load test details, including the number and location of tests, test layout and procedures, and loading increments.
10. A shop drawing for review indicating the spacing, location, and depth or installation criteria of RIs to achieve the criteria outlined in this specification.
11. Schedule of values.
12. Grout/Concrete mix design.

13. Grout/Concrete compression test results

1.07 INFORMATION SUBMITTALS

A. During Production Submittals: The following shall be submitted to the Owner's representative by the RI Contractor during the work:

1. Accurate daily records of all RIs constructed.

2. Any change in the predetermined RI program necessitated by a change in the subsurface conditions.

3. Load test results, analysis of the data and recommendations for design parameters prepared by an engineer licensed in the state of Montana.

B. Closeout Submittal: The following shall be submitted to the Owner's representative by the RI Contractor within 15 business days of the completion of the RI work.

1. As built drawings: Drawings documenting the as built conditions of the RI work.

2. A warranty document good for one year from the date of RI work completion.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. General: The RI Contractor shall supply equipment in good operating condition capable of performing the work specified herein.

B. Specific Equipment Capabilities:

1. The choice of installation rig is largely dictated by site conditions and is left to the experience of the Contractor. The equipment shall be able to apply sufficient force and/or torque to penetrate to the design depth based on the subsurface conditions represented in the project geotechnical report and CPT soundings. The installation tool shall be of sufficient length to reach the required depth.

2. Grout/concrete shall be placed using suitable pumping equipment and through suitable tubing. The system shall have a means of determining the volume of grout delivered to the tooling at any time during construction.

C. Equipment Instrumentation: The RI Contractor shall provide gauges or other instrumentation (measuring devices) to provide real time measurement and recording through a date acquisition system of:

1. RI number, start/finish time of installation, rate of penetration, crowd pressure and/or torque, depth of treatment (or tip elevation), neat volume based on depth of treatment and volume of grout placed.

D. Communication Equipment: An adequate communication system shall be maintained between the RI rig operator and the grout pump operator.

2.02 MATERIALS

A. Portland Cement: Type I or Type II conforming to the ASTM Standard C150/C150M.

B. Fluidifier (if required): Shall be a compound possessing characteristics which will increase the fluidity of the mixture, act as water reducing agent and retardant.

C. Water: Shall be potable, fresh, clean and free of sewage, oil, acid, alkali, salts, or organic matter.

D. Fine and Coarse Aggregate: Fine and coarse aggregate shall conform to the requirements of the RI designer, subject to review by the Owner's structural engineer.

E. Reinforcing Steel: If required, reinforcing steel shall conform to the requirements of the RI designer.

F. Geogrid/Geotextile: Geogrid (if required per the RI designer) shall conform to and be installed in accordance with the manufactures specifications and guidelines, as per the details in the drawings.

G. Grout/Concrete Mixes: Grout/concrete for Rigid Inclusions shall consist of Portland cement, sand, and water, and may also contain coarse aggregate, a mineral admixture and/or approved fluidifier. The components shall be proportioned and mixed to produce a grout capable of maintaining the solids in suspension, minimizing bleed and being pumped without difficulty. The required grout strength shall be determined by the RI design engineer.

1. Minimum Compressive Strength:

a. 4,000 psi at 28 days.

b. 2,000 psi at 7 days as required prior to pile integrity testing.

PART 3 - EXECUTION

3.01 SITE VISIT

A. Site visits are necessary in order to be aware of conditions at the work site.

1. Pre Bid Site Visit: Prior to submitting a bid price for the rigid inclusion program, the RI Contractor shall visit the site during the project prebid meeting to identify readily visible conditions in order to account for them in the bid.

3.02 SITE PREPARATION

A. The following shall be performed by the General Contractor in support of the RI Contractor:

1. Locate and protect underground and above ground utilities and other structures from damage during installation of the pier elements.

2. Utility excavations: coordinate all excavations made subsequent to Pier installations so that excavations do not encroach on the piers as shown in the Pier construction drawings. Protection of completed Pier elements is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Pier elements, the General Contractor shall contact the Pier Designer

immediately to develop construction solutions to minimize impacts on the installed Pier elements.

3. Removal of all surface or subsurface topsoil, brush, organic material, and other unacceptable material in accordance with the requirements of the contract documents. Removal of any surface or subsurface obstructions to the RI work.

4. Site shall be graded to an agreed working elevation. A dry, level, and stable working platform shall be provided and maintained throughout the work. Platform stability should be evaluated and certified by the owner's geotechnical engineer and the general contractor, based on equipment information provided by the specialty contractor.

5. Provision of all-weather access and maintenance thereof for the RI Contractor's equipment and workforce, and for delivery of materials to the worksite.

6. Horizontal and vertical survey control and survey layout of building corners, grid lines, footing locations, embankment limits, utilities etc., for reference by the RI Contractor for layout and performance of the RI work.

7. If spoils are generated by pier installation, spoil removal from the pier work area in a timely manner to prevent interruption of pier installation is required.

3.03 RIGID INCLUSIONS

A. Rigid inclusions shall be constructed in accordance with the approved design and shop drawings, provided in the design submittal (section 1.06.B).

B. Procedures: Rigid inclusions shall be constructed at the locations shown on the RI layout drawing.

1. (General procedure, actual procedures will vary based upon the Specialty Contractor's Means and Methods) The RI tool shall be advanced to design depth or tool refusal. During grouting the RI tool shall be filled with a grout/concrete volume adequate to maintain a positive grout head for the RI withdrawal of the tool. Grout/concrete shall be placed fully to the final RI cutoff elevation.

2. The grout/concrete shall be supplied at a sufficient rate during tool withdrawal to ensure that a continuous element of the full specified cross-section is formed, free from debris. The depth of the tool and volume of grout shall be measured and recorded for each element. If the grout placement in any element cannot be completed as described above, then the element shall be re-penetrated before grout has hardened and grout placed to the final RI cutoff elevation or the RI shall be completely replaced.

C. Installation criteria: Installation criteria shall be as follows:

1. Location of RIs: The RIs shall be located within 3 inches of the planned horizontal location unless otherwise approved by the RI designer and the Owner's structural engineer.

2. Obstructions: Obstructions encountered during advancement of the RI tool that will prevent installation to the design depth, or cause the RI tool to redirect from its design location during installation shall be removed.

    a. Obstruction include, but are not limited to: boulders, timbers, concrete, bricks, utility lines, etc. that prevent advancement of the RI tool to the required depth or cause the RI tool to redirect from the design location. Dense natural soil, natural rock or weathered rock shall not be considered obstructions. The RI design engineer shall be notified within 24 hours of any obstructions or unexpected early refusal to verify the revised location and/or depth are acceptable.

    b. In the event that obstruction removal is unfeasible, as agreed upon by the Contractor and Owner's engineer, one or more of the following procedures will be used:

        i. Position the element a short distance not more 1.5 feet away from the original position.

        ii. Pre-drill the obstruction.

        iii. Install additional elements to bridge over the obstruction.

    c. Any change made to the design or rigid inclusion layout because of obstructions shall be evaluated by the Contractor and approved by the Engineer. The Contractor shall provide to the Engineer an as-built submittal no later than 7 calendar days after the modification has been performed on site. This submittal shall be signed and sealed by the Registered Professional Engineer responsible to the Contractor and having stamped the design submittals. All elements that are abandoned due to obstructions or equipment malfunction shall be completely backfilled with grout. The cost for obstruction shall be compensated for per the unit cost per linear foot of rigid inclusion, no additional compensation or time shall be awarded to the contractor for delay, waiting, or moving between the obstruction location and the relocated position of the rigid inclusion.

3. Depth of work: The RIs shall be constructed to the depth/elevation shown on the approved shop drawings or to the specified refusal criteria. RI installation rigs are equipped with instrumentation to measure, display and record the tool penetration rate versus depth.

4. Diameter of RIs: The RIs shall be constructed to the diameter shown on the project drawings or the approved shop drawings.

5. Refusal Criteria: Refusal of the RI tool is defined as a reduction in the penetration rate during installation, and shall be determined by competent field personnel and the RI designer. Specific refusal criteria will depend on project geology and equipment used, and will be established at the start of fieldwork.

6. Limits of work: As shown on the project drawings.

D. Completion: Prior to completion of the RI program the following shall be completed at each RI location.

1. Grout/concrete shall be cast to the final RI cutoff elevation unless otherwise specified. If necessary, to protect Rigid Inclusions from damage due to subsequent construction activities, elements shall be dipped out prior to initial set and backfilled with gravel or granular fill. Alternatively, a steel reinforcing member may be installed into the upper portion of the element to protect against damage.

E. Subsequent Construction: A Load Transfer Platform (LTP) shall be constructed over the RI heads to transfer the design loads to the elements. The LTP shall be constructed by the project Earthwork Contractor. The lateral extend and thickness of the LTP shall be included in the RI Contractor's design submittal.

1. The LTP shall be constructed of a dense graded granular material (specified in the Earthwork specification section) and may be reinforced with one or more layers of biaxial geogrid and/or geotextile as shown in the approved RI design and shop drawings.

a. Construction of the LTP shall not commence until the compressive strength of the grout has reached a value provided by the RI design engineer. LTP material, lift thickness, and compaction shall conform to the approved RI design and shop drawings. Testing requirements shall be equal to those required by the project geotechnical engineer of record. Materials shall conform to those specified in the approved RI design and shop drawings.

b. Construction of the LTP shall be installed in a manner as to avoid direct contact with cured rigid inclusions. The RI Contractor and RI Design Engineer shall be notified if any heavy machinery makes contact with a cured RI during LTP construction or excessive rutting is experienced adjacent to cured RIs. Replacement RIs may be required if RIs are damaged during LTP construction. Cost of construction of the replacement RI shall be borne by the Contractor or LTP installer.

2. The Owner's engineer shall monitor LTP construction and foundation construction. Compaction shall be performed and accomplished as specified in the contract drawings for structural fill or LTP construction. Foundation construction shall be performed in a timely manner so that no degradation of the bearing surface occurs.

3.04 QUALITY CONTROL

A. The details of the quality control program are as follows:

B. Oversight: All RI construction shall be performed under the inspection of the Contractor's field Quality Control Officer.

C. Quality Control Technician The Installer shall have a full-time, on-site Quality Control Technician to verify and report all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Pier Designer, the General Contractor, and to the Testing Agency.

1. Include at a minimum Project name, number, contractor name, column location, column diameter, tip elevation, drilling ground surface elevation, total and

incremental volume of grout placed, amount of water (if any) added to the ready mix grout truck at the site, column reinforcing (if applicable) any unusual occurrences during the column installation.

D. A test program to determine specification and design compliance shall be determined by the RI designer of record and the Owner's Engineer. This test program shall be implemented in accordance with the approved design submittal and shall include; grout/concrete sampling & testing, and at a minimum of five Compression Load Tests. The load test shall be conducted consistent with applicable ASTM Standards and shall be conducted to a minimum of 125% of the design RI capacity.

E. A production quality control program shall be included in the work plan submittal describing sampling and testing procedures, frequency, and performance criteria to ensure that all construction materials are meeting the design requirements.

3.05 QUALITY ASSURANCE

A. Independent Engineering Testing Agency: The General Contractor is responsible for retaining an independent engineering testing firm to provide Quality Assurance services.

1. Independent Engineering Testing Agency Qualifications: Under direct supervision by a Professional Geotechnical Engineer registered in the State of Montana. The Geotechnical Engineer shall have supervised a minimum of five similar deep ground improvement projects.

B. Responsibilities of Independent Engineering Testing Agency

1. The Testing Agency shall monitor the modulus/compression test pier installations and testing. The Installer shall provide and install all dial indicators and other measuring devices.

2. The Testing Agency shall monitor the installation of Pier elements to verify that the production installation practices are similar to those used during the installation of the modulus test elements.

3. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.

3.06 ACCEPTANCE MEASUREMENTS, TESTING AND CRITERIA

A. The acceptance of the RI work shall be solely based on the following:

1. The performance verification load test program meets the requirements established by the RI designer of record.

2. All Rigid Inclusions are installed per the approved design and shop drawings.

3. All Rigid Inclusions are monitored in accordance with the quality control plan established by the RI designer of record.

B. A Rigid Inclusion may be rejected if it is installed in an incorrect location or the location exceeds the specified tolerance stated in Section 3.03C. If a Rigid Inclusion is rejected,

the RI Specialty Contractor shall replace the RI. Replacement of the RI may be avoided if alternate remedial procedures are approved by the RI design engineer.

END OF SECTION 31 66 00

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 05 16
AGGREGATES FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Aggregate materials.

B. Related Sections include, but are not limited to:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.
4. Division 32 – Exterior Improvements Specification Sections.
5. Section 31 23 21 – Fill and Backfill.
6. Section 31 23 33 – Trenching and Backfilling.
7. Section 32 11 23 – Aggregate Base Courses.
8. Section 33 31 19 – Site Piping.
9. Section 32 13 13 – Concrete Pavement.

1.02 SUBMITTALS FOR REVIEW

A. Section 01 33 00 - Submittals: Procedures for submittals.

B. Samples: Submit, in air-tight containers, 40 pound sample of each type of aggregate to testing laboratory. Submit Laboratory Results to Engineer.

1.03 QUALITY ASSURANCE

A. Section 01 40 00 - Quality Control: Field Samples.

B. Material Source: Submit name of imported material supplier(s). Provide materials from the same source throughout the Work. Change of source requires Engineer approval.

PART 2 - PRODUCTS

2.01 AGGREGATE MATERIALS

A. Coarse Aggregate (Concrete Mix and Type A1): Well graded crushed stone or gravel conforming to the requirements of ASTM C33, Gradation 67.

B. Coarse Aggregate (Surface Course and Type A2): Gravel; angular crushed, or natural stone; free of shale, clay, friable material and debris; graded in accordance with Montana Department of Transportation specifications. For all aggregate surface areas.

C. Coarse Aggregate (Base Course and Type A3): Gravel; Angular crushed, or natural stone; free of shale, clay, friable material and debris; graded in accordance with Montana Department of Transportation referenced specifications, Section 816, Class 5.

D. Fine Aggregate (Concrete Mix and Type A4): Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM C33.

E. Coarse Aggregate (Pipe Bedding and Type A5): All gravel for pipe encasement shall be in accordance with Montana Department of Transportation referenced specifications, Section 816, Class 3 with the Number 200 sieve requirement modified to be 3 – 15 percent passing.

F. Granular Fill (Base course under cast-in-place on-grade slabs): Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D448, Size 57, with 100 percent passing a 1½ inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

G. Structural Fill (between Rigid Inclusion Load Transfer Pad and Grit Building Sub-grade and elsewhere as described in the project drawings): Fully compliant with MPWSS Section 02234 - 4" Minus Sub-Base Course.

2.02 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Control: Source testing and analysis of aggregate material.

B. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698.

C. Fine Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698.

D. If tests indicate materials do not meet specified requirements, change material or material source and retest.

E. Provide materials of each type of aggregate from the same source throughout the Work.

PART 3 - EXECUTION

3.01 STOCKPILING

A. Stockpile materials in accordance with Section 31 14 13.

3.02 STOCKPILE CLEANUP

A. Cleanup stockpiles in accordance with Section 31 14 13.

END OF SECTION 32 05 16

SECTION 32 05 19
GEOSYNTHETICS FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Woven Geotextile Riprap Fabric.
2. Woven Geotextile Reinforcement Fabric.

B. Related Sections include, but are not limited to:

1. The General Conditions, Supplemental Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specifications Sections.
3. Division 31 – Earthwork Specifications Sections.
4. Division 32 – Exterior Improvements.

1.02 REFERENCES

A. Reference Standards include, but are not limited to:

1. Montana Department of Transportation Standard Specifications, latest edition.
2. ASTM D3786 – Mullen Burst, Latest Edition.
3. ASTM D4355 – UV-Resistance, Latest Edition.
4. ASTM D4491 – Permeability, Latest Edition.
5. ASTM D4533 – Trapezoid Tear Strength of Geotextiles
6. ASTM D4595 – Wide Width Tensile Strength, Latest Edition.
7. ASTM D4632 – Grab Tensile Strength and Elongation, Latest Edition.
8. ASTM D4751 – Apparent Opening Size (AOS), Latest Edition.
9. ASTM D4759 – Determining Specification Performance for Geosynthetics
10. ASTM D4833 – Puncture and Trapezoidal Tear, Latest Edition.
11. ASTM D4873 – Guide for Identification, Storage, and Handling of Geosynthetics, Latest Edition.

1.03 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Provide product data on Geotextile Fabric.

C. Submit manufacturer’s installation instructions. Indicate special procedures and conditions requiring special attention.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The geotextile rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement.

B. Rolls shall be stored in a manner which protects them from the elements. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days.

C. The geotextile rolls shall be labeled as per ASTM D 4873, "Guide for Identification, Storage, and Handling of Geosynthetics".

PART 2 - PRODUCTS

2.01 MATERIALS

A. Geotextile Riprap Fabric, Woven, as specified in Section 203 and 622 of the reference Montana Department of Transportation standard specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify subgrade has been inspected, gradients and elevations are correct; surface is dry, and ready to receive Work.

3.02 PREPARATION OF SUBSOIL

A. Correct irregularities in subgrade gradient and elevation by scarifying a minimum of 6-inches, reshaping, and re-compacting.

B. Do not place on soft, muddy, or frozen surfaces.

3.03 PLACEMENT

A. Geotextile fabric shall be placed in accordance with Manufacturer’s recommendations.

B. The geotextile shall be laid out smooth without wrinkles or folds on the prepared subgrade in the direction of the construction traffic.

C. Adjacent geotextile rolls shall be overlapped a minimum of 2.5 feet; ends of rolls shall be overlapped 3 feet.

D. On curves, the fabric may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and shall be held in place by staples, pins or aggregate piles.

E. Damaged areas shall be repaired by overlaying the area with sufficient material to overlap on all edges by at least 2.5 feet.

F. The aggregate base material shall be placed by end dumping onto the geotextile from the edge or over previously placed base aggregate. Construction equipment shall not be allowed directly on the geotextile fabric.

G. A minimum of 12 inches of aggregate must be placed on the geotextile prior to the movement of construction equipment above the fabric.

H. Turning movements must be carefully monitored to avoid rutting of the aggregate. Any ruts occurring during construction shall be filled with additional gravel aggregate and compacted to the specified density.

I. If placement of the backfill causes damage to the geotextile, the damaged area shall be repaired as described in Section 3.03.E.

J. Install in the locations as indicated on drawings.

3.04 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Assurance: Field inspection.

3.05 SCHEDULE OF LOCATIONS

A. Use Geotextile Riprap Fabric in the following locations:

1. Beneath areas of rock riprap.

B. Use Geotextile Reinforcement in the following locations:

1. For access roads between the subgrade and the aggregate base.

END OF SECTION 32 05 19

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements and procedures for furnishing and installing base and pavement courses, including:

1. Subbase Course.
2. Aggregate Base Course.

B. Related Sections include, but are not limited to:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 1 – General Requirement Specification Sections.
3. Division 31 – Earthwork Specification Sections.
4. Division 32 – Exterior Improvements.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

B. American Concrete Institute (ACI)

C. American Society for Testing Materials (ASTM)

D. MDT Specifications (latest edition)

1.03 SUBMITTALS

A. Subbase Course

1. Provide appropriate material date source testing for each granular material. Include name location of source, date of testing, and sample gradations. Tests shall not be more than 180 calendar days before date of submittal.

B. Aggregate Base Course

1. Submit gradation report on sample of aggregate base to be used.

1.04 SEQUENCING AND SCHEDULING

A. Construct aggregate base only after all of the following have been completed:

1. Subgrade has been corrected for instability problems and successfully passed a rolling test performed by the Contractor and witnessed by the Engineer.
2. Subgrade has been checked for conformance to line and string tolerances (stringline).

B. Aggregate base to be completed and approved by Engineer prior to placement of bituminous surfaces.

1.05 QUALITY ASSURANCE

A. Contractor shall establish and maintain the required lines and grades, including crown and cross-slope, for each course during work.

B. In-place finished thickness will not be acceptable if exceeding following allowable variation from thickness specified herein:

1. Aggregate Base Course: Plus or minus one-half inch.

PART 2 - PRODUCTS

2.01 SUBBASE COURSE

A. Subbase shall be Type A or B materials as specified in Section 31 05 13 unless otherwise indicated as granular materials which are specified in Section 32 05 16.

2.02 AGGREGATE BASE COURSE

A. Aggregate Base Course shall be as indicated on the Construction Drawings and as specified in Section 32 05 16.

2.03 AGGREGATE SURFACE COURSE

A. Aggregate Surface Course shall be as indicated on the Construction Drawings and as specified in Section 32 05 16.

PART 3 - EXECUTION

3.01 AGGREGATE BASE COURSE

A. Preparation:

1. Verify subsoil has been inspected; gradients and elevations are correct.
2. Prepare the sub-base course.
3. Verify subsoil is compacted to specified density and that subgrade test results have been submitted prior to placing aggregate course.
4. Subgrade to be completed and approved by Engineer prior to installation of the aggregate base course.
5. Verify subgrade is dry.

B. Construction Requirements; conform to MDT Specifications:

1. Place aggregate in maximum 6-inch layers and compact to specified density. When placing over geotextile fabric, place in minimum 8 inch layers.
2. Level and contour surfaces to elevations and gradients indicated.
3. Compact by mechanical means as specified in Section 01 40 00.
4. Install aggregate base in accordance with Detail Drawings.
5. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

6. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

C. Field Quality Control:

1. The Owner shall have an independent testing laboratory sample the aggregate base materials, determine the moisture/density relationships and gradation, and perform field moisture/density tests at locations determined by Engineer.

2. If, during progress of Work, tests indicate that compacted materials do not meet specified requirements, remove defective Work, replace, and retest. Contractor shall bear all costs associated with repair and retesting of defective Work.

3.02 TOLERANCES

A. Finished Grade:

1. Line and Grade Tolerance: The final aggregate base surface will be checked for conformance to specified tolerances by the "stringline" method prior to approval to pave the surface. Grade shall be ± 0.03 feet of grade.

END OF SECTION 32 11 23

SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bituminous Pavement.

B. Related Work:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 REFERENCES

A. Reference Standards include:

1. ASTM D946 – Penetration-Graded Asphalt Cement for Use in Pavement Construction.
2. ASTM D1559 – Test of Resistance to Plastic Flow of Bituminous Mixtures. Using Marshall Apparatus.
3. ASTM D2950 – Test for Density of Bituminous Concrete in Place by Nuclear Methods.
4. TAI – (The Asphalt Institute) – MS-2 Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.
5. TAI – (The Asphalt Institute) – MS-3 Asphalt Plant Manual.
6. TAI – (The Asphalt Institute) – MS-8 Asphalt Paving Manual.
7. TAI – (The Asphalt Institute) – MS-19 Basic Asphalt Emulsion Manual.
8. Montana Department of Transportation (MDT) Standard Specifications for Road Construction and Bridge Construction, 2008 Edition.

1.03 SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittals: Procedures for submittals.

B. Product Data: Furnish data on aggregates, asphalt cement, bituminous mixtures, and other materials required for the mix in accordance with Section 01 33 00 and 01 40 00 at least 7 days prior to beginning paving operations.

C. Asphalt Mix Formula.

1.04 PERFORMANCE REQUIREMENTS AND QUALITY ASSURANCE

A. When referenced, perform Work in accordance with the Montana State Highway Department standard Specifications for Road and Bridge Construction, latest edition.

B. Paving: Designed for H20 classification.

C. Mixing Plant and Mixing Plant Operations: Conform to the Montana State Highway Department Standard Specifications for Road and Bridge Construction, latest edition, and The Asphalt Institute (TAI) MS-3 Asphalt Plant Manual.

D. Obtain all materials from same source throughout project unless approved by the Engineer.

E. Paved surfaces shall be warranted against any materials and/or workmanship defects for a period of twelve months from placement.

F. The mix design and development of the Job Mix Formula shall be generated by a laboratory accredited by the AASHTO Materials Reference Laboratory (AMRL) at the Contractor's expense.

1.05 REGULATORY AND ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt when ambient air temperature (in the shade and away from artificial heat) or base surface temperature is less than 40 degrees F. or when surface is wet, dirty, or frozen.

B. No Work will be permitted in the spring until the frost has disappeared and the subgrade is stable so as to support the equipment without rutting, shoving, pumping, or other displacement.

C. Conform to applicable code for paving work on public property.

D. Conform to Section 01 50 00. Minimize interference with traffic.

E. Conform to the Montana Department of Environmental Quality Clean Air Standards and Storm Runoff Surface Water Standards.

F. Dispose of all waste material or reject material by approved methods.

1.06 SEQUENCING AND SCHEDULING

A. Construct aggregate base only after all of the following have been completed:

1. Subgrade has been corrected for instability problems and successfully passed a rolling test performed by the Contractor and witnessed by the Engineer.

2. Subgrade has been checked for conformance to line and string tolerances (stringline).

B. Aggregate base to be completed and approved by Engineer prior to placement of bituminous surfaces.

C. The Contractor shall provide a 48 hour notice for scheduling prior to paving operations.

D. Contractor shall allow aggregate base, asphalt base course, and curb to undergo one freeze thaw cycle before installing surface course. Aggregate base course, asphalt base course, and curb installation shall be required for final completion with surface course of

asphalt required for final completion.

PART 2 - PRODUCTS

2.01 GENERAL

A. Asphalt Cement: Asphalt Cement shall be produced in accordance with Section 818 of the MDT Standard Specification and meeting the following requirements:

1. ASTM 6373 (AASHTO M320) Asphalt Binder have a PG grading of:
2. PG 58-28

B. Aggregate for Mix:

1. Section 32 05 16 in accordance with the Montana State Highway Department Standard Specifications for Road and Bridge Construction, latest edition.

C. Asphalt Paving (Bituminous) Mixture (Base Course) shall have the following properties:

1. The Engineering shall approve the job mix formula submitted by the Contractor. Once the job mix formula is established, all mixtures furnished for the Project shall conform within the following maximum permissible variation:

a. Aggregate passing No. 4 and larger sieves..….. + or - 5.0%
b. Aggregate passing No. 8 to No. 100 sieves..….. + or - 3.0%
c. Aggregate passing No. 200 sieves.....…. + or - 2.0%
d. Asphalt.....……. + or - 0.4%
e. Temperature of mixture.....……. + or - 20°

2. The asphalt mixture shall have the following test properties:

a. Marshall Stability.....…. 1200 lbs. (minimum)
b. Marshall Flow (units of 0.01 in.)..... 8 to 18
c. Air Voids..... 3 to 7 percent

3. Adjustment of the job-mix base course formula may only be made with written approval of the Engineer.

D. Asphalt Paving (Bituminous) Mixture (Wear Course) shall have the following properties:

1. The Engineering shall approve the job mix formula submitted by the Contractor. Once the job mix formula is established, all mixtures furnished for the Project shall conform within the following maximum permissible variation:

a. Aggregate passing No. 4 and larger sieves..…….. + or - 5.0%
b. Aggregate passing No. 8 to No. 100 sieves..….. + or - 3.0%
c. Aggregate passing No. 200 sieves.....…. + or - 2.0%
d. Asphalt.....……. + or - 0.4%

2. The asphalt mixture shall have the following test properties:

a. Marshall Stability..... 1200 lbs. (minimum)
b. Marshall Flow (units of 0.01 in.)..... 8 to 18
c. Air Voids..... 3 to 5 percent

3. Adjustment of the job-mix wear course formula may only be made with written approval of the Engineer.

E. Tack Coat:

1. SS1H and CSS1H Emulsion meeting the appropriate requirements of ASTM for the specific grade of emulsion and the MDT Standard Specifications. Non-tracking tack products may also be used as approved by the Engineer.

2. Water should be clean and free of impurities, either in solution or colloidal suspension. The presence of ions, both positive and negative, must be carefully monitored.

3. Storage and handling of the emulsion should be performed in accordance with MS-19.

4. All conventional asphalt emulsions shall be diluted with water at a 50:50 ration. Polymer modified and non-tracking emulsions shall not be diluted. Dilution of the emulsion product should be performed at the emulsion terminal or in a tank at the asphalt plant. Emulsion should not be diluted in the distributor at the project site.

5. Never allow asphalt emulsion to freeze.

6. Use pumps with proper clearances for handling to avoid binding and seizing. Avoid repeated pump cycling or frequent pumping.

7. DO NOT mix different classes, grades, or types of emulsified asphalt in storage tanks, transports, or distributors. Make sure tanks are totally clean before changing to another class, grade, or type.

8. Always pump from bottom of tank.

9. Never overheat asphalt emulsion.

2.02 PAVEMENT MARKING PAINT

A. Paint shall be J.E. Bauer Company, Traffic Paint; Tnemec, Traffic Paint; Glidden-Durkee, Romark Traffic; PPG, Traffic & Zone Marking Paint; or equal.

B. Provide paint striping and logos as shown on the Drawings.

C. Provide colors as selected by the Engineer from the manufacturer’s standard color range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that compacted subgrade is dry, stable, compacted to specified density, at proper temperature, and to proper elevations and grade slopes. Do not begin asphalt-paving construction without Engineer’s authorization.

B. Each course shall be compacted and hardened to such a degree that it will not be displaced or otherwise damaged before another course may be placed thereon.

3.02 PREPARATION

A. Notify Engineer and Owner at least 72 hours in advance of temporary disruptions of traffic along route of construction.

B. Saw cut and tack all joints between new and existing pavement.

C. For asphalt overlay sections, mill a one (1) foot strip along all edges of the overlay area.

D. The Contractor shall review the proposed paving sequence with the Engineer prior to placement of bituminous course.

E. All surfaces shall be checked and approved by the Engineer prior to paving.

F. Existing courses must be dry prior to and during placement of any bituminous pavements.

G. Wearing course shall not be placed when the air temperature in the shade and away from artificial heat, is 50°F or less, unless otherwise approved by the Engineer.

H. Pavement shall not be installed on frozen or thawing ground.

3.03 TACK COAT

A. All equipment shall conform to MDT Standard Specifications for Road and Bridge Construction, latest edition, Section 151.

1. Tack distributor shall be designed, equipped, maintained, and operated so that tack material is applied at the specified rate per square yard with uniform pressure over the required width application.

2. The distributor shall be equipped with an onboard computer that determines the relationship between the distributor travel speed and pump speed to ensure a consistent application rate.

3. An accurate and calibrated thermometer with a range covering the specified application temperature for tack material shall be mounted at approximately center height of the tank with the stem extending into the tack material.

4. The distributor shall have a full circulating system with a spray bar, adjustable laterally and vertically. The spray bar shall be maintained at a constant height above the pavement under variable load conditions.

5. Ensure that all nozzles are of the same size and type to ensure uniform application of emulsion.

6. Ensure that all nozzles are at the same angle to ensure uniform application of emulsion.

7. The distributor shall be checked and calibrated. A certificate of the calibration shall be posted in the driver’s compartment stating that the distributing system is in good working condition and when used with the charts and instructions furnished by the manufacturer will give the required results. The certificate shall bear the date of

calibration and signature of the calibrating agency.

B. Always maintain proper distributor spray bar height and spray nozzle angle for proper coverage.

C. Always maintain proper distributor speed.

D. Always sweep and clean surfaces to be tack coated.

E. Never apply more tack coating than can be covered by the same day's operation.

F. Never apply tack coating when ambient air temperature is consistently below 40º F or when surface is wet.

G. Never over-spread tack coating. If "fat spots" develop, spread out excess oil by pneumatic tire rolling before placing pavement.

H. Always allow enough time for tack coat to "break" before placing pavement.

I. Apply tack coat as directed in Section 401 of the MDT Standard Specifications for Road and Bridge Construction, latest edition and NAPA's Best Practices for Emulsion Tack Coats. Hand spray wands and crack-sealing buckets are not acceptable methods of applying tack coat emulsion except on the vertical face of an adjoining lift of pavement.

J. Apply bituminous tack coat to existing bituminous pavement and to the surface of each lift or course constructed, other than the final course. Apply in a uniform rate with no missed areas permitted. Application rates shall be approved by the Engineer prior to commencing Work.

K. The bituminous tack coat shall be applied at a uniform rate of not less than:

1. 0.10 gallons per square yard, for undiluted asphalt emulsion (as supplied from the emulsion terminal); application rate shall be adjusted if necessary to attain bond between courses.

2. 0.20 gallons per square yard, for diluted asphalt emulsion (with water added at the terminal or plant emulsion tank).

L. The temperature of emulsion shall be between 70 and 160 degrees F at the time of application.

M. Apply immediately prior to the placement of the next bituminous course or lift. Do not allow public traffic on tack coated areas. The tack coat shall be applied in a manner that offers the least inconvenience to traveling public.

N. Apply the tack coat on the same day as the proposed surfacing is to be performed. Where emulsified asphalt is specified, dilute one part of water to one part of emulsion and apply the mixture at two times the undiluted rate of application. Allow water to evaporate completely before beginning paving operations. At request of Contractor, Engineer may approve a change in the dilution ratio of the water- emulsion mixture. Sampling and testing of the emulsion product will be performed at the discretion of the Engineer.

3.04 ASPHALT PAVEMENT CONSTRUCTION

A. All mixtures shall be spread and finished with a self-propelled, bituminous paver, to the required section, leaving the mixture uniformly dense, smooth, and free from irregularities.

B. The speed of the bituminous paver shall be controlled to place the mixture uniformly and continuously without tearing or gouging. The speed shall not exceed the Manufacturer's recommendation, and shall be coordinated with the output of the plant to provide for a smooth, continuous operation, minimizing starting and stopping.

C. Perform test strip compaction in field under observation of Engineer to determine the percentage of the asphalt mixture's maximum density achievable. If, in the Engineer's opinion, Contractor is unable to achieve the specified density corresponding with 95 percent of the maximum Marshall density (ASTM D1559), Contractor shall achieve an asphalt compaction equaling or exceeding that obtained in the test strip.

D. Compact pavement by rolling to specified density as follows:

1. Compaction shall consist of initial or breakdown rolling, intermediate rolling, and final or finish rolling with rollers meeting all requirements of MDT Standards Specifications and which are approved by the Engineer.

2. Breakdown rolling shall consist of one or more complete coverages with a rubber tired roller.

3. Breakdown rolling shall be followed by intermediate rolling with either a rubber tired roller or a vibratory steel roller and shall be continued until the surface is tightly bound and shows no displacement under the roller.

4. Intermediate rolling shall be completed before the mat temperature falls below 185º F.

5. Final rolling shall be performed with a steel roller and shall continue until roller marks are eliminated. Contractor may be required to modify rolling sequence to best suit the construction conditions.

6. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

7. Compaction shall be a minimum of 92% of the daily theoretical maximum density (ASTM D-2041).

E. Uniformly blend pavement surface into elevations at curbs, valve box castings, and other critical points of contact. Place pavement so that the pavement is ¼" higher than the edge of the structure after the pavement has been compacted.

F. Do not allow drainage to be impeded or casting covers to become difficult to remove.

G. All transverse and longitudinal joints, high or low areas, and surface irregularities, shall be leveled, filled, or raked prior to compaction. Any loose material dropped on previously compacted lanes shall be removed immediately.

H. Ensure joints made during paving operations are straight, clean, vertical, and free of broken or loose material. Joints shall be tacked and constructed with adequate bond on abutting surfaces. Vertical construction joints in successive courses shall be placed so that joints do not fall on the same vertical plane.

I. Rolling shall begin at the edges and proceed parallel to the road centerline, each trip overlapping the previous roller pass. On paving an echelon or abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure. Rolling shall begin at the low elevation and progress to the high elevation by overlapping of longitudinal passes, paralleling the centerline. Displacement resulting from reversing the direction of a roller or from other causes shall be corrected immediately.

J. The sequence of rolling operations and the selection of type and number of rollers shall be commensurate with production, and shall be adequate to obtain the specified density before the mat temperature falls below 185º F.

K. Install all bituminous pavement 3-inches and greater in thickness in a minimum of two lifts. Maximum thickness of a base course lift shall be 3-inches.

L. Ensure surface of completed asphalt pavement is true to lines, profiles, and elevations indicated and matches existing grade.

M. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

N. The surfaces of previously placed layers shall be swept and a tack coat applied before spreading the next layer.

O. The overall thickness shown on the Drawings shall be the minimum finished, in- place, compacted thickness of bituminous pavement.

P. Protect newly paved surfaces from traffic and mechanical injury until surface has cooled to 140°F.

Q. Any low or high defective areas shall be corrected immediately. Corrective Work shall include patching, cutting out the surface and replacing with fresh, hot bituminous mixture, or by milling the surface.

R. Clean up paving area.

S. Ensure manhole covers are clean of all asphalt material and tack coat and returned to the condition they were prior to asphalt paving activities.

3.05 PAVEMENT MARKINGS

A. Remove all dirt, oil, grease, and other foreign material from areas of pavement to be marked. Contractor is responsible for all preparation and layout.

B. Apply paint only on thoroughly dry surfaces when atmospheric temperature is above 40 degree Fahrenheit and when weather is favorable.

C. Apply respective markings in colors as indicated and sizes and dimensions as indicated,

or match existing colors and markings.

D. Contractor shall replace and/or restore all pavement markings after temporary patching or Work has removed such markings.

E. Contractor shall maintain pavement markings as required during all phases of construction.

F. Apply painted permanent pavement markings with a maximum coverage rate of 100 square feet per gallon with a 0.015 inch minimum film thickness on bituminous and concrete paved areas, and 0.020 inch minimum film thickness on seal coated areas.

G. Apply paint with atomizing spray type striping machine. Markings shall have clear- cut edges, true and smooth alignment, and uniform thickness. Do not permit traffic on pavement until markings are thoroughly dry. Other pavement markings shall be painted with the standard templates in an appropriate proportion.

H. Apply respective markings in colors as indicated and sizes, locations, and dimensions as follows:

1. All parking stalls to be marked with 4” wide striping, color as indicated on Drawings.

2. Crosswalk markings shall be as indicated on Drawings.

3. Pavement arrows, lettering, and symbol dimensions shall conform to MUTCD Standards.

4. All handicapped parking stalls shall be marked with striping and symbols in accordance with City and ADA Standards. Handicapped stalls to include both van accessible and non-van accessible. Locations as directed by Owner, or as shown on the drawings. Color shall be blue.

I. Contractor shall be responsible to replace and/or restore all pavement markings after temporary patching or other Work has removed such markings.

3.06 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Control: Field inspection and testing.

B. Perform field and laboratory testing by an independent testing laboratory appointed and paid for by the Contractor.

C. Determine maximum density in accordance with ASTM D2041, and compact each course in the field to a density not less than 92 percent of the Maximum Density attained by the theoretical maximum density method.

D. Perform field density testing in accordance with ASTM D2950; minimum frequency of one test per 2,000 square feet per lift, or once per day, whichever is more frequent. Ensure that the density gauge is properly calibrated and correlated to core density tests for the mix being used.

E. Notify testing laboratory to perform density tests when testing is to be performed during construction. Do not proceed with additional Work until results have been verified.

F. If, during progress of Work, tests indicate that compacted materials do not meet specified requirements, remove defective Work, replace, and retest. Contractor to bare all costs associated with defective pavement Work.

G. Perform gradation analysis of aggregate once for each 500 tons of mix produced, as construction progresses. Test base course and wear course for oil content and air voids to differentiate different mix designs.

3.07 TOLERANCES

A. Flatness: Maximum variation of 3/16 inch measured with 10-foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch of specified thickness.

C. Variation from true elevation: Within 1/4 inch.

D. Variation from horizontal location: Within ¼ inch.

E. Transverse slope of surface course shall not vary from the slope shown on Drawings by more than plus or minus ¼ inch in 12 feet.

F. Asphalt cement content within 0.24% of approved mix design as determined by daily cutoff report.

END OF SECTION 32 12 16

SECTION 32 13 13
CONCRETE PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Concrete curb and gutter.
2. Valley gutter.
3. Handicap curb ramps.
4. Concrete sidewalk.
5. Concrete driveways.

B. Related Sections included, but are not limited to:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 REFERENCES

A. Reference Standards include, but are not limited to:

1. Montana Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.
2. ACI 301 -Specifications for Structural Concrete Buildings.
3. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
4. ASTM A185 -Welded Steel Wire Fabric for Concrete Reinforcement.
5. ASTM A497 -Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
6. ASTM A615- Deformed and Plain Billet-Steel for Concrete Reinforcement.
7. ASTM C33- Concrete Aggregates.
8. ASTM C94 - Ready Mix Concrete.
9. ASTM C150 - Portland Cement.
10. ASTM C260 -Air-Entraining Admixtures for Concrete.
11. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
12. ASTM C494 - Chemical Admixtures for Concrete.

13. ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
14. ASTM D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
15. ASHTO M301

1.03 SUBMITTALS FOR REVIEW

A. See Section 01 33 00 - Submittals: Procedures for Submittals.

B. Product Data: Furnish data on aggregates, Portland cement, air-entraining agent, admixtures and other materials and on plant mix design in accordance with Sections 01 33 00 and 01 40 00 at least 7 days prior to beginning paving operations.

C. Concrete Mix Design Information and Analysis of Aggregate Materials.

1.04 PERFORMANCE REQUIREMENTS AND QUALITY ASSURANCE

A. Perform Work in accordance with the Montana Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

B. Batch Plant and Mixing Operations: Conform to Montana Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition; and ACI 304.

C. Obtain all materials from same source throughout project.

1.05 REGULATORY AND ENVIRONMENTAL REQUIREMENTS

A. Perform concrete paving Work in accordance with ACI 301.

B. Perform Work when ambient air temperature is rising and above 35 degrees F (measured in the shade and away from artificial heat).

C. Discontinue Work when ambient air temperature is falling and reaches 40 degrees

F. (measured in the shade and away from artificial heat). Submit details of Contractor's means of cold weather, frost protection for newly-placed concrete to Engineer for approval

D. Do not place concrete when base or foundation is wet or frozen or when atmospheric conditions exist that would cause abnormal shrinking and checking of the pavement.

E. Conform to applicable code for paving Work on public property.

F. Conform to Section 01 50 00. Minimize interference with traffic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland cement:

1. ASTM C150 Type I or Type II Portland cement, gray color.

B. Aggregates:

1. ASTM C33 fine and coarse aggregates in accordance with Section 32 05 16.

C. Water and Admixtures:

1. Air-entraining admixture conforming to ASTM C260.
2. Other admixtures only with the written approval of Engineer.
3. Water: potable.

D. Concrete Mix:

1. Mixed in accordance with ACI 304 and delivered in accordance with ASTM C94.
2. Minimum cement: 564 (6 bag mix) pounds per cubic yard. Water/cement ratio of 0.45 maximum.
3. Minimum 28-day compressive strength of 4,000 psi and minimum 7-day and 28-day moduli of rupture of 500 and 600 psi, respectively.
4. Air content between 5 and 7 percent.
5. Slump Limits: Maximum slump shall be 3-inches. Slump shall be consistent ± 1-inch.
6. Type C Fly Ash meeting ASTM C618 may be used for work of this Section. Fly ash replacement of cement shall be allowed on a 1:1 ratio, up to a maximum of 29 percent by weight.

E. Forms:

1. Steel form material, profiled to suit conditions.

F. Reinforcement:

1. Reinforcing Steel and Dowels: ASTM A615, 60 ksi yield grade billet steel deformed bars; uncoated finish.

G. Joint Sealers:

1. Silicone joint sealant shall meet the requirements of MDT Specifications.

H. Curing Compound:

1. ASTM C309, Type 2.

2.02 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 - Quality Control: Provide concrete mix design and testing and analysis of aggregate material.

B. Contractor shall submit samples, obtain aggregate gradation analyses, and submit for Engineer's approval. Minimum frequency for aggregate gradation analyses shall be one test per 500 tons of concrete mix produced or fraction thereof.

C. Coarse Aggregate Material- Testing and Analysis: Perform in accordance with ASTM C136.

D. Fine Aggregate Material -Testing and Analysis: Perform in accordance with ASTM C136.

E. If tests indicate materials do not meet specified requirements, change material or material source and retest.

F. Provide materials of each type from the same source throughout the Work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and that compacted subgrade is dry, stable, compacted to specified density per Section 01 40 00, and at proper temperature. Verify that subgrade elevations are correct and at proper grade to receive concrete paving.

B. Submit subgrade test results prior to placing concrete pavement.

C. Do not begin concrete paving construction without Engineer's authorization.

D. Verify Work of others affected has been completed and will not be adversely affected by paving operations. Verify that elevations of manhole and valve box castings in street or sidewalk are correct. Verify that curb depressions for sidewalks and driveways have been accommodated. Verify that drainage pattern matches storm water intake locations.

E. Notify Engineer and Owner at least 48 hours in advance of temporary disruptions of traffic along route of construction.

3.02 PREPARATION

A. Moisten subgrade to minimize absorption of water from fresh concrete.

B. Adjust valve boxes, curb stops, and manhole castings to grade, if required; coat manhole, catch basin, or other frames with oil to prevent bond with concrete pavement.

C. Notify Engineer minimum of 24 hours prior to commencement of concrete delivery and placement.

3.03 FORMING

A. Curb and gutter shape shall conform to the dimensions shown on Drawings.

B. Concrete curb shall be recessed for handicap ramps where sidewalks cross street. Conform to handicap curb ramp details shown on Drawings.

C. Curbs shall also be recessed for all driveways shown on Drawings.

D. Use approved flexible forms on all curves where the radius is less than 20 times the length of the form.

E. In the event of rain, forms shall be removed and reset as may be necessary to comply with above requirements.

F. Clean forms prior to placement. Place and secure forms to correct location, dimension, profile, and gradient for sidewalk and street paving thicknesses shown on Drawings and for curbs and gutters.

G. Forms shall have a height equal to the edge thickness of the sidewalk or pavement slab. Assemble formwork to fully support loading exerted by concrete placement and finishing operations without deflection, displacement, or settlement, and to permit easy stripping and dismantling without damaging concrete. Forms shall be well oiled on the contact faces.

H. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

I. Do not place concrete until Engineer has approved subgrade and forms. Forms for paving shall be set to the proper alignment and grade for a distance equal to at least 3 hours paving time prior to Engineer approval.

J. Moisten forms and subgrade immediately before placing concrete.

K. Forms shall remain in place for a minimum of 12 hours after concrete finishing is completed unless otherwise approved by Engineer. Remove forms only during daylight hours and in a manner that avoids damage to pavement and curbs.

3.04 REINFORCING

A. Reinforcement: Comply with ACI 301 and placement shown on the Drawings. Reinforcement shall be clean and free of rust scale, shall be of the type, style, and dimensions shown on the Drawings.

B. Place reinforcement as shown on Drawings within a tolerance of ± 1/2 inch.

C. Interrupt reinforcement at expansion joints.

D. Place dowels or rebar to achieve pavement and curb alignment as shown on Drawings.

E. Installation of curb and gutter dowels by pushing into plastic concrete will not be allowed. The dowel shall be grouted into 8-inch deep pre-drilled holes with an approved epoxy grout. Prior to grouting bar in place, pre-drilled hole shall be cleaned as recommended by grout manufacturer.

F. Dowels in driveway or roadway pavement shall be grouted into 8-inch deep pre drilled holes in the existing concrete with an approved epoxy grout. Prior to grouting bar in place, clean pre-drilled hole as recommended by grout manufacturer.

3.05 PLACING CONCRETE

A. Preparation

1. Do not place concrete until subgrade preparation, forms, and reinforcement have been inspected and until elevations of castings have been verified.

2. Before placing concrete, thoroughly clean forms, wash out with water, and make tight. Sweep and wash all adjacent sidewalks next to the pour, before placing concrete, so as to eliminate contamination from remaining debris.

3. Concrete in streets, sidewalks, etc. are to be of the thickness indicated on the Drawings.

4. Deposit concrete in a manner to form a continuous, full-width mass requiring a minimum of rehandling and/or redistribution and to a sufficient depth to provide an excess for finishing operations.
5. Do not dump or discharge concrete on or against a joint, reinforcement, insert, embedded part, or other assembly in a manner causing displacement or damage of the assembly.
6. Before new concrete is deposited upon or against concrete that has taken its initial set or has hardened, remove all incrustations from forms and reinforcement.

B. Method of Placing

1. Do not place concrete outside of regular working hours, unless Engineer has been notified properly and is present.
2. Do not permit concrete to drop more than 6 feet. The concrete shall be placed in forms by means of a chute or hand shoveling.
3. Deposit the concrete so that the surface is kept level throughout, a minimum being permitted to flow from one position to another, and place as rapidly as practicable after mixing.
4. Thoroughly work concrete around reinforcements and embedded fixtures and into corners of forms during placing operations.
5. If concrete placement is suspended for 30 minutes or less, cover the unfinished forward face of placed concrete with wet burlap until placement operations resume. When operations resume, break down forward face of placed concrete and thoroughly merge with fresh concrete. Continue consolidation and finishing operations on placed concrete through the suspension period.
6. Do not break or interrupt successive pours such that cold joints occur. If the suspension of concrete placement exceeds 30 minutes, a standard header joint shall be constructed; provided, however, that no header joint will be permitted within a distance of 10 feet from any adjacent transverse joint.

C. Consolidating

1. Consolidate concrete by an approved mechanical vibrator using a uniform rate of forward progress as soon as possible after placement of concrete on subgrade. Vibrate only once and thoroughly and uniformly consolidate concrete throughout its entire depth and width without damaging or displacing joint assemblies and reinforcing. Segregation of concrete or undesirable water gain in the upper pavement zone due to excessive vibration will not be permitted. Suspend vibration whenever the forward progress of the machine is interrupted. Hand-held vibratory equipment is not approved unless Contractor demonstrates that adequate manpower is dedicated to consolidation operations and Engineer approves Contractor's plan and manpower commitment in writing. Engineer may require the use of hand-held vibrators along the edge of existing pavement and curb. Suspend concrete paving if vibratory equipment failure occurs.

3.06 JOINTS

A. Intervals, type, and dimensions shown on Drawings; firmly support rebar off subgrade with chairs.

B. Construct joints straight and at right angles to pavement surface. Where practical, all joints shall match existing joints in adjoining work. Use joints to outline all panels in sidewalks, making panels square insofar as possible. Generally, no sidewalk panel shall exceed 36 square feet. All sidewalk joints shall be edged with a tool having a radius of 1/8 inch or less.

C. Joints in driveways and alley returns shall be aligned with joints in the street and sidewalk as shown on Drawings.

D. When placing concrete adjacent to existing working joints, Contractor shall use jointing techniques that will prevent random cracking of new pavement surfaces. Techniques may include soft sawing, placing pre-molded strips, or other approved methods.

E. After the curing period, joints to be dried and sand cleaned prior to installation of joint material. Slightly underfill joints by approximately 1/8 inch and remove excess seal material immediately.

F. Transverse joints: at right angles to pavement centerline:

1. Match existing transverse joints.

2. Saw cut 3/8 inch contraction joints to a depth of 1/4 slab depth at optimum time after finishing to prevent formation of uncontrolled cracks due to contraction of slab; Provide construction joints as shown on Drawings and when concrete placement is suspended more than 30 minutes; no transverse construction joints shall be allowed between normal contraction joint locations; Contractor shall layout joint locations to ensure that construction joints do not occur at prohibited locations.

3. Sidewalk transverse joints: place at uniform intervals not more than 60 feet for expansion joints, 5 feet for contraction joints and at abutment against another permanent fixed object; cut 1/8 inch wide and to a depth of 1/3 thickness of walk.

G. Longitudinal joints: parallel to pavement centerline.

1. Match existing longitudinal joints. Placed as shown on Drawings; saw cut 3/8 inch contraction joints to a depth of 1/4 slab depth at optimum time after finishing to prevent formation of uncontrolled cracks due to contraction of slab.

2. Construct longitudinal construction joints, if required, as shown on Drawings. The key shall be constructed by placing a deformed metal plate against the form when the first lane adjacent to the joint is placed. Remove this metal plate with the form. When placing the second slab, no concrete shall be left to overhang the lip formed on the first slab by the edging tool. Before placing the second slab, the entire edge of the first slab shall be sprayed with concrete form oil to completely break the bond between adjacent slabs.

H. Isolation joints: use to separate all fixed objects such as catch basins, manholes, castings,

etc. within or abutting pavement and at all street intersections; joint shall be full depth of pavement and dimensions shown in Drawings; when extending full width of 5-foot wide or wider pavement, increase depth 2 inches.

1. Sidewalk isolation joints: 5/8-inch wide and full slab thickness; pre-molded or poured material.

I. When separate curb and gutter is used, the longitudinal joint between the pavement and gutter shall be Type 3 joint as shown on Drawings. Transverse joint locations in curb and gutter shall match transverse joint locations in pavement.

3.07 FINISHING

A. Test the slab surface for trueness with a 10-foot long straightedge while the concrete is still plastic. Correct irregularities by adding or removing concrete and re-scraping disturbed area. Leave no depressions in which water will stand.

B. Ensure that paving grade has a minimum slope of 0.4 percent.

C. Approximately one hour after striking off and consolidation, scrape surface with a straightedge operated so that any excess water, laitance and inert material are removed from the pavement surface.

D. Brooms shall be clean and free of dry or hardened mortar.

E. Finishing Schedules:

1. Sidewalks: Floated smooth and immediately after the water sheen disappears, broom lightly perpendicular to centerline followed by troweling joint edges. Use a clean broom at least 24 inches long and having three rows of bass, bassine, or coire fibers. Broom fibers shall be free of dry or hardened mortar from previous use. The Contractor shall mark his name and the year of construction in the walks at each end of every 150 feet of work or fraction thereof by stamping or inlaying an approved metal plate. Letters shall be 1-inch high and 14-inch deep. Metal plates shall be flush with the walk surface.

2. Driveways and aprons: Light broom texture parallel to centerline of street and curb and gutter, true to line and grade. The surface shall be slightly rough but uniform.

3. Inclined vehicular and handicap ramps: Broomed perpendicular to slope with 3/8-inch deep V-jointed tread on 3-inch spacing.

4. Curbs and gutters: Light broom.

F. Finishing Tolerances:

1. The true plane of the surface shall not vary more than 1/4 of an inch in 10 feet, as determined by a 10 foot straightedge placed anywhere on the slab in any direction.

2. Produce an initial surface which is relatively free from defects, but which still may show some trowel marks.

3. Provide a finished surface essentially free from trowel marks, uniform in texture and appearance, and in a plane of tolerance specified.

3.08 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature curing, sun, wind, excessively hot or cold temperatures, travel, and mechanical injury. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

B. Cure concrete by covering all exposed surfaces immediately after finishing for at least 30 hours with curing paper or plastic curing blanket or by application of a liquid membrane curing compound.

1. When liquid membrane curing compound is used, apply at a rate of at least one gallon per 150 square feet in two equal applications 30 minutes apart. Protect joints to be sealed from entry of curing compound.

2. Apply curing compound to exposed concrete after removal of forms.

3. Promptly repair damaged curing compounds, paper, or blankets during the 30-hour curing period.

C. Prevent the temperature of deposited concrete from falling below 50 degrees F. until at least 30 hours of curing has taken place. Engineer may, at his discretion, extend this curing time for cold weather operations.

D. Power equipment shall not operate on a pavement slab until it has attained a minimum modulus of rupture flexural strength of 500 psi. Engineer's written approval shall be required prior to equipment access onto pavement. In the event of damage to concrete resulting from the equipment or operations, suspend operation and correct damage. Contractor shall be responsible for any damage to concrete pavement caused by his equipment or operations, regardless of Engineer's approval.

E. New pavement shall not be opened for traffic for 7 days after placement and until the joints have been sealed. New pavement may be opened to use by pedestrians and light vehicles having axle loads less than 6,000 pounds once the concrete has attained a modulus of rupture flexural strength of 550 psi, provided pavement conditions are safe for such traffic. Vehicular access limitations at colder temperatures will be extended at the Engineer's discretion; consult Engineer before allowing vehicle access.

F. Clean up paving area in accordance with the Specifications.

3.09 DEFECTIVE CONCRETE

A. The following concrete will be deemed to be defective, poor in quality standards, and shall be removed and replaced promptly from the job site at no additional expense to the Owner.

1. All concrete which is not formed as indicated, is not true to intended alignment, is not plumb or level where as intended, is not true to intended grades and levels.

a. Has voids, honeycombs, or spalling that have been cut, resurfaced, or filled, unless with the approval of the Engineer.

b. Has uncontrolled cracks greater than 1/32 inch in width.

c. Has sawdust, shaving, wood, dirt, rocks, or other embedded debris.

d. The flow line surface of gutters not finished and shaped as necessary to eliminate low spots and entrapment of water.

e. The top surface of the curbs, gutters, and curb radius shall be free from humps, sags, and other irregularities, shall be constructed to the elevations and widths shown in the Drawings and shall have edge alignment as straight as practicable on tangent sections and of uniform curvature on curved sections.

f. Or does not conform fully to provisions of the contract documents.

B. Repairs and Replacements:

1. Where defective concrete is found after removal of the forms, cut it out, if necessary, and make the surfaces match adjacent surfaces

3.10 FIELD QUALITY CONTROL

A. Section 01 40 00- Quality Assurance: Field inspection and testing.

B. Perform field and laboratory testing by an independent testing laboratory appointed and paid for by the Contractor.

C. Perform one (1) field slump, one (1) air entrainment, one (1) 7-day and two (2) 28- day cylinder compression tests, and one (1) each 7-day and 28-day beam modulus of rupture tests in accordance with ACI 301 on the following schedule. Minimum testing frequency shall be the greater number of tests determined by the following criteria: 1) Once per day of paving operation, 2) Once per City block of paving or fraction thereof, or 3) Once per 75 cubic yards or fraction thereof. When ambient temperatures are below 45 degrees, one additional test cylinder shall be molded, cured on site under the same conditions as concrete it represents, and subsequently tested for 28 day compressive strength. Notify testing laboratory to perform tests when testing is to be performed during construction. Do not proceed with additional Work until 7-day modulus of rupture results have been verified.

D. Provide computer generated batch tickets showing the weight of each component in the concrete mixture and the batching time with each batch of concrete delivered to the project. Contractor shall collect the batch ticket from each load delivered and shall deliver the batch tickets to the Engineer at the end of each day.

E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature (3 times daily), and test samples taken.

F. If, during progress of Work, tests indicate that concrete paving materials do not meet specified requirements, remove defective Work, replace and retest. Contractor to bare all costs associated with defective pavement Work.

3.11 WORKMANSHIP AND TOLERANCES

A. Flatness: Maximum variation of measured with a 10-foot straight edge shall be ¼ inch for

pavement slabs and 1/8 inch for sidewalks.

B. Scheduled thickness: Within ¼ inch of specified thickness.

C. Variation from true elevation: Within ¼ inch.

D. Transverse slope of surface course shall not vary from the slope shown on Drawings by more than plus or minus ½ inch in 12 feet. It is recognized by the Engineer that this tolerance may not be met at the asphalt concrete blend-in locations near sawcuts.

END OF SECTION 32 13 13

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Fence framework, fabric, and accessories.
2. Excavation for post bases, concrete foundation for posts, and center drop for gates.

B. Related Sections include, but are not limited to:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.
4. Division 32 – Exterior Improvements.

1.02 REFERENCES

A. Reference Standards include:

1. ANSI/ASTM A123 – Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A90/A90M – Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASNI/ASTM F567 – Installation of Chain-Link Fence.
4. ASTM A116 – Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
5. ASTM A120 – Pipe, Steel, Black, and Hot-dipped Zinc Coated (Galvanized) Welded and seamless, for Ordinary Uses.
6. ASTM A121 – Zinc-Coated (Galvanized) Steel Barbed Wire.
7. ASTM A153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
8. ASTM A370 – Mechanical Testing of Steel Products.
9. ASTM A392 – Zinc-Coated Steel chain-Link Fence Fabric.
10. ASTM A428 – Weight of Coating on Aluminum-Coated Iron or Steel Articles.
11. ASTM A491 – aluminum-Coated Steel chain Link Fence Fabric.
12. ASTM A569 – Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality.
13. ASTM A585 – Aluminum Coated Steel Barbed Wire.

14. ASTM C94 – Ready-mixed Concrete.
15. ASTM F552 – Terminology Relating to Chain Link Fencing.
16. ASTM F567 – Installation of Chain Link Fence.
17. ASTM F573 – Residential Zinc-Coated Steel chain Link Fence Fabric.
18. ASTM F626 – Fence Fittings.
19. ASTM F900 – Industrial and Commercial Swing Gates.
20. ASTM F1043 – Specifications for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
21. ASTM F1083 – Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded for Fence Structures.

B. Chain Link Fence Manufacturers Institute (CLFMI) Product Manual.

1.03 SYSTEM DESCRIPTION

A. Fence Height: 6 feet with 3-inch clear terminal.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Three strands of barbed wire at top.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

C. Product Data: Provide data on fabric, posts, accessories, fittings, and hardware.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 78 00.

B. Accurately record actual locations of fence perimeter post relative to project site.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI/ASTM F567.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum of three years' experience.

1.08 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Shop Drawings.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Delivered materials shall be stockpiled and stored at locations approved by the Owner until required for installation. Materials shall be stored in accordance with manufacturer's

instructions.

B. Contractor shall inspect materials upon delivery for loss or damage in transit. Contractor shall be responsible for the replacement of damaged materials; damaged materials shall be removed from the site.

PART 2 - PRODUCTS

2.01 FENCE MATERIALS

A. Fence Components

1. Fabric Wire: ASTM A392 zinc coated wire fabric woven in a 2-inch mesh from 9-gauge wire. Top selvage twist and bottom selvage knuckle end closed.
2. Line Posts: 2-3/8 inch O.D. galvanized steel Type I or Type II round posts in accordance with the requirements of the CLFMI Product Manual.
3. Corner and Terminal Posts: 2-7/8 inch O.D. galvanized steel Type I or Type II round posts in accordance with the requirements of the CLFMI Product Manual.
4. Top Rails and Post Braces: 1-5/8 inch O.D. galvanized steel tube weighing 1.83 lbs per foot.
    a. Top rails shall be in lengths not less than 18 feet and shall be fitted with galvanized steel couplings for connecting the lengths into a continuous run. The couplings shall not be less than 6 inches long, with 0.070 inches minimum wall thickness, and shall allow for expansion and contraction of the rail.
    b. Post braces shall be provided for each gate, corner pull, and end post, and shall consist of a brace rail extending to each adjacent line post at approximately mid-height of the fabric, and a truss consisting of a galvanized steel rod not less than 3/8 nominal diameter from the line post back to the gate, corner, pull, or end post, with a turnbuckle or other equivalent provision for adjustment.
5. Post Tops: Galvanized steel ornamental tops provided with a hole suitable for the through passage of the top rail. The post tops shall fit over the outside of posts and shall exclude moisture from posts.
6. Tension Bars: 3/16 inch by ¾ inch galvanized steel, not less than 2 inches shorter than the normal height of the fabric with which they are to be used. One tension bar shall be provided for each end and gate post, and two for each corner and pull post.
7. Ties or Clips: Aluminum or galvanized steel of sufficient strength for application.
8. Bands or Clips: Aluminum or galvanized steel per ASTM F-626. Attachment bolts shall be 5/16 x 1-1/4 inch galvanized carriage bolts with nuts.
9. Tension Wire: 7-gauge coil spring wire, galvanized, located at the bottom of fabric.
10. Barbed Wire Supporting Arms: Arms shall be at an angle of approximately 45 degrees, and shall be fitted with clips or other means of attaching three strands of barbed wire. With 45 degree arms, the top wire shall be approximately 12 inches

horizontally from the fence line and the other wires spaced uniformly between the top of the fence fabric and the outside strand. Barbed wire arm shall be sufficient strength to withstand a weight of 250 pound applied at the outer strand of barbed wire.

11. Barbed wire strands shall consist of three strands of twisted wire, zinc coated, conforming to ASTM A121, chain link fence grade, with 4 point barbs on 5-inch centers.

2.02 ELECTRICAL GROUNDS

A. Electrical grounds consisting of copper coated steel rods having a nominal diameter of five-eighths inch or more and a minimum length of eight feet shall be provided along each fence line.

B. Grounds rods shall be driven to an elevation approximately flush with the ground surface, at points directly below or adjacent to the fence wire, and each ground rod shall be connected to the fence with a solid No. 6 gauge copper wire. The ground wire shall be attached to the ground rod and to the fence wires with approved type metal clamps in such a manner that each longitudinal fence wire is electrically grounded. No more than one connection will be required on woven wire and chain link fabric, that being near the bottom at each ground rod.

2.03 CONCRETE

A. Concrete shall have minimum compressive strength of 3,000 psi at 28 days, using three-fourths inch maximum size aggregate.

B. Non-shrink grout shall consist of one part Portland cement to three parts clean, well-graded sand, non-shrinking grout additive and the minimum amount of water to produce a workable mix.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation framework, fabric, accessories, and gates shall be done by skilled mechanics in accordance with ANSI/ASTM F567.

B. Terminal posts shall be set at the beginning and end of each continuous length of fence and at changes in vertical or horizontal alignments.

C. Terminal posts shall be set in concrete with a hole diameter of three (3) times the diameter of post being set (minimum), at post embedment depth required for an 6- foot fence, 36 inches minimum or as indicated by manufacturer.

D. Line posts shall be set in concrete with a hole diameter of 9 inches minimum, at a depth and post embedment to a depth of 36-inches minimum. Line post shall be set equidistant at intervals not exceeding 10 feet. Measure the interval parallel to the grade of the proposed fence and in the line of the fence from center to center of the posts.

E. Gate posts shall be set in concrete with a minimum hole diameter of three (3) times the

diameter (minimum) of post being set, at a post embedment depth required for the size and type of gate installed, 48 inches minimum or as indicated by the manufacturer.

F. Sleeves may be used in order to leave voids in new concrete construction. Half- fill the void with non-shrink hydraulic cement and force the post to the bottom of the hole and plumb. Thoroughly work additional grout into the hole so as to leave no voids. Crown the grout to shed water.

G. Top rail shall be supported at each post so that a continuous brace from end to end of each stretch of fence is formed. Securely fasten the top rail to the terminal posts and join with couplings to allow for expansion and contraction.

H. Tension wire shall be stretched from end to end of each stretch of fence. Place tension wire within the bottom 4-inches of the fabric. The tension wire shall be taut and free of sag.

I. Chain link fabric shall be placed on the outside of the area enclosed. Place the fabric by securing one end, applying sufficient tension to remove all slack before making attachments elsewhere. Tighten the fabric to provide a smooth uniform appearance free from sag. Use stretcher bars with tension bands or other suitable devices at 15 inch maximum intervals. The fence fabric shall be installed 3 inches above finished grade level. Ground clearance shall be measured at each post, with a tolerance of ±2 inches. Fabric shall be fastened to the line posts at intervals not exceeding 15 inches vertically. Fasten the fabric to the rail or tension wire at intervals not exceeding 24 inches horizontally.

J. Fence sides shall run parallel with adjacent City streets, avenues, or roads where applicable.

K. Gate fabric shall be fastened to the frame on all four sides with tension rods per manufacturer’s recommendations.

L. Install all gate accessories and hardware per manufacturer’s recommendations.

M. Install barbed wire on supporting arms above the fence posts. Extend each end member of gate frames sufficiently above the top member to carry three stands of barbed wire in horizontal alignment with the fence. Pull each strand taut and securely fasten to each supporting arm and extended member.

3.02 ERECTION TOLERANCES

A. Maximum Variation from plumb: ¼ inch.

B. Maximum offset from true position: 1 inch.

C. Components shall not infringe adjacent property lines.

END OF SECTION 32 31 13

SECTION 32 32 16
PRECAST MODULAR BLOCK RETAINING WALL

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes furnishing all materials and labor required for the design and construction of a precast concrete modular block (PMB) retaining wall with or without geosynthetic reinforcement. Precast modular block retaining wall blocks under this section shall be cast utilizing a wet-cast concrete mix and exhibit a final handling weight in excess of 1,000 pounds (450 kg) per unit.

B. Scope of Work: The work shall consist of furnishing materials, labor, equipment and supervision for the construction of a precast modular block (PMB) retaining wall structure in accordance with the requirements of this section and in acceptable conformity with the lines, grades, design and dimensions shown in the project site plans.

C. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 31, Division 32 and Division 33 also apply to this Section.

1.02 REFERENCES

A. Where the specification and reference documents conflict, the Owner's designated representative will make the final determination of the applicable document.

B. Definitions:

1. Precast Modular Block (PMB) Unit – machine-placed, "wet cast" concrete modular block retaining wall facing unit.

2. Geotextile – a geosynthetic fabric manufactured for use as a separation and filtration medium between dissimilar soil materials.

3. Geogrid – a geosynthetic material comprised of a regular network of tensile elements manufactured in a mesh-like configuration of consistent aperture openings. When connected to the PMB facing units and placed in horizontal layers in compacted fill, the geogrid prevents lateral deformation of the retaining wall face and provides effective tensile reinforcement to the contiguous reinforced fill material.

4. Drainage Aggregate – clean, crushed stone placed within and immediately behind the precast modular block units to facilitate drainage and reduce compaction requirements immediately adjacent to and behind the precast modular block units.

5. Unit Core Fill – clean, crushed stone placed within the hollow vertical core of a precast modular block unit. Typically, the same material used for drainage aggregate as defined above.

6. Foundation Zone – soil zone immediately beneath the leveling pad and the reinforced zone.

7. Retained Zone – soil zone immediately behind the drainage aggregate and wall infill

for wall sections designed as modular gravity structures. Alternatively, in the case of wall sections designed with geosynthetic soil reinforcement, the retained zone is the soil zone immediately behind the reinforced zone.

8. Reinforced Zone – structural fill zone within which successive horizontal layers of geogrid soil reinforcement have been placed to provide stability for the retaining wall face. The reinforced zone exists only for retaining wall sections that utilize geosynthetic soil reinforcement for stability.
9. Reinforced Fill – structural fill placed within the reinforced zone.
10. Leveling Pad – hard, flat surface upon which the bottom course of precast modular blocks are placed. The leveling pad may be constructed with crushed stone or cast-in-place concrete. A leveling pad is not a structural footing.
11. Wall Infill – the fill material placed and compacted between the drainage aggregate and the excavated soil face in retaining wall sections designed as modular gravity structures.

C. Reference Standards

1. Design
    a. AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014.
    b. Minimum Design Loads for Buildings and Other Structures – ASCE/SEI 7-10.
    c. International Building Code, 2012 Edition.
    d. FHWA-NHI-10-024 Volume I and GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
    e. FHWA-NHI-10-025 Volume II and GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
2. Precast Modular Block Units
    a. ACI 201 – Guide to Durable Concrete
    b. ACI 318 – Building Code Requirements for Structural Concrete
    c. ASTM C33 – Standard Specification for Concrete Aggregates
    d. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
    e. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
    f. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
    g. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.
    h. ASTM C150 – Standard Specification for Portland Cement
    i. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed

Concrete by the Pressure Method.

j. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.

k. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

l. ASTM C595 - Standard Specification for Blended Hydraulic Cements.

m. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

n. ASTM C666 – Standard Test Method for Concrete Resistance to Rapid Freezing and Thawing.

o. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.

p. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.

q. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.

r. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.

s. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.

t. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.

u. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

v. ASTM C1611 – Standard Test Method for Slump Flow of Self-Consolidating Concrete.

w. ASTM C1776 – Standard Specification for Wet-Cast Precast Modular Retaining Wall Units.

x. ASTM D6638 – Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks).

y. ASTM D6916 – Standard Test Method for Determining Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks).

3. Geosynthetics

a. ASTM D3786 – Mullen Burst, Latest Edition.

b. ASTM D4355 – UV-Resistance, Latest Edition.

c. ASTM D4491 – Permeability, Latest Edition.

d. ASTM D4533 – Trapezoid Tear Strength of Geotextiles

e. ASTM D4595 – Wide Width Tensile Strength, Latest Edition.

f. ASTM D4632 – Grab Tensile Strength and Elongation, Latest Edition.

g. ASTM D4751 – Apparent Opening Size (AOS), Latest Edition.

h. ASTM D4759 – Determining Specification Performance for Geosynthetics

i. ASTM D4833 – Puncture and Trapezoidal Tear, Latest Edition.

j. ASTM D4873 – Guide for Identification, Storage, and Handling of Geosynthetics, Latest Edition.

k. ASTM D5262 – Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics.

l. ASTM D5321 – Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.

m. ASTM D5818 – Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics.

n. ASTM D6241 – Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

o. ASTM D6637 – Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.

p. ASTM D6706 – Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.

q. ASTM D6992 – Standard Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method.

4. Soils

a. AASHTO M 145 – AASHTO Soil Classification System.

b. AASHTO T 104 – Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.

c. AASHTO T 267 – Standard Method of Test for Determination of Organic Content in Soils by Loss of Ignition.

d. ASTM C33 – Standard Specification for Concrete Aggregates.

e. ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils.

f. ASTM D448 – Standard Classification for Sizes of Aggregates for Road and Bridge Construction.

g. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. (12,400 ft-lbf/ft (2,700 kN-m/m)).

h. ASTM D1241 – Standard Specification for Materials for Soil-Aggregate Subbase, Base and Surface Courses.

i. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

j. ASTM D1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. (56,000 ft-lbf/ft (2,700 kN-m/m)).

k. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

l. ASTM D2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

m. ASTM D3080 – Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions.

n. ASTM D4254 – Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

o. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

p. ASTM D4767- Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils.

q. ASTM D4972 – Standard Test Method for pH of Soils.

r. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Aggregate by Nuclear Methods (Shallow Depth).

s. ASTM G51 – Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing.

t. ASTM G57 – Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method.

5. Drainage Pipe

a. ASTM D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

b. ASTM F2648 – Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preconstruction Meeting. As directed by the Owner, the General Contractor shall schedule a preconstruction meeting at the project site prior to commencement of retaining wall construction. Participation in the preconstruction meeting shall be required of the General Contractor, Retaining Wall Design Engineer, Retaining Wall Installation Contractor, Grading Contractor and Inspection Engineer. The General Contractor shall provide notification to all parties at least 10 calendar days prior to the meeting.

1. Preconstruction Meeting Agenda:
    a. The Retaining Wall Design Engineer shall explain all aspects of the retaining wall construction drawings.
    b. The Retaining Wall Design Engineer shall explain the required bearing capacity of soil below the retaining wall structure and the shear strength of in-situ soils assumed in the retaining wall design to the Inspection Engineer.
    c. The Retaining Wall Design Engineer shall explain the required shear strength of fill soil in the reinforced, retained and foundation zones of the retaining wall to the Inspection Engineer.
    d. The Retaining Wall Design Engineer shall explain any measures required for coordination of the installation of utilities or other obstructions in the reinforced or retained fill zones of the retaining wall.
    e. The Retaining Wall Installation Contractor shall explain all excavation needs, site access and material staging area requirements to the General Contractor and Grading Contractor.

1.04 SUBMITTALS

A. Product Data. At least 14 days prior to construction, the General Contractor shall submit a minimum of six (6) copies of the retaining wall product submittal package to the Owner's Representative for review and approval. The submittal package shall include technical specifications and product data from the manufacturer for the following:
    1. Precast Modular Block System brochure
    2. Precast Modular Block concrete test results specified in paragraph 2.01, subparagraph B of this section as follows:
        a. 28-day compressive strength
        b. Air content
        c. Slump or Slump Flow (as applicable)
    3. Drainage Pipe
    4. Geotextile
    5. Geosynthetic Soil Reinforcement (if required by the retaining wall design). The contractor shall provide certified manufacturer test reports for the geosynthetic soil reinforcement material in the manufactured roll width specified. The test report shall list the individual roll numbers for which the certified material properties are valid.

B. Installer Qualification Data. At least 14 days prior to construction, the General Contractor shall submit the qualifications of the business entity responsible for installation of the retaining wall, the Retaining Wall Installation Contractor, per paragraph 1.07, subparagraph A of this section.

C. Retaining Wall Design Calculations and Construction Shop Drawings. At least 14 days

prior to construction, the General Contractor shall furnish six (6) sets of construction shop drawings and six (6) copies of the supporting structural calculations report to the Owner for review and approval. This submittal shall include the following:

1. Signed, sealed and dated drawings and engineering calculations prepared in accordance with these specifications.
2. Qualifications Statement of Experience of the Retaining Wall Design Engineer as specified in paragraph 1.07, subparagraph B of this section.
3. Certificate of Insurance of the Retaining Wall Design Engineer as specified in paragraph 1.06, subparagraph B of this section.

1.05 CONSTRUCTION SHOP DRAWING PREPARATION

A. The Retaining Wall Design Engineer shall coordinate the retaining wall construction shop drawing preparation with the project Civil Engineer, project Geotechnical Engineer and Owner's Representatives. The General Contractor shall furnish the Retaining Wall Design Engineer the following project information required to prepare the construction shop drawings. This information shall include, but is not limited to, the following:

1. Current versions of the site, grading, drainage, utility, erosion control, landscape, and irrigation plans;
2. electronic CAD file of the civil site plans listed in (1);
3. report of geotechnical investigation and all addenda and supplemental reports;
4. recommendations of the project Geotechnical Engineer regarding effective stress shear strength and total stress shear strength (when applicable) parameters for in-situ soils in the vicinity of the proposed retaining wall(s) and for any fill soil that may potentially be used as backfill in retained and/or foundation zones of the retaining wall.

B. The Retaining Wall Design Engineer shall provide the Owner with a certificate of professional liability insurance verifying the minimum coverage limits of $1 million per claim and $1 million aggregate.

C. Design of the precast modular block retaining wall shall satisfy the requirements of this section. Where local design or building code requirements exceed these specifications, the local requirements shall also be satisfied.

D. The Retaining Wall Design Engineer shall note any exceptions to the requirements of this section by listing them at the bottom right corner of the first page of the construction shop drawings.

E. Approval or rejection of the exceptions taken by the Retaining Wall Engineer will be made in writing as directed by the Owner.

F. The precast modular block design, except as noted herein, shall be based upon AASHTO Load and Resistance Factor Design (LRFD) methodology as referenced in paragraph 1.03, subparagraph C.1.

G. In the event that a conflict is discovered between these specifications and a reasonable interpretation of the design specifications and methods referenced in paragraph F above, these specifications shall prevail. If a reasonable interpretation is not possible, the conflict shall be resolved per the requirements in paragraph 1.03, subparagraph A of this section.

H. Soil Shear Parameters. The Retaining Wall Design Engineer shall prepare the construction shop drawings based upon soil shear strength parameters from the available project data and the recommendations of the project Geotechnical Engineer. If insufficient data exists to develop the retaining wall design, the Retaining Wall Design Engineer shall communicate the specific deficiency of the project information or data to the Owner in writing.

I. Allowable bearing pressure requirements for each retaining wall shall be clearly shown on the construction drawings.

J. Global Stability. Overall (global) stability shall be evaluated in accordance with the principals of limit equilibrium analysis as set forth in FHWA-NHI-10-024 Volume I and FHWA-NHI-10-025 Volume II GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes as referenced in paragraph 1.03, subparagraph C.1. The minimum factors of safety shall be as follows:

Normal Service (Static)	1.4
Seismic	1.1
Rapid Drawdown (if applicable)	1.2

K. Seismic Stability. Seismic loading shall be evaluated in accordance with AASHTO Load and Resistance Factor Design (LRFD) methodology as referenced in paragraph 1.03, subparagraph C.1.

1.06 QUALITY ASSURANCE

A. Retaining Wall Installation Contractor Qualifications. In order to demonstrate basic competence in the construction of precast modular block walls, the Retaining Wall Installation Contractor shall document compliance with the following:

1. Experience.

    a. Construction experience with a minimum of 30,000 square feet (2,800 square meters) of the proposed precast modular block retaining wall system.

    b. Construction of at least ten (10) precast modular block (large block) retaining wall structures within the past three (3) years.

    c. Construction of at least 50,000 square feet (4,650 square meters) of precast modular block (large block) retaining walls within the past three (3) years.

2. Retaining Wall Installation Contractor experience documentation for each qualifying project shall include:

    a. Project name and location

    b. Date (month and year) of construction completion

c. Contact information of Owner or General Contractor

d. Type (trade name) of precast modular block system built

e. Maximum height of the wall constructed

f. Face area of the wall constructed

3. In lieu of the requirements set forth in items 1 and 2 above, the Retaining Wall Installation Contractor must be a certified Precast Modular Block Retaining Wall Installation Contractor as demonstrated by satisfactory completion of a certified precast modular block retaining wall installation training program administered by the precast modular block manufacturer.

B. Retaining Wall Design Engineer Qualifications and Statement of Experience. The Retaining Wall Design Engineer shall submit a written statement affirming that he or she has the following minimum qualifications and experience.

1. The Retaining Wall Design Engineer shall be licensed to practice in the jurisdiction of the project location.

2. The Retaining Wall Design Engineer shall be independently capable of performing all internal and external stability analyses, including those for seismic loading, compound stability, rapid draw-down and deep-seated, global modes of failure.

3. The Retaining Wall Design Engineer shall affirm in writing that he or she has personally supervised the design of the retaining walls for the project, that the design considers all the requirements listed in paragraph 1.06 and that he or she accepts responsibility as the design engineer of record for the retaining walls constructed on the project.

4. The Retaining Wall Design Engineer shall affirm in writing that he or she has personally designed in excess of 100,000 face square feet (9,000 face square meters) of modular block earth retaining walls within the previous three (3) years.

5. In lieu of these specific requirements, the engineer may submit alternate documentation demonstrating competency in Precast Modular Block retaining wall design.

C. The Owner reserves the right to reject the design services of any engineer or engineering firm who, in the sole opinion of the Owner, does not possess the requisite experience or qualifications.

1.07 QUALITY CONTROL

A. The Owner’s Representative shall review all submittals for materials, design, Retaining Wall Design Engineer qualifications and the Retaining Wall Installation Contractor qualifications.

B. The General Contractor shall retain the services of an Inspection Engineer who is experienced with the construction of precast modular block retaining wall structures to perform inspection and testing. The cost of inspection shall be the responsibility of the

General Contractor. Inspection shall be continuous throughout the construction of the retaining walls.

C. The Inspection Engineer shall perform the following duties:

1. Inspect the construction of the precast modular block structure for conformance with construction shop drawings and the requirements of this specification.
2. Verify that soil or aggregate fill placed and compacted in the reinforced, retained and foundation zones of the retaining wall conforms with paragraphs 2.04 and 2.05 of this section and exhibits the shear strength parameters specified by the Retaining Wall Design Engineer.
3. Verify that the shear strength of the in-situ soil assumed by the Retaining Wall Design Engineer is appropriate.
4. Inspect and document soil compaction in accordance with these specifications:
    a. Required dry unit weight
    b. Actual dry unit weight
    c. Allowable moisture content
    d. Actual moisture content
    e. Pass/fail assessment
    f. Test location – wall station number
    g. Test elevation
    h. Distance of test location behind the wall face
5. Verify that all excavated slopes in the vicinity of the retaining wall are bench-cut as directed by the project Geotechnical Engineer.
6. Notify the Retaining Wall Installation Contractor of any deficiencies in the retaining wall construction and provide the Retaining Wall Installation Contractor a reasonable opportunity to correct the deficiency.
7. Notify the General Contractor, Owner and Retaining Wall Design Engineer of any construction deficiencies that have not been corrected timely.
8. Document all inspection results.
9. Test compacted density and moisture content of the retained backfill with the following frequency:
    a. At least once every 1,000 square feet (90 square meters) (in plan) per 9-inch (230 mm) vertical lift, and
    b. At least once per every 18 inches (460 mm) of vertical wall construction.

D. The General Contractor’s engagement of the Inspection Engineer does not relieve the Retaining Wall Installation Contractor of responsibility to construct the proposed retaining wall in accordance with the approved construction shop drawings and these

specifications.

E. The Retaining Wall Installation Contractor shall inspect the on-site grades and excavations prior to construction and notify the Retaining Wall Design Engineer and General Contractor if on-site conditions differ from the elevations and grading conditions depicted in the retaining wall construction shop drawings.

1.08 DELIVERY, STORAGE AND HANDLING

A. The Retaining Wall Installation Contractor shall inspect the materials upon delivery to ensure that the proper type, grade and color of materials have been delivered.

B. The Retaining Wall Installation Contractor shall store and handle all materials in accordance with the manufacturer's recommendations as specified herein and in a manner that prevents deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure or other causes. Damaged materials shall not be incorporated into the work.

C. Geosynthetics

1. All geosynthetic materials shall be handled in accordance with ASTM D4873. The materials should be stored off the ground and protected from precipitation, sunlight, dirt and physical damage.

D. Precast Modular Blocks

1. Precast modular blocks shall be stored in an area with positive drainage away from the blocks. Be careful to protect the block from mud and excessive chipping and breakage. Precast modular blocks shall not be stacked more than three (3) units high in the storage area.

E. Drainage Aggregate and Backfill Stockpiles

1. Drainage aggregate or backfill material shall not be piled over unstable slopes or areas of the project site with buried utilities.

2. Drainage aggregate and/or reinforced fill material shall not be staged where it may become mixed with or contaminated by poor draining fine-grained soils such as clay or silt.

PART 2 - MATERIALS

2.01 PRECAST MODULAR BLOCK RETAINING WALL UNITS

A. All units shall be wet-cast precast modular retaining wall units conforming to ASTM C1776.

B. All units for the project shall be obtained from the same manufacturer. The manufacturer shall be licensed and authorized to produce the retaining wall units by the precast modular block system patent holder/licensor and shall document compliance with the published quality control standards of the proprietary precast modular block system licensor for the previous three (3) years or the total time the manufacturer has been licensed, whichever is less.

C. Concrete used in the production of the precast modular block units shall be first-purpose, fresh concrete. It shall not consist of returned, reconstituted, surplus or waste concrete. It shall be an original production mix meeting the requirements of ASTM C94 and exhibit the properties as shown in the following table:

Concrete Mix Properties

Freeze Thaw Exposure Class(1)	**Minimum 28-Day Compressive Strength(2)**	**Maximum Water Cement Ratio**	**Nominal Maximum Aggregate Size**	**Aggregate Class Designation(3)**	**Air Content(4)**
Moderate	4,000 psi (27.6 MPa)	0.45	1 inch (25 mm)	3M	4.5% +/- 1.5%
Severe	4,000 psi (27.6 MPa)	0.45	1 inch (25 mm)	3S	6.0% +/- 1.5%
Very Severe	4,500 psi (30.0 MPa)	0.40	1 inch (25 mm)	4S	6.0% +/- 1.5%
Maximum Water-Soluble Chloride Ion (Cl-) Content in Concrete, Percent by Weight of Cement(5,6)					0.15
Maximum Chloride as Cl- Concentration in Mixing Water, Parts Per Million					1000
Maximum Percentage of Total Cementitious Materials By Weight (7,9) (Very Severe Exposure Class Only):					
Fly Ash or Other Pozzolans Conforming to ASTM C618					25
Slag Conforming to ASTM C989					50
Silica Fume Conforming to ASTM C1240					10
Total of Fly Ash or Other Pozzolans, Slag, and Silica Fume(8)					50
Total of Fly Ash or Other Pozzolans and Silica Fume(8)					35
Alkali-Aggregate Reactivity Mitigation per ACI 201					
Slump (Conventional Concrete) per ASTM C143(10)			5 inches +/- 1½ inches (125 mm +/- 40 mm)		
Slump Flow (Self-Consolidating Concrete) per ASTM C1611			18 inches – 32 inches (450 mm – 800 mm)		

(1)Exposure class is as described in ACI 318. "Moderate" describes concrete that is exposed to freezing and thawing cycles and occasional exposure to moisture. "Severe" describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture. "Very Severe" describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture and exposed to deicing chemicals. Exposure class should be specified by owner/purchaser prior to order placement.

(2)Test method ASTM C39.

(3)Defined in ASTM C33 Table 3 Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregates for Concrete.

(4)Test method ASTM C231.

(5)Test method ASTM C1218 at age between 28 and 42 days.

(6)Where used in high sulfate environments or where alkali-silica reactivity is an issue, water soluble chloride shall be limited to no more than trace amounts (from impurities in concrete-making components, not intended constituents.)

(7)The total cementitious material also includes ASTM C150, C595, C845, C1157 cement. The maximum percentages shall include:

(a)Fly ash or other pozzolans in type IP, blended cement, ASTM C595, or ASTM C1157.

(b)Slag used in the manufacture of an IS blended cement, ASTM C595, or ASTM C1157.

(c)Silica fume, ASTM C1240, present in a blended cement.

(8)Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.

(9)Prescriptive limits shown may be waived for concrete mixes that demonstrate excellent freeze/thaw durability in a detailed and current testing program.

(10)Slump may be increased by a high-range water-reducing admixture.

D. Each concrete block shall be cast in a single continuous pour without cold joints. With the exception of half-block units, corner units and other special application units, the precast modular block units shall conform to the nominal dimensions listed in the table below and be produced to the dimensional tolerances shown.

Block Type	Dimension	Nominal Value	Tolerance
28” (710 mm) Block	Height	18” (457 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	28” (710 mm)	+/- 1/2” (13 mm)
41” (1030 mm) Block	Height	18” (457 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	40-1/2” (1030 mm)	+/- 1/2” (13 mm)
60” (1520 mm) Block	Height	18” (457 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	60” (1520 mm)	+/- 1/2” (13 mm)

* Block tolerance measurements shall exclude variable face texture

E. Individual block units shall have a nominal height of 18 inches (457 mm).

F. With the exception of half-block units, corner units and other special application units, the precast modular block units shall have two (2), circular dome shear knobs that are 10 inches (254 mm), 7.5 inches (190 mm), or 6.75 inches (171 mm) in diameter and 4 inches (102 mm) or 2 inches (51 mm) in height. The shear knobs shall fully index into a continuous semi-cylindrical shear channel in the bottom of the block course above. ThePeak interlock shear between any two (2) vertically stacked precast modular block units, with 10 inch (254 mm) diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 6,500 lb/ft (95 kN/m) at a minimum normal load of 500 lb/ft (7kN/m). as well as an ultimate peak interface shear capacity in excess of 11,000 lb/ft (160 kN/m). The peak interlock shear between any two (2) vertically stacked precast modular block units, with 7.5 inch (190 mm) or 6.75 inch (171 mm) diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 1,850 lb/ft (27 kN/m) at a minimum normal load of 500 lb/ft (7kN/m) as well as an ultimate peak interface shear capacity in excess of 10,000 lb/ft (146 kN/m).Test specimen blocks tested under ASTM D6916 shall be actual, full-scale production blocks of known compressive strength. The interface shear capacity reported shall be corrected for a 4,000 psi (27.6 MPa) concrete compressive strength. Regardless of precast modular block configuration, interface shear testing shall be completed without the inclusion of unit core infill aggregate.

G. The 28” (710 mm) and 41" (1030 mm) precast modular block units shall be cast with a

13” (330 mm) wide, continuous vertical core slot that will permit the insertion of a 12″ (305 mm) inch wide strip of geogrid reinforcement to pass completely through the block. When installed in this manner, the geogrid reinforcement shall form a non-normal load dependent, positive connection between the block unit and the reinforcement strip. The use of steel for the purposes of creating the geogrid to block connection is not acceptable.

H. Without field cutting or special modification, the precast modular block units shall be capable of achieving a minimum radius of 14 ft 6 in (4.42 m).

I. The precast modular block units shall be manufactured with an integrally cast shear knobs that establishes a standard horizontal set-back for subsequent block courses. The precast modular block system shall be available in the four (4) standard horizontal set-back facing batter options listed below:

Horizontal Set-Back/Blk. Course	**Max. Facing Batter**
3/8” (10 mm)	1.2˚
1-5/8” (41 mm)	5.2˚
9-3/8” (238 mm)	27.5˚
16-5/8” (422 mm)	42.7˚

The precast modular block units shall be furnished with the required shear knobs that provide the facing batter required in the construction shop drawings.

J. The precast modular block unit face texture shall be selected by the owner from the available range of textures available from the precast modular block manufacturer. Each textured block facing unit shall be a minimum of 5.76 square feet (0.54 square meters) with a unique texture pattern that repeats with a maximum frequency of once in any 15 square feet (1.4 square meters) of wall face.

K. The block color shall be selected by the owner from the available range of colors available from the precast modular block manufacturer.

L. All precast modular block units shall be sound and free of cracks or other defects that would interfere with the proper installation of the unit, impair the strength or performance of the constructed wall. PMB units to be used in exposed wall construction shall not exhibit chips or cracks in the exposed face or faces of the unit that are not otherwise permitted. Chips smaller than 1.5” (38 mm) in its largest dimension and cracks not wider than 0.012” (0.3 mm) and not longer than 25% of the nominal height of the PMB unit shall be permitted. PMB units with bug holes in the exposed architectural face smaller than 0.75” (19 mm) in its largest dimension shall be permitted. Bug holes, water marks, and color variation on non-architectural faces are acceptable. PMB units that exhibit cracks that are continuous through any solid element of the PMB unit shall not be incorporated in the work regardless of the width or length of the crack.

M. Preapproved Manufacturers.

1. Manufacturers of Redi-Rock Retaining Wall Systems as licensed by Redi-Rock International, LLC, 05481 US 31 South, Charlevoix, MI 49720 USA; telephone

(866) 222-8400; website www.redi-rock.com.

N. Substitutions. Technical information demonstrating conformance with the requirements of this specification for an alternative precast modular block retaining wall system must be submitted for preapproval at least 14 calendar days prior to the bid date. Acceptable alternative PMB retaining wall systems, otherwise found to be in conformance with this specification, shall be approved in writing by the owner 7 days prior to the bid date. The Owner's Representative reserves the right to provide no response to submissions made out of the time requirements of this section or to submissions of block retaining wall systems that are determined to be unacceptable to the owner.

O. Value Engineering Alternatives. The owner may evaluate and accept systems that meet the requirements of this specification after the bid date that provide a minimum cost savings of 20% to the Owner. Construction expediency will not be considered as a contributing portion of the cost savings total.

2.02 GEOGRID REINFORCEMENT

A. Geogrid reinforcement shall be a woven or knitted PVC coated geogrid manufactured from high-tenacity PET polyester fiber with an average molecular weight greater than 25,000 (Mn > 25,0000) and a carboxyl end group less than 30 (CEG < 30). The geogrid shall be furnished in prefabricated roll widths of certified tensile strength by the manufacturer. The prefabricated roll width of the geogrid shall be 12" (300 mm) +/- 1/2" (13 mm). No cutting of geogrid reinforcement down to the 12" (300 mm) roll width from a larger commercial roll width will be allowed under any circumstances.

B. The ultimate tensile strength (Tult) of the geogrid reinforcement shall be measured in accordance with ASTM D6637.

C. Geogrid – Soil Friction Properties

1. Friction factor, F*, shall be equal to 2/3 Tan ϕ, where ϕ is the effective angle of internal friction of the reinforced fill soil.

2. Linear Scale Correction Factor, α, shall equal 0.8.

D. Long-Term Tensile Strength (Tal) of the geogrid reinforcement shall be calculated in accordance with Section 3.5.2 of FHWA-NHI-10-024 and as provided in this specification.

1. The creep reduction factor (RFCR) shall be determined in accordance with Appendix D of FHWA-NHI-10-025 for a minimum 75 year design life.

2. Minimum installation damage reduction factor (RFID) shall be 1.25. The value of RFID shall be based upon documented full-scale tests in a soil that is comparable to the material proposed for use as reinforced backfill in accordance with ASTM D5818.

3. Minimum durability reduction factor (RFD) shall be 1.3 for a soil pH range of 3 to 9.

E. Connection between the PMB retaining wall unit and the geogrid reinforcement shall be determined from short-term testing per the requirements of FHWA NHI-10-025,

Appendix B.4 for a minimum 75-year design life.

F. The minimum value of Tal for geogrid used in design of a reinforced precast modular block retaining wall shall be 2,000 lb/ft (29 kN/m) or greater.

G. The minimum length of geogrid reinforcement shall be the greater of the following:

1. 0.7 times the wall design height, H.
2. 6 feet (1.83 m).
3. The length required by design to meet internal stability requirements, soil bearing pressure requirements and constructability requirements.

H. Constructability Requirements. Geogrid design embedment length shall be measured from the back of the precast modular block facing unit and shall be consistent for the entire height of a given retaining wall section.

I. Geogrid shall be positively connected to every precast modular block unit. Design coverage ratio, Rc, as calculated in accordance with AASHTO LRFD Bridge Design Specifications Figure 11.10.6.4.1-2 shall not exceed 0.50.

J. Preapproved Geogrid Reinforcement Products.

1. Miragrid XT Geogrids as manufactured by TenCate Geosynthetics of Pendergrass, Georgia USA and distributed by Manufacturers of the Redi-Rock Retaining Wall System.

K. Substitutions. No substitutions of geogrid reinforcement products shall be allowed.

2.03 GEOTEXTILE

A. Nonwoven geotextile fabric shall be placed as indicated on the retaining wall construction shop drawings. Additionally, the nonwoven geotextile fabric shall be placed in the v-shaped joint between adjacent block units on the same course. The nonwoven geotextile fabric shall meet the requirements Class 3 construction survivability in accordance with AASHTO M 288.

B. Preapproved Nonwoven Geotextile Products

1. Mirafi 140N
2. Propex Geotex 451
3. Skaps GT-142
4. Thrace-Linq 140EX
5. Carthage Mills FX-40HS
6. Stratatex ST 142

2.04 DRAINAGE AGGREGATE AND WALL INFILL

A. Drainage aggregate (and wall infill for retaining walls designed as modular gravity

structures) shall be a durable crushed stone conforming to No. 57 size per ASTM C33 with the following particle-size distribution requirements per ASTM D422:

U.S. Standard Sieve Size	% Passing
1-½" (38 mm)	100
1" (25 mm)	95-100
½" (13 mm)	25-60
No. 4 (4.76 mm)	0-10
No. 8 (2.38 mm)	0-5

2.05 REINFORCED FILL

A. Material used as reinforced backfill material in the reinforced zone (if applicable) shall be a granular fill material meeting the requirements of USCS soil type GW, GP, SW or SP per ASTM D2487 or alternatively by AASHTO Group Classification A-1-a or A-3 per AASHTO M 145. The backfill shall exhibit a minimum effective internal angle of friction, ϕ = 34 degrees at a maximum 2% shear strain and meet the following particle-size distribution requirements per ASTM D422.

U.S. Standard Sieve Size	% Passing
3/4" (19 mm)	100
No. 4 (4.76 mm)	0-100
No. 40 (0.42 mm)	0-60
No. 100 (0.15 mm)	0-10
No. 200 (0.07 mm)	0-15

B. The reinforced backfill material shall be free of sod, peat, roots or other organic or deleterious matter including, but not limited to, ice, snow or frozen soils. Materials passing the No. 40 (0.42 mm) sieve shall have a liquid limit less than 25 and plasticity index less than 6 per ASTM D4318. Organic content in the backfill material shall be less than 1% per AASHTO T-267 and the pH of the backfill material shall be between 5 and 8.

C. Soundness. The reinforced backfill material shall exhibit a magnesium sulfate soundness loss of less than 30% after four (4) cycles, or sodium sulfate soundness loss of less than 15% after five (5) cycles as measured in accordance with AASHTO T-104.

D. Reinforced backfill shall not be comprised of crushed or recycled concrete, recycled asphalt, bottom ash, shale or any other material that may degrade, creep or experience a loss in shear strength or a change in pH over time.

2.06 LEVELING PAD

A. The precast modular block units shall be placed on a leveling pad constructed from crushed stone or unreinforced concrete. The leveling pad shall be constructed to the dimensions and limits shown on the retaining wall design drawings prepared by the Retaining Wall Design Engineer.

B. Crushed stone used for construction of a granular leveling pad shall meet the requirements of the drainage aggregate and wall infill in section 2.04 or a preapproved alternate material.

C. Concrete used for construction of an unreinforced concrete leveling pad shall satisfy the criteria for AASHTO Class B. The concrete should be cured a minimum of 12 hours prior to placement of the precast modular block wall retaining units and exhibit a minimum 28-day compressive strength of 2,500 psi (17.2 MPa).

2.07 DRAINAGE

A. Drainage Pipe

1. Drainage collection pipe shall be a 4" (100 mm) diameter, 3-hole perforated, HDPE pipe with a minimum pipe stiffness of 22 psi (152 kPa) per ASTM D2412.

2. The drainage pipe shall be manufactured in accordance with ASTM D1248 for HDPE pipe and fittings.

B. Preapproved Drainage Pipe Products

1. ADS 3000 Triple Wall pipe as manufactured by Advanced Drainage Systems.

PART 3 - EXECUTION

3.01 GENERAL

A. All work shall be performed in accordance with OSHA safety standards, state and local building codes and manufacturer's requirements.

B. The General Contractor is responsible for the location and protection of all existing underground utilities. Any new utilities proposed for installation in the vicinity of the retaining wall, shall be installed concurrent with retaining wall construction. The General Contractor shall coordinate the work of subcontractors affected by this requirement.

C. New utilities installed below the retaining wall shall be backfilled and compacted to a minimum of 98% maximum dry density per ASTM D698 standard proctor.

D. The General Contractor is responsible to ensure that safe excavations and embankments are maintained throughout the course of the project.

E. All work shall be inspected by the Inspection Engineer as directed by the Owner.

3.02 EXAMINATION

A. Prior to construction, the General Contractor, Grading Contractor, Retaining Wall Installation Contractor and Inspection Engineer shall examine the areas in which the retaining wall will be constructed to evaluate compliance with the requirements for installation tolerances, worker safety and any site conditions affecting performance of the completed structure. Installation shall proceed only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

A. Fill Soil.

1. The Inspection Engineer shall verify that reinforced backfill placed in the reinforced soil zone satisfies the criteria of this section.

2. The Inspection Engineer shall verify that any fill soil installed in the foundation and retained soil zones of the retaining wall satisfies the specification of the Retaining Wall Design Engineer as shown on the construction drawings.

B. Excavation.

1. The Grading Contractor shall excavate to the lines and grades required for construction of the precast modular block retaining wall as shown on the construction drawings. The Grading Contractor shall minimize over-excavation. Excavation support, if required, shall be the responsibility of the Grading Contractor.

2. Over-excavated soil shall be replaced with compacted fill in conformance with the specifications of the Retaining Wall Design Engineer and "Division 31, Section 31 20 00 – Earthmoving" of these project specifications.

3. Embankment excavations shall be bench cut as directed by the project Geotechnical Engineer and inspected by the Inspection Engineer for compliance.

C. Foundation Preparation.

1. Prior to construction of the precast modular block retaining wall, the leveling pad area and undercut zone (if applicable) shall be cleared and grubbed. All topsoil, brush, frozen soil and organic material shall be removed. Additional foundation soils found to be unsatisfactory beyond the specified undercut limits shall be undercut and replaced with approved fill as directed by the project Geotechnical Engineer. The Inspection Engineer shall ensure that the undercut limits are consistent with the requirements of the project Geotechnical Engineer and that all soil fill material is properly compacted according project specifications. The Inspection Engineer shall document the volume of undercut and replacement.

2. Following excavation for the leveling pad and undercut zone (if applicable), the Inspection Engineer shall evaluate the in-situ soil in the foundation and retained soil zones.

   a. The Inspection Engineer shall verify that the shear strength of the in-situ soil assumed by the Retaining Wall Design Engineer is appropriate. The Inspection Engineer shall immediately stop work and notify the Owner if the in-situ shear strength is found to be inconsistent with the retaining wall design assumptions.

   b. The Inspection Engineer shall verify that the foundation soil exhibits sufficient ultimate bearing capacity to satisfy the requirements indicated on the retaining wall construction shop drawings per paragraph 1.06 I of this section.

D. Leveling Pad.

1. The leveling pad shall be constructed to provide a level, hard surface on which to place the first course of precast modular block units. The leveling pad shall be placed in the dimensions shown on the retaining wall construction drawings and extend to the limits indicated.

2. Crushed Stone Leveling Pad. Crushed stone shall be placed in uniform maximum

lifts of 6” (150 mm). The crushed stone shall be compacted by a minimum of 3 passes of a vibratory compactor capable of exerting 2,000 lb (8.9 kN) of centrifugal force and to the satisfaction of the Inspection Engineer.

3. Unreinforced Concrete Leveling Pad. The concrete shall be placed in the same dimensions as those required for the crushed stone leveling pad. The Retaining Wall Installation Contractor shall erect proper forms as required to ensure the accurate placement of the concrete leveling pad according to the retaining wall construction drawings.

3.04 PRECAST MODULAR BLOCK WALL SYSTEM INSTALLATION

A. The precast modular block structure shall be constructed in accordance with the construction drawings, these specifications and the recommendations of the retaining wall system component manufacturers. Where conflicts exist between the manufacturer’s recommendations and these specifications, these specifications shall prevail.

B. Drainage components. Pipe, geotextile and drainage aggregate shall be installed as shown on the construction shop drawings.

C. Precast Modular Block Installation

1. The first course of block units shall be placed with the front face edges tightly abutted together on the prepared leveling pad at the locations and elevations shown on the construction drawings. The Retaining Wall Installation Contractor shall take special care to ensure that the bottom course of block units are in full contact with the leveling pad, are set level and true and are properly aligned according to the locations shown on the construction drawings.

2. Backfill shall be placed in front of the bottom course of blocks prior to placement of subsequent block courses. Nonwoven geotextile fabric shall be placed in the V-shaped joints between adjacent blocks. Drainage aggregate shall be placed in the V-shaped joints between adjacent blocks to a minimum distance of 12” (300 mm) behind the block unit.

3. Drainage aggregate shall be placed in 9 inch maximum lifts and compacted by a minimum of three (3) passes of a vibratory plate compactor capable exerting a minimum of 2,000 lb (8.9 kN) of centrifugal force.

4. Unit core fill shall be placed in the precast modular block unit vertical core slot. The core fill shall completely fill the slot to the level of the top of the block unit. The top of the block unit shall be broom-cleaned prior to placement of subsequent block courses. No additional courses of precast modular blocks may be stacked before the unit core fill is installed in the blocks on the course below.

5. Base course blocks for gravity wall designs (without geosynthetic soil reinforcement) may be furnished without vertical core slots. If so, disregard item 4 above, for the base course blocks in this application.

6. Nonwoven geotextile fabric shall be placed between the drainage aggregate and the

retained soil (gravity wall design) or between the drainage aggregate and the reinforced fill (reinforced wall design) as required on the retaining wall construction drawings.

7. Subsequent courses of block units shall be installed with a running bond (half block horizontal course-to-course offset). With the exception of 90 degree corner units, the shear channel of the upper block shall be fully engaged with the shear knobs of the block course below. The upper block course shall be pushed forward to fully engage the interface shear key between the blocks and to ensure consistent face batter and wall alignment. Geogrid, drainage aggregate, unit core fill, geotextile and properly compacted backfill shall be complete and in-place for each course of block units before the next course of blocks is stacked.
8. The elevation of retained soil fill shall not be less than 1 block course (18" (457 mm)) below the elevation of the reinforced backfill throughout the construction of the retaining wall.
9. If included as part of the precast modular block wall design, cap units shall be secured with an adhesive in accordance with the precast modular block manufacturer's recommendation.

D. Geogrid Reinforcement Installation (if required)

1. Geogrid reinforcement shall be installed at the locations and elevations shown on the construction drawings on level fill compacted to the requirements of this specification.
2. Continuous 12" (300 mm) wide strips of geogrid reinforcement shall be passed completely through the vertical core slot of the precast modular block unit and extended to the embedment length shown on the construction plans. The strips shall be staked or anchored as necessary to maintain a taut condition.
3. Reinforcement length (L) of the geogrid reinforcement is measured from the back of the precast modular block unit. The cut length (Lc) is two times the reinforcement length plus additional length through the block facing unit. The cut length is calculated as follows:

   Lc = 2*L + 3 ft (2*L + 0.9 m) (28" (710 mm) block unit)
   Lc = 2*L + 5 ft (2*L + 1.5 m) (41" (1030 mm) block unit)
4. The geogrid strip shall be continuous throughout its entire length and may not be spliced. The geogrid shall be furnished in nominal, prefabricated roll widths of 12" (300 mm)+/- ½" (13 mm). No field modification of the geogrid roll width shall be permitted.
5. Neither rubber tire nor track vehicles may operate directly on the geogrid. Construction vehicle traffic in the reinforced zone shall be limited to speeds of less than 5 mph (8 km/hr) once a minimum of 9 inches (230 mm) of compacted fill has been placed over the geogrid reinforcement. Sudden braking and turning of construction vehicles in the reinforced zone shall be avoided.

E. Construction Tolerance. Allowable construction tolerance of the retaining wall shall be as follows:

1. Deviation from the design batter and horizontal alignment, when measured along a 10’ (3 m) straight wall section, shall not exceed 3/4” (19 mm).
2. Deviation from the overall design batter shall not exceed 1/2” (13 mm) per 10’ (3 m) of wall height.
3. The maximum allowable offset (horizontal bulge) of the face in any precast modular block joint shall be 1/2” (13 mm).
4. The base of the precast modular block wall excavation shall be within 2” (50 mm) of the staked elevations, unless otherwise approved by the Inspection Engineer.
5. Differential vertical settlement of the face shall not exceed 1’ (300 mm) along any 200’ (61 m) of wall length.
6. The maximum allowable vertical displacement of the face in any precast modular block joint shall be 1/2” (13 mm).
7. The wall face shall be placed within 2” (50 mm) of the horizontal location staked.

3.05 WALL INFILL AND REINFORCED BACKFILL PLACEMENT

A. Backfill material placed immediately behind the drainage aggregate shall be compacted as follows:

1. 98% of maximum dry density at ± 2% optimum moisture content per ASTM D698 standard proctor or 85% relative density per ASTM D4254.

B. Compactive effort within 3’ (0.9 m) of the back of the precast modular blocks should be accomplished with walk-behind compactors. Compaction in this zone shall be within 95% of maximum dry density as measured in accordance with ASTM D698 standard proctor or 80% relative density per ASTM D 4254. Heavy equipment should not be operated within 3’ (0.9 m) of the back of the precast modular blocks.

C. Backfill material shall be installed in lifts that do not exceed a compacted thickness of 9” (230 mm).

D. At the end of each work day, the Retaining Wall Installation Contractor shall grade the surface of the last lift of the granular wall infill to a 3% ± 1% slope away from the precast modular block wall face and compact it.

E. The General Contractor shall direct the Grading Contractor to protect the precast modular block wall structure against surface water runoff at all times through the use of berms, diversion ditches, silt fence, temporary drains and/or any other necessary measures to prevent soil staining of the wall face, scour of the retaining wall foundation or erosion of the reinforced backfill or wall infill.

3.06 OBSTRUCTIONS IN THE INFILL AND REINFORCED FILL ZONE

A. The Retaining Wall Installation Contractor shall make all required allowances for obstructions behind and through the wall face in accordance with the approved

construction shop drawings.

B. Should unplanned obstructions become apparent for which the approved construction shop drawings do not account, the affected portion of the wall shall not be constructed until the Retaining Wall Design Engineer can appropriately address the required procedures for construction of the wall section in question.

3.07 COMPLETION

A. For walls supporting unpaved areas, a minimum of 12” (300 mm) of compacted, low-permeability fill shall be placed over the granular wall infill zone of the precast modular block retaining wall structure. The adjacent retained soil shall be graded to prevent ponding of water behind the completed retaining wall.

B. For retaining walls with crest slopes of 5H:1V or steeper, silt fence shall be installed along the wall crest immediately following construction. Silt fence shall be located 3’ to 4’ (0.9 m to 1.2 m) behind the uppermost precast modular block unit. The crest slope above the wall shall be immediately seeded to establish vegetation. The General Contractor shall ensure that the seeded slope receives adequate irrigation and erosion protection to support germination and growth.

C. The General Contractor shall confirm that the as-built precast modular block wall geometries conform to the requirements of this section. The General Contractor shall notify the Owner of any deviations.

END OF SECTION 32 32 16

SECTION 32 80 00
IRRIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of the irrigation system, complete as shown on the drawings and as specified herein.

B. Section Includes:

1. Piping
2. Manual valves
3. Automatic control valves
4. Master control valves
5. Flow sensors
6. Transition fittings
7. Miscellaneous piping specialties
8. Sprinklers
9. Drip irrigation specialties
10. Automatic controllers
11. Automatic controller accessories
12. Controller decoders
13. Electrical control wiring
14. Valve boxes and materials
15. Main line accessories
16. Backflow prevention device

1.02 CONTRACT DOCUMENTS

A. Shall consist of specifications, general conditions, and the drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

1.03 RELATED DOCUMENTS AND REFERENCES

A. Drawings and general provisions of the Contract, including General Conditions and Supplementary Conditions apply to this Section.

B. Related Sections:

1. Section 31 14 13 – Soil Stripping and Stockpiling
2. Section 32 90 00 - Landscaping
3. Section 32 92 19 - Seeding
4. Section 32 97 00 – Restoration of Disturbed Areas
5. Division 26 - Electrical Specifications

1.04 SUBSTITUTIONS

A. Refer to General Conditions for regarding “Or Approved Equal” Items

B. “Or approved equal” means that the contractor may propose alternates for certain items, with justification for such alterations, including possible reductions in cost. All cost reductions derived from these changes shall be credited to the end user of the project.

C. Proprietary materials and equipment found herein have been specified for optimal performance of the irrigation system. Available manufacturers are listed, but not limited to those listed in these specifications. “Or Approved Equal” items shall meet the specifications and performance requirements per plans, schedules and details. All material and equipment substitution requests shall be approved by the Owner’s Representative.

D. Approval of substitution of material and/or products, other than those specified shall not relieve the Contractor from complying with the requirements of the contract documents and specifications. The Contractor shall be responsible, at their own expense, for all changes that may result from the approved substitutions, which affect the installation or operations other items of their own work and/or the work of other Contractors.

1.05 VERIFICATION

A. Irrigation piping and related equipment are drawn diagrammatically. Scaled dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions and immediately notify the Owner’s Representative of discrepancies between the drawings or specifications and the actual conditions. Although sizes and locations of plants and or irrigation equipment are drawn to scale wherever possible, it is not within the scope of the drawings to show all necessary offsets, obstructions, or site conditions. The Contractor shall be responsible to install the work in such a manner that it will be in conformance to site conditions, complete, and in good working order.

B. Piping and equipment is to be located within the designated planting areas wherever possible unless specifically defined or dimensioned otherwise.

1.06 DEFINITIONS

A. Lateral Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.

C. Mainline Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

E. Owner's Representative: The person or entity, appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.

F. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Owner's Representative accepts that all work in these sections is complete and the Warranty period has begun. This date may be different that the date of substantial completion for the other sections of the project.

G. Final Acceptance: The date when the Owner's Representative accepts that the plants and work in this section meet all the requirements of specification. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrently.

1.07 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be automatic operation with controller and automatic control valves.

B. Location of Sprinklers and Specialties: Design location of valve boxes is approximate. Design and layout of lateral piping and zones to be determined by Contractor. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards.

C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: 200 psig.

2. Lateral Piping: 150 psig.

D. Each pressure zone shall be designed to deliver no more than 30 gallons per minute of non-potable water to the specified planting areas on the contract drawings.

1.08 SUBMITTALS

A. Refer to the contract Supplementary Conditions for policy and procedures related to submittals.

B. Irrigation Plan

1. Contractor shall submit a plan view map of each planting area with the following items indicated:

a. Location of valve box

b. Layout of valves within the valve box

c. Location of low voltage wire

d. Location of mainline piping

e. Location of lateral piping

f. Location and type of sprinkler head

i. Nozzle size (water demand)

g. Water demand calculations for each pressure zone (no zone shall exceed 30 gpm)

2. Contractor shall submit an As-Built map of the irrigation system with the following items indicated:

a. Location of valve box

b. Layout of valves within the valve box

c. Wiring schematic of valves to controller (ex: what color wire strand is what zone number within the controller program)

d. Location of low voltage wire

e. Location of mainline piping

f. Location of lateral piping

g. Location and type of sprinkler head

i. Nozzle size (water demand)

h. Water demand calculations for each pressure zone (no zone shall exceed 30 gpm)

C. Product Data

1. For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

a. This submission may be done digitally and all documents shall be submitted in one PDF document.

2. Clearly identify on each submitted sheet by underlining or highlighting (on each copy) the specific product being submitted for approval. No substitutions of material or procedures shall be made concerning these documents without the written consent of an accepted equivalent by the Owner's Representative.

3. Equipment or materials installed or furnished without prior approval of the Owner's Representative, may be rejected by the Owner's Representative and the Contractor shall be required to remove such materials from the site at their own expense.

D. Other Submittals: Submit for approval:

1. Qualification Data: For qualified Installer.

2. Field quality-control reports.

a. Static pressure reading at POC(s): Submit prior to installation of irrigation system.

b. Testing data from pressure testing

1.09 OBSERVATION OF THE WORK

A. The Owner’s Representative may inspect the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.

B. The Owner’s Representative shall be informed of the progress of the work so the work may be observed at the following key times in the construction process. The Owner’s Representative shall be afforded sufficient time to schedule visit to the site. Failure of the Owner’s Representative to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.

1. Equipment and sprinkler head layout review (stake of flag locations of equipment prior to trenching)
2. Trenching, directional boring, and sleeving review
3. Hydrostatic pressure testing
4. Adjustment and coverage test
5. Pre-maintenance observation
6. Final acceptance / system malfunction corrections

1.10 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Irrigation Installer whose work has resulted in successful irrigation system installation.

1. Experience: Five years experience in irrigation system installation in addition to requirements in Standard General Conditions and Supplementary Conditions.
2. Installer’s Field Supervision: Requires Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.11 WARRANTY

A. The Contractor shall warranty all workmanship and materials for a period of 24 months following the acceptance of the work.

B. Any parts of the irrigation work that fails or is defective shall be replaced or reconstructed at no expense to the Owner including but not limited to: restoring grades that have settled in trenches and excavations related to the work. Reconstruction shall include any plantings, soil, mulch or other parts of the constructed landscape that may be damaged during the repair or that results from soil settlement.

C. The date of acceptance of the work and start of the Warranty period shall be determined by the Owner's Representative, upon the finding that the entire irrigation system is installed as designed and specified, and found to be operating correctly, supplying water evenly to all planting and/or lawn areas.

D. Neither the final acceptance nor any provision in the contract documents shall relieve the Contractor of responsibility for faulty materials or workmanship. The Contractor shall remedy any defects within a period of 7 days (s) from the date of notification of a defect.

E. Provide extended warranty for period equal to original warranty period, for replaced irrigation material.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

C. Replacements

1. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

1.13 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner's Representative and Owner no fewer than two days in advance of proposed interruption of water service.

2. Do not proceed with interruption of water service without written permission from the Owner's Representative.

1.14 EQUIPMENT TO BE FURNISHED TO THE OWNER

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spray Sprinklers and Rotors: Equal to 10 percent of amount installed for each type and size indicated.

2. Emitters/Bubblers: Equal to 10 percent of amount installed for each type indicated.

1.15 EQUIPMENT TO BE FURNISHED TO OWNER

A. Two (2) sets of keys for each automatic controller

B. Two (2) sets of keys for backflow preventer cage

C. Three (3) sets of special tools required for removing, disassembling and adjusting each

type of sprinkler and valve supplied on this project

D. Five (5) Extra sprinkler heads, nozzles, shrub adapters, nozzle filter screens, for each type used on the project

E. Two (2) quick coupler keys to match manufacturer type of quick coupler

F. Drip-Tube System Tubing: Equal to 10 percent of total length installed for each type and size indicated

1.16 EXCAVATING AROUND UTILITIES

A. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.

B. Do not begin any excavation until all underground utilities have been located and marked. The Contractor is responsible for knowing the location and avoiding utilities that are not located by a locator.

C. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain stakes and or markings set by others until parties concerned mutually agree to their removal.

1.17 POINT OF CONNECTION

A. The point of connection of the irrigation system to its electrical power sources shall be provided by a licensed electrical Contractor per governing codes at the location shown on the drawings.

B. The irrigation Contractor (licensed or not as an electrical contractor) will connect the power to provided junction box or grounded plug receptacle.

C. The point of connection of the irrigation system to its non-potable water source, including the main shutoff valve and backflow preventer shall be provided by a licensed plumbing Contractor per governing codes at the location shown on the drawings. The minimum size and water pressure of the pressurized line will be as noted on the irrigation drawing.

1.18 AS BUILT RECORD SET OF DRAWINGS

A. Immediately upon the installation of any buried pipe or equipment, the Contractor shall indicate on the progress record drawings the locations of said pipe or equipment. The progress record drawings shall be made available at any time for review by the Owner's Representative.

B. Before final acceptance of work, the Contractor shall provide an as built record set of drawings showing the irrigation system work as built. The drawings shall be transmitted to the Owner's Representative in paper format and as a pdf file of each document on compact disk or flash drive. The drawings shall include all information shown on the original contract document and revised to reflect all changes in the work. The drawings shall include the following additional information

1. All valves shall be numbered by station and corresponding numbers shall be shown on the as built record set of drawings.

2. All main line pipe or irrigation equipment including sleeves, valves, controllers, irrigation wire runs which deviate from the mainline location, backflow preventers, remote control valves, grounding rods, shut-off valves, rain sensors, wire splice locations, and quick coupling valves shall be located by two (2) measured dimensions, to the nearest one-half foot. Dimensions shall be given from permanent objects such as buildings, sidewalks, curbs, walls, structures and driveways. All changes in direction and depth of main line pipe shall be noted exactly as installed.

C. As built record set of drawings shall be signed and dated by the Contractor attesting to and certifying the accuracy of the as built record set of drawings. As built record set of drawings shall have "As Built Record Set of Drawings", company name, address, phone number and the name of the person who created the drawing and the contact name (if different).

D. The Owner shall make the original contract drawing files available to the Contractor.

1.19 CONTROLLER CHARTS:

A. Provide one controller chart for each automatic controller installed.

B. On the inside surface of the cover of each automatic controller, prepare and mount a color- coded chart showing the valves, main line, and systems serviced by that particular controller. All valves shall be numbered to match the operation schedule and the drawings. Only those areas controlled by that controller shall be shown. This chart shall be a plot plan, entire or partial, showing building, walks, roads and walls. The plan, reduced as necessary and legible in all details, shall be made to a size that will fit into the controller cover. This print shall be approved by the Owner's Representative and shall be protected in laminated in a plastic cover and be secured to the inside back of the controller cabinet door.

C. The controller chart shall be completed and approved prior to acceptance of the work.

PART 2 - PRODUCTS

2.01 MATERIALS GENERAL

A. All materials shall be of standard, approved and first grade quality and shall be new and in perfect condition when installed and accepted.

B. Refer to the Irrigation Schedule on the drawings, or the specifications herein for specific components and manufacturers.

C. No substitutions without written authorization and approval from the Owner's representative.

D. Approval of any items or substitutions indicates only that the product(s) apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted. The Contractor shall be responsible for the performance of substituted items. If the substitution proves to be unsatisfactory or not compatible with other parts of the system, the Contractor shall replace said items with the originally specified items, including all necessary work and modifications to replace the items, at no cost to the

owner.

2.02 PIPING SCHEDULE & FITTINGS

A. Install components having pressure rating equal to or greater than system operating pressure.

B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.

C. Mainline Pipe shall be rigid unplasticized Schedule 40 PVC. Mainline Pipe shall be gasketed.

D. Lateral Pipe shall be butt- fused, socket-fused or Oetiker-clamped DR13.5 HDPE, conforming to ASTM D2239, ASTM D2737, ASTM D3035, ASTM D and AWWA C901 - standard specifications for Polyethylene pressure pipe and tubing. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, deleterions, wrinkles, and dents.

E. All pipe shall be continuously and permanently marked with the following information.

1. Manufacturer's name or trademark, size, schedule and type of pipe, working pressure At 73 degrees F. and National Sanitation Foundation (N.S.F.) approval.

F. Mainline Pipe from shall be a gasketed pipe. All Lateral Pipe shall be installed with butt-fused or mechanically-clamped pipe joints. Drip emitter line may be installed with barbed fittings of the same manufacturer.

2.03 PIPING JOINING MATERIALS

A. General

1. All plastic pipe fittings shall be permanently marked with the following information:

a. Manufacturer's name or trademark, size, schedule and type of pipe, working pressure at 73 degrees F. and National Sanitation Foundation (N.S.F.) approval.

2. All plastic pipe fittings to be installed shall be molded fittings manufactured of the same material as the pipe and shall be (individually) suitable for butt-fusing, mechanically-clamped, or Oetiker clamped connection.

3. All plastic pipe fittings shall provide the same pressure performance as the pipe itself. For the PVC Mainline Pipe, that shall be equivalent to Schedule 40, or 158 psi. maximum operating pressure. For the HDPE Lateral Pipe, that shall be 160 psi. maximum operating pressure.

4. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. If the joining method is the butt fusion method, it shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 500 Degrees F, alignment, and 150 psi interfacial fusion pressure. Butt fusion joining shall be 100% efficient offering a joint weld strength equal to or

greater than the tensile strength of the pipe. Socket fusion shall not be used. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications, nor in fabrications where shear or structural strength is important. Flanges, unions, grooved-couplers, transition fittings and some mechanical couplers may be used to mechanically connect HDPE pipe without butt fusion. Connection method shall be approved by the Engineer. Refer to the manufacturer's recommendations

5. Slip fitting socket taper shall be so sized that a dry unsoftened pipe end, conforming to these special provisions, can be inserted no more than halfway into the socket. Plastic flange fittings will not be permitted. Only schedule 80 fittings may be threaded.

6. When connection is plastic to metal, plastic male adaptors shall be used. The male adaptor shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Teflon Tape.

B. Fittings- Butt Fused or Mechanically Clamped

1. All Lateral Pipe fittings shall be HDPE DR 13.5 butt-fused or mechanically-clamped. Fittings shall be manufactured by Lasco, Spears or acceptable equal.

C. Fittings- Gasketed

1. All Mainline Pipe fittings shall be gasketed ductile iron.

2. Fittings shall be manufactured by Harco or acceptable equal.

D. Fittings Mainline to Lateral

1. Connection between Mainline Pipe and Lateral control valve piping can be made using HDPE DR 13.5 butt-fused or mechanically-clamped.

2. Fittings shall be manufactured by Harco or acceptable equal.

E. PVC to HDPE Transition

1. HDPE to PVC transition shall be accomplished with a threaded coupling. The PVC pipe shall have a solvent welded, NTP-threaded, female fitting. The HDPE shall have a butt-fused, NTP-threaded, male fitting. The threaded transition shall be properly thread taped and secured to avoid leakage.

F. Fittings- Saddle Tees

1. Shall not be permitted.

G. Solvent Cement

1. All solvent cement and primer shall be manufactured by the same manufacturer for use together. Cement and primer products shall be manufactured with all virgin materials only. Solvent cement shall be NSF listed and shall meet or exceed ASTM D-2564. Primer shall be NSF listed and shall meet or exceed ASTM F-656.

2.04 AUTOMATIC CONTROL VALVES

A. Automatic irrigation control valves shall be of the same manufacturer as the selected automatic irrigation controller and have the following features:

1. Normally closed, electronically-actuated, diaphragm-operated, remote-control valve. The valve will be capable of operating between 20 and 220 psi. with a flow range of between 20 and 150 gpm. Pressure loss shall be 1.7 psi maximum at 60 gpm.
2. Globe body style with 2-inch Female National Pipe Thread (FNPT) inlet and outlet.
3. Flow control mechanism with removable handle that will regulate flow from full on to completely off.
4. Body and bonnet shall be molded of non-corrodible, glass-reinforced nylon, rated to 220 psi. The body of the valve shall have brass inserts, with through-holes, which will accept the bonnet bolts. The bonnet bolts shall be serviceable with a slotted screwdriver, Phillips screwdriver, or a hex wrench, and shall be held captive in the bonnet when the bonnet is removed from the valve body.
5. The diaphragm assembly shall be of molded EPDM construction, reinforced with nylon fabric and have an EPDM seating material.
6. Internal filter as well as a self-cleaning metering rod, so only clean water can enter the solenoid chamber. An optional filter cleaning system that cleans a stainless steel filter each time the valve opens and closes shall be available.
7. All metal parts internal to the valve shall be manufactured from corrosion-resistant stainless steel.
8. An adjustable pressure regulating device with a calibrated dial for setting of the outlet pressure. (The regulator shall be capable of adjusting the outlet pressure from between 20 and 100 psi. when inlet pressure is 15 psi. or greater than regulated outlet pressure. The regulated downstream pressure shall remain constant regardless of variations in upstream pressure. The regulation shall be maintained when valve is manually operated with use of internal bleed valve.
9. Standard solenoid shall be a 24 VAC unit with a 370mA inrush current and 190mA holding current at 60 cycles and a 475 mA inrush current and 230 mA holding current at 50 cycles.
10. Solenoid shall be an encapsulated, one-piece unit with captive plunger. It shall be equipped with manual internal and external bleed capability to release the upper chamber water to the downstream piping, or to atmosphere, allowing the valve to open.
11. No less than a five-year, exchange warranty (not prorated).

B. The automatic irrigation control valves shall be the ICV-201G-AS as manufactured by Hunter Industries Incorporated, San Marcos, California, or pre-approved equal

C. All automatic control valves shall be connected with gasketed gray manifold pieces to allow for valve maintenance if required in the future.

2.05 RISERS

A. Stationary Spray Heads

1. All stationary spray heads shall have Hunter model SJ-512 pre-manufactured swing assemblies or equal approved in advance by the Owner's Representative. Swing assembly shall be 1/2"x 1/2"x 12" NPT.

B. Rotor Pop-up Sprinklers

1. All 1" inlet rotor pop-up sprinklers shall have an adjustable pre-assembled double swing joint riser. Swing joints shall be Rain Bird model TSJ-12 or equal approved in advance by the Owner's Representative. Swing joints shall be 1" x 12" and shall be threaded both ends.

2. All 3/4" inlet rotor pop-up sprinklers shall have an adjustable pre-assembled swing assembly risers. Swing assemblies shall be Rain Bird model TSJ-12075 or equal approved in advance by the Owner's Representative. Swing assemblies shall be 3/4" x 12" and shall be threaded both ends.

C. Quick Coupling Valves

1. All quick coupling valves shall have an adjustable pre-assembled double swing joint riser. Swing joints shall be Lasco model G13S-218 or equal approved in advance by the Owner's Representative. Swing joints shall be 1" x 18" and shall be threaded both ends. The swing joint riser shall be of proper pipe size to match quick coupling valve threads.

2.06 VALVE BOXES

A. General

1. All valve boxes containing automatic valves shall be a model JUMBO at a minimum. All remote control valves, manual control valves, zone shut-off valves, gate valves or globe valves, quick coupling valves, grounding rods, air relief valves, and 120 volt and communication wiring splices, unless otherwise indicated, shall be installed in valve access box of proper size as required for easy access to the valve. All covers to be T- Cover type and locking. All valve boxes shall be of the same manufacturer. Locking bolts shall be delivered to the Owner unless directed otherwise by the Owner's Representative.

2. All valve boxes shall be installed with 8” of 3/4" minus compacted gravel below the box to allow water to drain from box if maintenance within the valve box is required.

B. Grounding Rods

1. Standard box for all ground rod installations to be Carson 910-10-4 or NDS 212BCB ELEC, with gray cover.

C. Lateral, Isolation, Quick Coupling, and Drain Valves

1. Standard box for all lateral, isolation, quick coupling, and drain valves to be Carson 910- 10-4 or NDS 212BCB with locking green cover. Provide 4" PVC pipe sleeve

valve box extensions as required.

2. All boxes for valves 3" and larger shall be Carson 1419-12-4 or NDS 214BCB with locking green cover.

D. Control Valves

1. Standard box for all electric control valves, shall be Carson L-1730-18 or NDS 17"x30" standard box with locking green cover. Provide matching valve box extensions as required. Contractor is allowed to use smaller valve boxes and place 2 control valves per box rather than 4 in one box.

E. Air Relief Valves

1. Standard box for air relief valves shall be Carson 1220-12-4 or NDS 218BCB with locking green cover. Provide matching valve box extensions as required.

F. Pull Boxes

1. Standard box for all electrical and communication cable pull boxes shall be Carson 1419- 12-4 or NDS 214BCB ELEC with locking gray cover, electrical marking. Provide matching valve box extensions as required.

2.07 SPRINKLER HEADS

A. General

1. Sprinkler heads shall be constructed of bronze, brass, stainless steel, cast iron and/or non-metallic materials.

2. All heads of a particular type and for a particular function in the system shall be of the same manufacture and shall be marked with the manufacturer's name and identification, in such a position that they can be identified without being removed from the system.

B. All rotor heads shall be model I-20-04 as manufactured by Hunter Industries, or pre-approved equal.

C. All spray heads shall be models Pro-PSU as manufactured by Hunter Industries, or pre-approved equal.

2.08 DRIP TUBING AND EMITTERS

A. Drip tubing and emitters shall be used for irrigating hedges, shrubs and trees as shown on the drawings. Drip tubing and emitters shall have the following features:

1. In-line, pressure-compensating, non-draining, non-clogging emitters;

2. Built-in check valves;

3. Operating pressure range from 15 to 50 psi;

4. UV resistant, kink resistant, flexible;

5. Natural color.

B. Drip tubing and emitters shall be PLD-10 (1 gpm. emitters) with emitter spacing of 12"

or 18" as specified on the drawings, manufactured by Hunter Industries, or approved equal.

2.09 AUTOMATIC IRRIGATION CONTROLLER

A. The automatic field controller shall have the following features:

1. Modular design that is provided with adequate available stations to control all pressure zones from each irrigation stub-out at the specified locations on the contract drawings.
2. When installed or removed, the modules, and station count shall be automatically recognized by the controller.
3. UL listed, NEMA 3R rated cabinet for use in the outdoor models. The front panel of the controller shall be removable to allow for remote programming.
4. No less than three independent programs (A, B, C) with 4 start times per program for a total of up to 12 start times per zone. Watering times for each station shall be available from 1 minute to 120 minutes in 1-minute increments and in 10 minute increments from 120 minutes up to 6 hours.
5. No less than 4 weekly schedule options to choose from: 7-day calendar, 31-day interval calendar, odd day programming and even day programming. It shall also have a 365-day calendar clock to accommodate true odd-even watering. The controller shall be capable of determining and displaying the total run time input for each program.
6. Capability to store a program in backup memory for easy retrieval, and also have a test program for quick system checks.
7. Capable of identifying field wiring problems through the use of a troubleshooting feature.
8. Operation shall be available in automatic, semi-automatic and manual modes. All programming shall be accomplished by use of a programming dial and selection buttons with user feed-back provided by a LCD display.
9. Rain sensor on-off switch that allows the user to override a sensor that has suspended watering. The controller shall have a programmable rain delay that turns off the controller for a predetermined period of time, from 1 to 7 days, and shall allow the sensor input to be programmed by station.
10. Seasonal adjust feature that allows for station run times to be changed from 0% to 300% in 10% increments to compensate for weather changes.
11. Programmable event day off to prevent watering on a selected day of the week. It shall also have a programmable delay between valve stations. Delays between stations shall be programmable in 5 second increments from 0 to 60 seconds and in 1-minute increments from 60 seconds up to 4 hours. A pump start/master valve circuit shall be included (if necessary), and shall be programmable by station.

12. Transformer input shall be 120 VAC, 60Hz or 230 VAC 50Hz depending on requirements. Transformer output shall be 24 VAC, 1.0A. Maximum output per station shall be 24 VAC, 0.56A.
13. Program backup shall be provided by a non-volatile memory circuit that will hold the program data indefinitely. It shall also track time of day, and date indefinitely.
14. Metal Oxide Varistors (MOVs) on the power input portion and the secondary output portion to help protect the micro-circuitry from power surges. The secondary MOVs shall be enclosed in the station modules for easy servicing.
15. Self-diagnostic, electronic short circuit protection that detects a faulty circuit, continues watering the remainder of the program, and reports the faulty station on the display. The diagnostic function shall also be capable of being initiated manually by the user.
16. No less than 2 options for remote control use, the ROAM remote control package that enables remote operation of the controller up to 1000 feet away and the ICR remote control package that enables remote operation of the controller up to 2 miles away. Connection of remotes to the controller shall be provided through the SmartPort® outlet. The controller shall have central control capability through the Irrigation Management and Monitoring System (IMMSO).

B. The controller shall be installed in accordance with the manufacturer’s published instructions.

C. The controller shall carry a conditional two-year exchange warranty.

D. The automatic controller(s) shall be the PRO-C series controller as manufactured for Hunter Industries Incorporated, or pre-approved equal.

2.10 CONTROL CABLE

A. All electrical control and ground wire shall be irrigation control cable as manufactured by Paige Electric Co., Box 368, Union, NJ 07083, telephone 800-327-2443 or equal approved in advance by the Owner's Representative. All control cable shall be 14-gauge and all common cable shall be 12-gauge unless otherwise indicated on the drawings, and rated for direct burial applications.

B. All wiring to be used for connecting the automatic remote control valve to the automatic controllers shall be 600 volt, soft drawn solid copper single conductor wire meeting the requirements of ASTM B-3 or B-8, -55° C to +60° C temperature rated with 0.045" polyethylene insulation. All control cable shall be marked with manufacturer identification, voltage rating, size and type and shall bear UL file number.

C. All cables shall be tested physically and electrically in accordance with UL Standard 493, and 83, paragraphs 28.1, 29.1 and 29.2. All reels and cartons shall bear UL labels.

D. All control or "hot" wires shall be of color coded irrigation control cable. When more than one valve is operated by a single controller station provide separate control wire from the controller to each valve. All control cable shall run continuously from the

controller to the valve without splicing.

E. Connection to remote control valve solenoid shall be made with 3M DBY/DBR Splice kits and located in valve the box.

F. Verification of wire types and installation procedures shall be checked to conform to local codes

G. All control cable shall be installed in conduit to allow pulling new wire in the event of wire failure.

2.11 120 VOLT WIRING

A. Refer to Division 26

2.12 GROUNDING

A. General

1. All controllers shall be properly grounded in accordance with manufacturer's installation requirements

2.13 OTHER MATERIALS

A. Materials to be furnished

1. Two keys for each automatic controller.

2. Two isolation valve keys for each type of valve installed. Five heads of each type installed with nozzles.

3. Two automatic control valves for each size and type installed.

4. Five sprinkler head adjustment tools for each size and type of sprinkler installed.

5. The above equipment shall be turned over to the Owner at the conclusion of the project. Before final inspection can occur, evidence that the Owner has received materials must be shown to the Owner's Representative.

B. All other materials, not specifically described but required for a complete and proper irrigation system installation, shall be new, first quality of their respective kinds, and subject to the approval of the Owner's Representative

2.14 CONCRETE

A. All concrete used for securing irrigation system components shall be 3,000 psi at 28 days, transit mixed. Provide certifications with each delivery

2.15 BACKFLOW PREVENTION DEVICE

A. Backflow Prevention Device:

1. All backflow prevention devices shall be manufactured by Wilkins, or pre-approved equal.

2.16 BACKFLOW PREVENTER CAGE

A. A heavy-duty steel mesh cage with rust proof finish. The caging shall be sized to allow

space for the entire piping assembly associated with the Backflow Preventer unit, and all associated equipment.

B. The cage shall include the manufacturers' standard tamper proof locking mechanism.

C. Provide a concrete base as detailed on the drawings.

D. Backflow Preventer Cage type, manufacturer and color shall be as indicated on the plans.

2.17 DETECTABLE WARNING TAPE

A. General Requirements: Marking tape for easy buried pipeline detection and below ground identification and warning, detectable with a non-ferrous metal detector when buried at the proper depths.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or approved equal:

1. T. Christy Enterprises
2. NMC (National Marker Company)
3. Pro-Line Safety Products

C. Description: 3" wide detectable tape of 5 mil overall thickness, with a .35 mil solid aluminum foil core muli-ply composition, acid, alkaline and corrosion resistant. The tape tensile strength is in accordance with ASTM 882-80A and shall not be less than 4500 PSI. Tape The color is Blue to conform with the APWA Uniform Color Code. The text shall indicate "Irrigation" lines.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. All equipment shall be installed to meet all installation requirements of the product manufacturer. In the event that the manufacturer's requirements cannot be implemented due to particular condition at the site or with other parts of the design, obtain the Owner's Representative's written authorization and approval for any modifications.

B. Extreme care shall be exercised at all times by the Contractor in excavating and working in the project area due to existing utilities and irrigation systems to remain.

C. The Contractor is responsible for identifying and maintaining existing irrigation main lines that supply water to areas on the site as noted on the drawings and outside of the proposed limit of work. The Contractor shall relocate or replace existing irrigation main line piping as required to provide a continuous supply of water to all areas of existing irrigation on site.

D. Group valves and general irrigation equipment together where practical and locate in shrub planting areas.

E. Final site conditions and existing and proposed plantings shall determine final locations and adjust coverage. Minor changes in locations of the above from locations shown shall

be made as necessary to avoid existing and proposed trees, piping, utilities, structures, etc. at the contractor's expense or when directed by the Owner's Representative.

1. The Contractor shall be held responsible for relocation of any items without first obtaining the Owner's Representative's approval. The Contractor shall remove and relocate such items at their expense if so directed by the Owner's Representative.

F. Prior to any work the Contractor shall stake out locations of all pipe, valves, equipment and irrigation heads and emitters using an approved staking method and maintain the staking of the approved layout in accordance with the drawings and any required modifications. Verify all horizontal and vertical site dimensions prior to staking of heads. Do not exceed spacing shown on drawings for any given area. If such modified spacing demand additional or less material than shown on the drawings, notify the Owner's Representative before beginning any work in the adjacent area.

G. Prior to starting any work, Contractor shall obtain a reading of existing static water pressure (no flow condition) at the designated point of connection and immediately submit written verification of pressure with date and time of recording to Owner's Representative.

H. All sprinkler irrigation systems shall require backflow prevention. All backflow prevention devices shall meet and be installed in accordance with requirements set forth by local codes and the health department.

I. Stub out main line at all end runs and as shown on drawings.

J. No fittings shall be installed on pipe underneath pavement or walls.

3.02 EARTHWORK

A. Excavating, trenching, and backfilling are specified in other specifications bound herein.

B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.

D. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 24 inches below finished grade.
2. Lateral Piping: 18 inches.
3. Drain Piping: 12 inches.
4. Sleeves:
    a. 24" under sidewalks
    b. 30" under driveways
    c. 36" under streets.

3.03 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Owner’s Representative's approval before excavation.

3.04 PIPE INSTALLATION

A. Location and Arrangement: Approved submittal plan drawings indicate location and arrangement of piping systems. Install piping as indicated on approved submittal.

B. Install piping free of sags and bends.

C. Install groups of pipes parallel to each other, spaced to permit valve servicing.

D. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.

E. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.

F. Lay piping on solid subbase, uniformly sloped without humps or depressions.

G. Install PVC piping in dry weather when temperature is above 40 deg F . Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

H. Install water hammer arresters, if needed, between connection to main line and lateral valves aboveground or in control-valve boxes.

I. Install piping in sleeves under parking lots, roadways, and sidewalks.

J. Install transition fittings for plastic-to-metal pipe connections according to the following:

1. Underground Piping:

a. NPS 1-1/2 and Smaller: Plastic-to-metal transition fittings.

b. NPS 2 and Larger: AWWA transition couplings.

3.05 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

D. Plastic Pipe shall be installed in a manner so as to provide for expansion and contraction as recommended by the manufacturer.

E. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC

socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

3. PVC Nonpressure Piping: Join according to ASTM D 2855.
4. The solvent-weld joints shall be allowed to set at least 24 hours before pressure is applied to the system on PVC pipe.
5. Only the solvent cement recommended by the pipe manufacturer shall be used. All plastic pipe and fittings shall be installed as outlined and instructed by the pipe manufacturer and it shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. The Contractor shall assume full responsibility for the correct installation.

F. All HDPE DR 13.5 joints shall be butt-fused or mechanically-clamped.

G. All plastic to metal joints shall be made with plastic male adaptors. The solvent-weld joints shall be made dry.

H. Thrust Blocks

1. Provide concrete thrust blocks for all pipe as required by the schedule on the drawings. All thrust blocks shall bear directly on undisturbed earth. Center pipe in the middle of thrust block.

3.06 VALVE INSTALLATION

A. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.

1. Install valves and PVC pipe with restrained, gasketed joints.

B. Pressure-Reducing Valves: Install in boxes for automatic control valves.

C. Throttling Valves: Install in underground piping in boxes for automatic control valves.

3.07 AUTOMATIC CONTROL VALVES PRESSURE REGULATORS

A. Install Adjustable pressure regulator on every valve, for use with latching valve solenoid.

B. Set pressure regulation to 5% higher than Zone Design presser on Valve Schedule per drawings.

3.08 VALVE BOX INSTALLATION

A. Install one valve box for each type of valve installed as per the details.

B. Install boxes where indicated on Contract Drawings and perpendicular to edge of – paving and parallel to each other. Allow 12 inches clearance between adjacent valve boxes.

C. Automatic Control Valve Boxes:

1. Install flush with topsoil grade in lawn areas.
2. Install 1” above topsoil grade in planter beds.

D. Gravel sump, eight inch minimum depth shall be installed at the base of each valve box after compaction of all trenches.

E. Permanently label valve number and or controller letter on top of valve box lid using a method approved by the Owners Representative.

F. HDPE Valve Boxes: Install to a 30” depth with valve box lids located below mulch layer.

3.09 SPRINKLER INSTALLATION

A. Flush system after hydrostatic test is completed before installing sprinkler heads.

B. Install sprinkler heads to final grade where sod lawn will be installed. Make necessary field adjustments for full coverage.

C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

D. All sprinkler heads shall be set perpendicular to finish grade unless otherwise designated on the drawings or details.

3.10 DRIP IRRIGATION INSTALLATION

A. Irrigation specialty type, arrangement, sizes, water-flow data, and mounting heights are shown on Drawings and details.

B. Install drip tubing at finished grade over weed barrier fabric, cover with mulch.

C. Install drip tubes with direct-attached emitters with plastic tubing stake per manufacturer’s specifications.

D. Install dripline tubing per drawings and manufacturer’s specifications.

E. Install drip control zone kits per drawings and manufacturer’s specifications.

F. Clamp fittings with Oetiker clamps or approved equal when operating pressure exceeds specific drip tubing fitting requirements.

G. When installing drip tubing, install soil staples as listed below:

1. Sandy Soil - One staple every three (3’) feet and two (2) staples on each change of direction (tee, elbow, or cross).

2. Loam Soil - One staple every four (4’) feet and two (2) staples on each change of direction (tee, elbow, or cross).

3. Clay Soil - One staple every five (5’) feet and two (2) staples on each change of direction (tee, elbow, or cross).

H. Cap or plug all openings as soon as lines have been installed to prevent the intrusion of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.

I. Thoroughly flush all water lines before installing valves and other hydrants.

3.11 AUTOMATIC CONTROLLER

A. Equipment Mounting: Install all controllers on the interior of the buildings.

B. Setup controller to operate with all sensors, flow sensors and master valves for proper system operation.

C. Controller shall be tested with complete electrical connections. The Contractor shall be responsible for temporary power to the controller for operation and testing purposes.

D. Connections to control wiring shall be made within the controller cabinet. All wire shall follow the pressure mainline insofar as possible.

E. Electrical wiring shall be in conduit from controller to electrical outlet per Engineer's plans and specifications. A licensed electrical Contractor shall be responsible for installing all wiring to the controller, in order to complete this installation. A disconnect switch shall be included.

3.12 WIRING

A. Low Voltage

1. Control wiring between controller and electrical valves shall be installed in the same trench as the main line where practical. The wire shall be bundled and secured to the lower quadrant of the trench at 10 foot intervals with plastic electrical tape.

2. When the control wiring cannot be installed in the same main line trench it shall be installed a minimum of 18 inches below finish grade and a bright colored plastic ribbon with suitable markings shall be installed in the trench 6 inches below grade directly over the wire.

3. An expansion loop shall be provided every 1000 feet in a box and inside each valve box. Expansion loop shall be formed by wrapping wire at least eight (8) times around a ¾ inch pipe and withdrawing pipe.

4. All control wire splices not occurring at control valve shall be installed in a separate splice valve box.

5. All control wiring shall be installed in separate sleeves.

B. High Voltage

1. All electrical work shall conform to local codes, ordinances and any authorities having jurisdiction. All high voltage electrical work to be performed by licensed electrician.

2. The Contractor shall provide 120-volt power connection to the automatic controller unless noted otherwise on drawings.

3.13 BACKFLOW PREVENTION DEVICE

A. Backflow Prevention Device shall be installed in a locking backflow cage.

1. Lock cage after installation.

B. Pressure Vacuum Breaker shall be installed 12" above highest elevation of irrigation system.

1. Refer to drawings for proper elevation.

3.14 CONNECTIONS

A. Comply with requirements for piping per Engineers Drawings and Specifications for water supply from exterior water service piping, water meter, and vault to Point of Connection. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

C. Connect wiring, equipment and decoders between controller and automatic control valves.

3.15 IDENTIFICATION

A. Permanently label valve number on top of valve box lid using a method approved by the Owners Representative. Method shall be highly resistant to wear.

B. Valve Identification Tags: Install tags on each automatic control valve with corresponding valve number per the valve schedule. Install on Master Valve with initials “MV”. Secure tags to each valve in visible location without impeding valve operation.

C. Detectable Warning Tape: Install continuous, underground, detectable warning tapes 6 inches below finished grades, directly above all underground mainline and lateral piping.

3.16 BACKFILLING AND COMPACTING

A. Irrigation trenches shall be carefully backfilled with material approved for backfilling and free of rocks and debris one (1) inch in diameter and larger. When back filling trenches in areas of imported or modified planting soil, replace any excavated subsoil at the bottom and the imported soil or modified planting soil at the top of the trench.

B. Backfill shall be compacted with approved equipment to the following densities

1. Backfill under pavement and within 2 feet of the edge of pavement: Compact to 95% or greater of maximum dry density standard proctor.

2. Backfill of subsoil under imported planting mixes or modified existing planting soil: Between 85 and 90% of maximum dry density standard proctor.

3. Backfill of imported planting mixes or modified existing planting soil: Compact to the requirements of the adjacent planting mix or planting soil as specified in section “Planting Soil”.

C. Finished grade of all trenches shall conform to adjacent grades without dips or other irregularities. Dispose of excess soil or debris off site at Contractor's expense.

D. Any settling of backfill material during the maintenance or warranty period shall be repaired at the Contractor’s expense, including any replacement or repair of soil, lawn, and plant material or paving surface.

3.17 REPAIR OF PLANTING SOIL

A. Any areas of planting soil including imported or existing soils or modified planting soil

which become compacted or disturbed or degraded as a result of the installation of the irri- gation system shall be restored to the specified quality and compaction prior to beginning planting operations at no additional expense to the Owner. Restoration methods and depth of compaction remediation shall be approved by the Owner’s Representative.

3.18 TESTING AND INSPECTION

A. Closing-in Uninspected Work

1. Do not allow or cause any of the work in this section to be covered up or enclosed until it has been inspected, tested, and approved by the Owner's Representative.

2. Where trenches are not closed at the end of the day Contractor shall accept all liability for any damage or injury that may result from open trenches. Provide barricades and warning tape as necessary around all open trenches.

B. Flushing

1. Before backfilling the mainline, and with all control valves in place, but before lateral pipes are connected, completely flush and test the mainline and repair for all leaks; flush out each section of lateral pipe before sprinkler heads are attached.

C. Testing

1. Make all necessary provisions for thoroughly bleeding the line of air and debris. Before testing, fill the line with water for a period of at least 24 hours.

2. After valves have been installed, test all live water lines for leaks at a pressure of 100 psi for a period of two hours, with all couplings exposed and with all pipe sections centerloaded.

3. Furnish all necessary testing equipment and personnel.

4. Correct all leaks and retest until acceptance by the Owner's Representative.

5. All couplings/joints shall remain exposed until the pressure test has been approved by the Owner’s Representative.

D. Final Inspection

1. Thoroughly clean, adjust, and balance all systems.

2. Demonstrate the entire system to the Owner's Representative, proving that all remote control valves are properly balanced, that all heads are properly adjusted for radius and arc of coverage, and that the installed system is workable, clean, and efficient

3.19 INSTRUCTIONS

A. Record Drawings

1. Record accurately on one set of black and white prints of the site plan all installed work including both pressure and non-pressure lines.

2. Upon completion of each increment of work, transfer all such information and

dimensions to the print. The dimensions shall be recorded in a legible and workmanlike manner. Maintain as-built drawings on site at all times.

3. All payment requests shall be accompanied by interim record drawings showing all work completed to that date. No payment request will be processed without an acceptable interim record drawing. Finished record drawings must be received and approved by the Owner's Representative before final payment will be approved.
4. Make all notes on drawing in pencil (no ball point pen). When the work has been completed, transfer all information from the field record print to a set of reproducible drawings.
5. Dimension from two permanent points of reference (buildings, monuments, sidewalks, curbs, pavement, etc.). Locations shown on as-built drawings shall be kept day to day as the project is being installed. All dimensions noted on drawings shall be 1/8-inch in size (minimum).
6. Show locations and depths of the following items:
    a. Point of connection(s)
    b. Routing of sprinkler lateral lines (dimension maximum 200 feet along routing and at all changes in direction)
    c. Gate valves
    d. Sprinkler control valves
    e. Quick coupling valves
    f. Routing of control and power wires
    g. Sprinkler heads
    h. Other related irrigation equipment

B. Controller Charts

1. As-Built drawings must be approved by Owner's Representative before charts are prepared.
2. Provide one controller chart for each controller supplied showing the area covered by automatic controller, of the maximum size controller door will allow.
3. The chart is to be a reduced drawing of the actual as-built system. Chart shall be a photo positive with different colored shading used to show area of coverage for each station. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic. The chart shall be mounted in the controller using Velcro or equal type of semi-permanent fastening device.
4. All controller charts must be completed and approved prior to final payment.

C. Operation and Maintenance Manuals

1. Coordinate with requirements of Section 01 77 00 to provide the following:

2. Prepare and deliver to the Owner's Representative within ten calendar days prior to completion of construction, all required and necessary descriptive material in complete detail and sufficient quantity, properly prepared in four individually bound copies of the operations and maintenance manual. The manual shall describe the material installed and shall be in sufficient detail to permit operating personnel to understand, operate and maintain all equipment. Spare parts lists and related manufacturer information shall be included for each equipment item installed. Each complete, bound manual shall include the following information:

    a. Index sheet stating Contractor's address and telephone number, duration of guarantee period, list of equipment with names and addresses of local manufacturer representatives.

    b. Complete operating and maintenance instructions on all major equipment.

3. In addition to the above maintenance manuals, provide the maintenance personnel with instructions for system operation and show written evidence to the Owner at the conclusion of the project that this service has been rendered.

3.20 MAINTENANCE

A. System Operation

1. During and following installation of the irrigation system, the Contractor shall operate the irrigation system as required to maintain healthy turf. The Contractor shall continue to operate the irrigation system until the project is substantially complete and all construction Punch List items are satisfactorily complete as determined by the Owner's Representative.

3.21 GUARANTEE PERIOD

A. Guarantee

1. The entire irrigation and water system shall be guaranteed to give satisfactory service for a period of one year from date of acceptance by the Owner.

2. Should any trouble develop within the time specified above due to inferior or faulty materials or workmanship, the trouble shall be corrected at no expense to the Owner.

3. Any and all damages resulting from faulty materials or workmanship shall be repaired by the Contractor to the satisfaction of the Owner, at no cost to the Owner.

B. Guarantee Period Services

1. The Contractor shall winterize the system and perform spring start-up of the system during the guarantee period. These functions shall be coordinated in advance with the Owner, and the Owner's personnel shall be encouraged to participate.

2. Upon re-energizing the system, the Contractor shall repair any leaks or breaks and shall check each head and valve, making any adjustment necessary.

3. The irrigation system shall preform and provide coverage equal to performance at the time of acceptance by the Owner. If the system does not perform equal to the

performance at the time of acceptance, the Contractor shall repair/replace components necessary to obtain original performance at no additional cost to the Owner.

END OF SECTION 32 80 00

SECTION 32 90 00
LANDSCAPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Seeding (also see Section 32 90 19).
2. Planting.
3. Erosion control mulch.
4. Hydro-mulch.
5. Erosion control mat.
6. Turf reinforcement mat.
7. Hardwood mulch.
8. Landscaping materials.
9. Fertilizer.
10. Landscape maintenance.
11. Landscape warranty.

B. Related Sections

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.
4. Division 32 – Exterior Improvements.

1.02 DEFINITIONS

A. Growing Season: May 1 through September 30

B. Weeds – Any vegetation that is either not planted or seeded that is within areas to be seeded or planted as part of this Contract.

C. Planting Bed – Planted areas around the ADM building.

D. Seeding Bed – All areas seeded as part of this Contract.

E. Noxious Weeds – As defined by the MDT Standard Specifications

1.03 REFERENCES

A. Montana Standard Specifications for Road and Bridge Construction, 2008 edition, referred to as MDT Standard Specifications in this specification section.

B. General Permit No. MTR100000 (or its successor), Effective Date January 1, 2013 and Expiration Date December 31, 2017 - Authorization to Discharge under the National Pollutant Discharge Elimination System, referred to as the State's Construction General Permit in this specification section.

1.04 SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittal Procedures.

B. Seed Data: Provide seed testing data and labeling consistent with MDT Standard Specifications.

C. Plant Material: Include quantities, sizes, quality and sources for plant materials.

D. Submit samples or product data sheets and installation specifications / details of the following materials. Contractor shall not place materials until Engineer reviews submittal and provides a submittal review noting no exceptions taken:

1. Landscape Rock
2. Landscape Gravel
3. Hardwood Mulch
4. Erosion Control Mulch, including anchoring approach
5. Hydro-Mulch
6. Erosion Control Mat
7. Weed Control Barriers
8. Landscape Edging

E. Proposed seeding equipment and methods.

1.05 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 01 77 00 – Closeout Procedures for submittals.

B. Maintenance Data: Include maintenance instructions for all seeding and planting areas including cutting / pruning method and maximum height; types, application frequency, and recommended coverage of fertilizer and/or mulching.

1.06 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies and MDT Standard Specifications for herbicide, insecticide, pesticide, and fertilizer application rates and composition.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 60 00 for product delivery, storage, and handling requirements.

B. Deliver seed mixture in sealed containers, open or damaged packaging is not acceptable.

C. For Engineer's field review, each bag of seed delivered to the site shall bear a tag with labeling meeting MDT Standard Specification requirements.

D. Deliver fertilizer in waterproof bags, labeled according to state law and bearing weight, chemical analysis, name of manufacturer, and warranty of producer.

E. Deliver plants after preparations for planting have been completed, and install within the same working day. Prior to planting:

1. Set plants in cool, covered, and shaded area;
2. Protect from weather;
3. Protect from mechanical damage;
4. Keep roots moist.

1.08 PLANTING BED ESTABLISHMENT PERIOD

A. The Planting Bed Establishment Period shall begin immediately after installation, with the approval of the Engineer, and continue for forty-five (45) growing season days within the same growing season, seventy-five (75) growing season days if the growing season spans more than one calendar year, or thirty (30) days after Substantial Completion, whichever is latest.

B. During the Planting Bed Establishment Period the Contractor shall:

1. Water all plants to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of one (1) inch of absorbed water per week either through natural rainfall or augmented by periodic watering. Apply water at a moderate rate so as not to displace the hardwood mulch or flood the plants and turf.
2. Prune plants and replace hardwood mulch as required.
3. In planting beds, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 3 inches and/or re- seed, whichever comes first.
4. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, if recommended by a certified horticulturalist.
5. Mechanically remove or spot spray with approved herbicide all weeds.
6. Remove plants that die during the Planting Bed Establishment Period and replace each plant with one of the same size and species, following the specifications for allowable planting schedule.

1.09 SEEDING BED ESTABLISHMENT PERIOD

A. The Seeding Bed Establishment Period shall begin immediately after installation, with the approval of the Engineer, and continue until:

1. A Notice of Termination can be filed for the State’s Construction General Permit, and meeting all the requirements of the State’s Construction General Permit; and
2. No single bare area is greater than 36 square feet.

B. During the Seeding Bed Establishment Period the Contractor shall:

1. Water all seeded areas to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of one (1) inch of absorbed water per week either through natural rainfall or augmented by periodic watering. Apply water at a moderate rate so as not to displace the mulch or seed flood the plants and turf.

2. Mechanically remove or spot spray noxious weeds prior to reseeding and such that noxious weeds are less than 10 percent of the overall coverage in the Seeding Bed, with no area greater than 100 square feet that is more than 50 percent noxious weed coverage at the end of the Seeding Bed Establishment Period.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. Per specification Section 31 05 13.

2.02 SEED

A. All areas except around ADM building: As shown on Drawings

B. ADM building: Seed around ADM building shall be Premium Sunny Brand Lawn or Classic Shade/Sun Brand Mixtures as provided by Agassiz Seed & Supply or approved equal.

C. Seed shall meet MDT Standard Specifications, except the following additional provisions shall apply / supersede the MDT Standard Specifications:

1. Seed shall have a minimum 80 percent germination rate and maximum inert matter and other seeds of 4%. Maximum weed seed shall be 0.5 percent.

2. Seed shall be tested within six months prior to date of seeding and conform to latest seed laws of the State of Minnesota. A certified test report shall be submitted to the Engineer at least 21 days before seeding begins.

3. Origin of native species shall be limited to North Dakota, eastern Montana, South Dakota, or western Minnesota.

D. Temporary cover crop, if used, shall be per MDT Standard Specifications.

2.03 FERTILIZER

A. Fertilizer shall meet MDT Standard Specifications. In the case where both Class I and Class III seed are applied, the Class III fertilizer will apply.

2.04 EROSION CONTROL MULCH

A. Erosion control mulch shall meet the MDT Standard Specifications.

2.05 HYDRO-MULCH

A. Hydro-mulch shall meet the MDT Standard Specifications.

2.06 EROSION CONTROL MAT

A. Erosion Control Mat shall be classified as ECB 2, as outlined in Table 856-1 of the MDT Standard Specifications.

2.07 TURF REINFORCEMENT MAT (TRM)

A. As shown on the Drawings.

2.08 HARDWOOD MULCH

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of 2” ground or shredded bark in its natural color.

2.09 LANDSCAPE ROCK

A. Landscape rock shall be water worn river rock 20 percent maximum jagged edges 3/4-inch to 1 1/2-inch diameter, ASTM C33.

2.10 LANDSCAPE GRAVEL

A. Landscape gravel shall be as shown on the Drawings.

2.11 LANDSCAPE EDGINGS

A. As shown on the Drawings.

2.12 WEED-CONTROL BARRIERS

A. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8oz/sq. yd.

2.13 PLANT MATERIAL

A. Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings.

B. Plants shall have healthy root systems developed by transplanting or root pruning. Plants shall not be pot bound.

C. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

D. Contractor shall not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

E. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required.

F. Labeling:

1. Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species.

2. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

PART 3 - EXECUTION

3.01 TOPSOIL PREPARATION

A. Verify that prepared topsoil meets the topsoil and grading specifications and is ready to receive work of this Section.

B. Kill all weeds prior to planting or seeding.

1. For broad removal of weeds, Contractor shall use disking or mechanical removal.

2. Herbicide shall only be allowed for spot spraying and if the herbicide will not have a detrimental effect on the intended seeded or planted species.

C. Fill all depressions to provide a smooth grade. Sticks, stones, and other rubbish on the surface shall be raked and removed.

D. Seeding: Immediately prior to sowing seed, soil shall be loosened to a depth of approximately three (3) inches all areas except slopes steeper than 2 horizontally to 1 vertically, using discs, harrows, or other suitable equipment.

E. Planting: Immediately prior to planting, soil shall be dug and loosened to a depth of approximately 1.25 times the pot depth and diameter using hand or rotary drill equipment.

F. On slopes, the cultivating equipment shall operate in a general direction at right angles to the direction of surface drainage.

G. On slopes steeper than 2 horizontally to 1 vertically, no loosening of the soil will be required except that created by equipment used in the finishing operations.

3.02 SEEDING BEDS

A. Seed all disturbed areas designated for revegetation.

B. Stake out areas to receive different seed mixes.

C. Seeding Equipment Requirements.

1. The specified seed or seed mixture shall be drilled in uniformly using a grass drill equipped with individually mounted adjustable spring loaded, double disk furrow openers fitted with depth bands and packer wheels. The drill furrow spacing shall not exceed 8 inches. The depth control bands shall be of a size to provide final planting depth of ½ to ¾ inch. Packer wheels shall have adjustable spring tension and be mounted individually on each furrow opener or be mounted independently with a press wheel situated to follow directly behind each opener. The seed box shall be equipped with a positive feed mechanism which accurately meters free flowing introduced (tame) grasses in a uniform manner and shall have agitators which prevent seed bridging. If chaffy native grasses are part of the specified seed mixture, the seed box shall be equipped with a positive feed picker-wheel mechanism with oversize teeth and augur style agitators which accurately meters the chaffy native grasses either in a mixture or separately in a uniform manner. The seed box shall have baffles or partitions that keep all seeds uniformly mixed during drilling.

2. Equipment to be used when Hydro-Mulch seeding is required shall be hydraulic equipment capable of uniformly mixing the specified seed in water for uniform distribution. The mulch may be applied simultaneously with the seed and fertilizer, or within 24 hours after application of seed and fertilizer.

3. Other Equipment. Power sprayers, blowers, hydraulic applicators, or broadcasters may be used on slopes steeper than 3:1 or areas too small to be seeded with a drill. The seeding rate shall be at least 120% of the normal rate, and the seed shall be covered by operating a drag harrow and a light packer over the seeded area.

4. Areas will be visually inspected for uniformity of application. Areas which do not reveal adequate and uniform coverage shall be reseeded at the Contractor's expense.

D. Seasonal considerations for seeding shall be implemented per MDT Standard Specifications, Section 708.02C1d.

E. No seed shall be sown when the wind velocity exceeds 15 miles per hour, in standing water, or on frozen ground.

F. Do not sow within 24 hours after a rain event.

G. Within the same work day, Contractor shall stabilize the soil surface with the appropriate surface stabilization (erosion control mulch, hydro-mulch, or erosion control mat) as shown in these specifications and/or the Drawings. Hydro-mulch shall be applied at the same time as seeding, unless approved by Engineer.

H. Following surface stabilization, Contractor shall water seeded areas consistent with the Seeding Bed Establishment Period requirements.

3.03 PLANTING BEDS

A. Contractor shall plant areas more than 30 days prior to the end of the Growing Season to limit the potential for frost heave.

B. Do not plant when soil is excessively wet.

C. Stake out and space plants as indicated on Drawings, in even rows with triangular spacing.

D. Use topsoil for backfill.

E. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

F. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

G. Within one hour of planting, Contractor shall spread hardwood mulch as shown on the Drawings and water planting areas with sufficient water consistent with the Planting Bed Establishment Period requirements, taking care not to cover plant crowns with wet soil or hardwood mulch.

3.04 SURFACE STABILIZATION

A. Erosion Control Mulch shall be applied according to MDT Standard Specifications at a rate of 2 tons per acre with approximately 10 percent of the soil surface visible. Contractor shall anchor the mulch using either the punching or tackifier approach.

B. Hydro-Mulch shall be applied per MDT Standard Specifications at a rate of 1 ton per acre with a minimum of 95 percent coverage.

C. Erosion control mat shall be installed per the Drawings and manufacturer's recommendations, whichever is more stringent.

D. Turf Reinforcement Mat shall be installed per the Drawings, which may include placing the TRM below the ground surface prior to seeding with an erosion control mat on the surface, if recommended by the manufacturer.

3.05 LANDSCAPE ROCK AND GRAVEL PLACEMENT

A. Landscape rock and gravel will be placed in areas identified in the Specifications and Drawings at a uniform depth of four inches, plus or minus 1 inch.

B. Provide a two (2) foot wide border of landscape rock at all structures not adjacent to asphalt or concrete surfaces.

C. Place landscape gravel on areas shown on the ADM landscaping plan noted with "Gravel" label.

D. Place weed control barrier and landscape edging (5-inch) prior to placement of landscape rock and gravel.

3.06 CLEANUP AND PROTECTION

A. During and after landscaping, keep pavements clean and work area in orderly condition.

B. Protect existing improvements from damage from landscaping operations.

C. Contractor shall clean up the site following work and repair any damage caused by landscaping operations, at Contractor's cost.

3.07 MAINTENANCE

A. Contractor shall be responsible for maintenance of the planting and seeding beds for the Planting and Seeding Bed Establishment Periods, respectively.

B. Contractor shall spot spray weeds in the landscape gravel and landscape rock areas before they reach a height of 3 inches and/or re-seed, whichever comes first.

C. If Contractor has used a temporary cover crop, Contractor shall mow temporary cover crop prior to cover crop re-seeding.

3.08 WARRANTY

A. For Seeding Beds:

1. Initial Acceptance:

a. All seeding beds shall be evaluated for Initial Acceptance after the seeding beds

have been covered with the specified seed and the specified soil protection measure (such as erosion control mulch or mat) as shown on the Drawings. Initial Acceptance shall be based on the Contractor providing the Engineer with the specified submittals and a visual inspection by the Contractor and Engineer of the seeding beds.

2. Maintenance:

   a. Contractor shall maintain the seeding beds, consistent with the Seeding Bed Establishment Period, until Final Acceptance.

   b. Other maintenance activities may be completed at the Contractor's discretion to meet the Final Acceptance performance criteria. Contractor shall notify the Engineer of planned additional maintenance activities prior to implementation.

3. Final Acceptance:

   a. Final Acceptance will occur at the end of the Seeding Bed Establishment Period.

   b. If after a period of ninety (90) growing season days, vegetation coverage does not meet the minimum requirements outlined in the Seeding Bed Establishment Period, Contractor shall re-seed all areas that do not meet the minimum coverage, at Contractor's cost. A new Seeding Bed Establishment Period shall begin, except the maintenance period will be thirty (30) growing season days.

B. For Planting:

1. Initial Acceptance:

   a. All planting areas shall be evaluated for Initial Acceptance after the plants have been installed and surrounding planting beds covered with hardwood mulch. Initial Acceptance shall be based on the Contractor providing the Engineer with the specified submittals and a visual inspection by the Contractor and Engineer of the planting beds.

2. Maintenance:

   a. Contractor shall maintain the planted beds, consistent with the Planting Bed Establishment Period, until Final Acceptance.

   b. Other maintenance activities may be completed at the Contractor's discretion to meet the Final Acceptance performance criteria. Contractor shall notify the Engineer of planned additional maintenance activities prior to implementation.

3. Final Acceptance:

   a. Final Acceptance will occur at the end of the Planting Bed Establishment Period.

   b. Prior to Final Acceptance, the Engineer shall determine if planted materials are in a healthy condition.

   c. Contractor shall replace all dead or visibly dying plants consistent with the planting bed execution requirements.

d. All replacement and associated repair activities shall be at the Contractor's expense.

e. Contractor shall maintain newly planted areas for a period of fifteen (15) days.

END OF SECTION 32 90 00

SECTION 32 92 19
SEEDING
(Reference MPWSS Section 02910)

All applicable portions of MPW standard specification Section 02910 shall apply with the following additions, deletions and/or modifications.

PART 2 - PRODUCTS

2.01 SEED

Add following:

E. Seed mixtures shall be proportioned as follows:

1. Dryland Seed.

Seed Species or Variety	Seed Mix %	Application Rate
Western Wheatgrass	20%	21 lbs. Per acre
Pryor Slender Wheatgrass	20%	
Crituna Thickspike Wheatgrass	30%	
Sudar Stream Bank Wheatgrass	20%	
Canada Bluegrass	10%	

Note: All seed shall be 98% pure and shall have a germination percentage of 90%. Do not sow immediately following rain, when ground is to dry, or during windy periods. Apply water with fine spray after seeding. Saturate to 3 inches of soil.

2. Lawn or Turf Grass Seed.

Lawn or turf grass seed shall be a blend of at least 24 percent Kentucky Bluegrass plus a blend of at least three other bluegrasses in approximately equal proportions. Acceptable blend grasses include Adelphi, Silkins, Birka, Nuglade, Rambo, Ram Eclipsey, Quantum, Merian, Nustar or others commonly used in the area by sod producers.

2.02 TOPSOIL

Add the following:

1. Topsoil shall be the existing top 6-12 inches of silty sand surface layer of soil at the site with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (1.0 inches or more in diameter), clay lumps or similar objects. Brush and other vegetation which will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary herbaceous growth such as grass and weeds do not need to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. The Contractor will be required to compact the topsoil to reduce settling and ensure a uniform grade in the disturbed areas.

2.04 FERTILIZER

Add the following:

C. Fertilize uniformly across all surfaces at the following rate:

Dryland Grass

Nitrogen	25 lbs/acre
Phosphate	25 lbs/acre

Lawn Grass

Nitrogen	50 lbs/acre
Phosphate	50 lbs/acre

2.05 MULCH

Add the following:

A. Mulch with a loose 1-inch layer of straw.

PART 3 - EXECUTION

Add the following:

3.05 CARE OF SEEDED AREAS

D. All weeds including (spotted knapweed, leafy spurge, and all others identified by the State of Montana as non-native) shall be controlled by the Contractor while grass is becoming established and during the full one year warranty period after the project is complete and accepted by the Owner. Chemical control may be utilized where permitted by State Laws and regulations.

PART 4 - MEASURMENT AND PAYMENT

DELETE: Entire Section

END OF SECTION 32 92 19

SECTION 32 92 23
TOPSOIL AND SODDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section

1.02 GENERAL

A. This section covers the work necessary to furnish, haul, and place approved topsoil and live sod on prepared areas at the locations shown on the Drawings or as directed by the Engineer.

1.03 SUBMITTALS

A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.

1. Topsoil particle size analysis; characterization; acidity; salinity; organic matter percentage.
2. Sod supplier name, address and telephone number.
3. Grass mixture contained in sod.
4. Manufacturer’s Fertilizer Data Sheets.

PART 2 - MATERIALS

2.01 TOPSOIL

A. Topsoil shall consist of friable surface soil reasonably free of grass, roots, weeds, sticks, stones, or other foreign materials.

B. The topsoil shall consist of sandy loam, with soil particles within the following percentages: clay; 0-25; silt; 25-50; sand; 50-70; decomposed organic matter; 5-10.

C. The clay content is optional.

D. The soil shall have a soil acidity range between a pH 5.0 to pH 7.0. The soil salinity

E. shall not exceed 3 millimhos per centimeter at 25oC (as described by USDA Circular

F. No. 982).

G. The Contractor shall notify the Engineer of the source of topsoil not less than 10 days prior to excavation.

2.02 SOD

A. Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period.

B. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil.

C. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials which might be detrimental to the development of the sod or to future maintenance.

D. Sod shall be 100 percent Kentucky Bluegrass.

E. Before harvesting, the turfgrass shall be mowed to a uniform height of not more than 5/8".

F. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than 2 inches.

2.03 WATER

A. The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass. It shall be subject to the approval of the Engineer prior to use.

PART 3 - EXECUTION

3.01 GENERAL

A. Areas to be solid, strip, or spot sodded are shown on the Drawings. Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition which are to remain undisturbed shall also be shown on the Drawings.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil

C. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

D. Uniformly moisten excessively dry soil that is not workable or which is dusty.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARING THE GROUND SURFACE

A. Placing and spreading of topsoil shall not be done when the ground is frozen, excessively wet or otherwise in a condition detrimental to the work. Surfaces designated to be covered shall be lightly scarified just prior to the spreading operation. Compaction of topsoil will not be required.

B. After placement is completed the surface of the topsoil shall be finished to a reasonably smooth surface.

C. After application of the topsoil and grading of areas has been completed and before applying fertilizer, areas to be sodded shall be raked or otherwise cleared of stones larger

than 2 inches in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

D. All areas to receive sod or turf grass seed shall have the native material properly scarified, a minimum of 6" of approved topsoil applied and lightly rolled, prior to installation of the sod or seed.

E. Over-compaction the topsoil at any time before or during application of the sod or seed is not acceptable.

3.03 APPLYING FERTILIZER

A. Following ground surface preparation, fertilizer shall be uniformly spread at the rates specified below.

1. All areas shall be fertilized with an inorganic chemical fertilizer with the following nutrients:

a. Nitrogen (Elemental) 40 lbs/acre

b. Phosphorus (P205) 60 lbs/acre

c. Potassium (K20) 30 lbs/acre

3.04 OBTAINING AND DELIVERING SOD

A. After inspection and approval of the source of sod by the Engineer, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 2 inches. Sod sections or strips shall be cut in uniform widths, not less than 10 inches, and in lengths of not less than 18 inches, but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside.

B. The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, permission to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

3.05 LAYING SOD

A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not

stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. After establishment, if necessary to smooth surface, tamp and roll lightly to remove surface undulations. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. On slopes exceeding 1:6, and in V-shaped or flat-bottom ditches or gutters, the sod shall be pegged with wood pegs not less than 12 inches in length and have a cross-sectional area of not less than 3/4 square inch. The pegs shall be driven flush with the surface of the sod.

C. Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the Engineer, provided the sod bed is watered to moisten the soil to a depth of at least 4 inches immediately prior to laying the sod.

D. The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and insure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen when replacing it shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately 1 inch below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

3.06 WATERING

A. Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner which will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

3.07 ESTABLISHING TURF

A. General. The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work.

B. Protection. All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the Engineer.

C. Mowing. The Contractor shall mow the sodded areas with approved mowing equipment,

depending upon climatic and growth conditions and the needs for mowing specific areas. In the event that weeds or other undesirable vegetation are permitted to grow to such an extent that, either cut or uncut, they threaten to smother the sodded species, they shall be mowed and the clippings raked and removed from the area.

3.08 REPAIRING

A. When the surface has become bullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the Engineer, and shall then be re-sodded.

END OF SECTION 32 92 23

SECTION 32 97 00
RESTORATION OF DISTURBED AREAS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Restoration of all areas disturbed during construction.
2. Restoration of all items not specifically identified for restoration, but damaged through construction.

B. Related Sections include:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.
4. Division 32 – Exterior Improvements.

1.02 REFERENCES

A. Reference Standards include:

1. Montana State Highway Department Standard Specifications for Road and Bridge Construction, latest edition.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Material Sections include:

1. Topsoil and Subsoil: Per Section 32 92 23.
2. Aggregate Materials: Per Section 32 11 23.
3. Seed: Per Section 32 92 19.

PART 3 - EXECUTION

3.01 EXECUTION

A. Observe all surface features requiring protection, removal and replacement, and/or restoration prior to construction.

B. The Contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

C. The Contractor shall be responsible for all damage or injury to property of any character during the prosecution of the Work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the Work, or at any time due to defective Work or materials, and said responsibility will not be released until the Project shall have been completed and accepted.

D. When any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work, or in consequence of the non-execution thereof by the Contractor, he shall restore, at his own expense, such property to the condition similar or equal to that existing before such damage or injury was done by repairing, rebuilding, or otherwise restoring as may be directed or he shall make good such damage or injury in an acceptable manner.

3.02 RESTORATION

A. Restore all areas disturbed by construction to a condition equal to or better than existed prior to construction.

B. Replace, restore, repair, or otherwise make good any damage done to any tree, bush, or shrub that is not specifically designated for removal.

C. Restore items such as culverts, road signs, power poles, sodding, fences, driveways, mailboxes, and like, whether or not specifically identified on the Drawings, to a condition equal to or better than existed before construction.

D. Replace or repair all concrete or asphalt roads or driveways, removed or damaged during construction with equal or better materials. Replace or repair to match existing conditions.

E. Stabilize subgrade sufficiently to prevent mixing of granular material with subgrade prior to application of base material.

F. Place topsoil per Section 32 92 23 and seed areas disturbed by construction in grassed areas per Section 32 92 19.

G. All damage to streets, driveways, berms, etc. due to the Contractor’s construction techniques and equipment shall be repaired at the Contractor’s expense prior to final payment.

H. Remove all excess dirt, concrete, and other debris from work area immediately upon completion of Work and deposit on-site in a disposal area designated by Owner. Contractor shall be required to clean site to the condition prior to the start of construction before final payment will be made.

I. All restoration shall be completed prior to opening any section of Work.

END OF SECTION 32 97 00

DIVISION 33

UTILITIES

SECTION 33 01 10.58
DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Disinfection of potable water system.
2. Testing and reporting results.

B. Related Sections include, but are not limited to:

1. Section 01 33 00 – Submittal Procedures.
2. Section 01 40 00 – Quality Control.
3. Section 01 77 00 – Closeout Procedures.
4. Section 33 31 19 – Site Water Utility Distribution Piping.

1.02 REFERENCES

A. Reference Standards include, but are not limited to:

1. AWWA B300 - Standard for Hypochlorites.
2. AWWA B301 - Standard for Liquid Chlorine.
3. Federal Specifications BB-C-12a, O-C-114a, and O-C-602b.
4. AWWA C651 – Disinfection of Water Mains.
5. Montana Public Works Standard Specifications.

1.03 SUBMITTALS FOR INFORMATION

A. Submit under provisions of Section 01 33 00.

B. Test Reports: Indicate results comparative to specified requirements

1.04 DEFINITIONS

A. Disinfectant Residual means the concentration of disinfectant in the treated water.

B. PPM means parts per million.

1.05 QUALITY ASSURANCE

A. Regulatory Agency Requirements: Comply with Montana Department of Environmental Quality (DEQ) requirements.

B. Perform work in accordance with AWWA C651 for the disinfection of water main

C. Testing Firm: Company specializing in testing potable water systems, approved by the DEQ. Contractor shall obtain sampling bottles from an approved laboratory and perform sampling per project requirements and sampling protocol. Contractor shall coordinate

sampling and testing schedule with the laboratory. Contractor shall pay all testing fees and lab costs.

D. Submit bacteriologist's signature and authority associated with testing.

E. The cleaning and disinfection work shall be conducted prior to connection to the existing water lines or to any portion that has been put into service. Unless otherwise approved, hydrostatic testing shall be completed prior to final cleaning and disinfection.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect against damage and contamination.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 and 80 degrees F.

D. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.

1.07 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures and Section 01 77 00 – Closeout Procedures.

B. Disinfection report:

1. Type and form of disinfectant used.
2. Date and time of disinfection.
3. Test locations.
4. Initial and final disinfectant residuals (quantity in treated water) in ppm for each test.
5. Date and time of flushing start and completion.
6. Disinfectant residual after flushing in ppm for each location test.

C. Bacteriological report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and final disinfectant residuals in ppm for each test location.
6. Coliform bacteria test results for each test.

PART 2 - PRODUCTS

2.01 ACCEPTABLE DISINFECTION CHEMICALS

A. AWWA B300, Hypochlorite: Shall conform to Federal Specification O-C-114a, Type II, Grade B, or Federal Specification O-C-602b.

B. AWWA B301, Liquid Chlorine: Shall conform to Federal Specification BB-C- 120a.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that piping system has been cleaned, inspected, and pressure tested.

B. Do not start Work until conditions are satisfactory.

C. Select one form of chlorine for use in disinfection.

D. Flush mains thoroughly before introduction of chlorinating material. Maintain flushing velocity in main of not less than 2.5 feet per second unless the Engineer determines that conditions do not permit the required flow to be discharged to waste.

3.02 DISINFECTION OF WATER SYSTEMS

A. Provide and attach required tools, equipment, and materials to perform the Work of this Section. Disinfectant material shall be introduced into the water system in a manner approved by the Engineer. For wells, add the required amount of chlorination material into the casing before installation of pumping equipment. Agitate as required for thorough mixing.

B. Use of calcium hypochlorite granules for use on solvent welded plastic or on screwed joint steel pipe is prohibited because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

C. Perform disinfecting in accordance with AWWA C651 prior to start-up. Coordinate with other Contractors, Engineer, and Owner.

D. Inject treatment disinfectant into piping system to obtain 50 to 80 ppm residual.

E. Test for disinfectant residual at each of the following locations:

1. End of piping runs.

F. Maintain disinfectant in system for 24 hours. If disinfectant residual is less than 25 ppm, repeat system treatment.

G. All water supply and distribution mains shall be disinfected with chlorine prior to acceptance by the owner.

H. As chlorinated water flows past new fittings and valves, related valves shall be operated so as to disinfect appurtenances and pipe branches. All valves shall be opened and closed several times during the contact period.

I. Drain and flush using fresh water pumped through the system.

J. Flush heavily chlorinated water from main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system.

K. Provide bacteriological test at Owner or Engineer’s request.

L. Any sections of equipment in contact with water shall be swabbed with a chlorine solution prior to installation.

M. Properly dispose of heavily chlorinated water supply in an environmentally acceptable manner.

N. Contractor shall pay all testing costs.

3.03 BACTERIOLOGICAL TESTING

A. After disinfection and flushing, test water for bacteriological contamination. Samples for bacteriological analysis shall be collected in sterile bottles obtained from the testing laboratory and submitted for testing.

B. Samples shall be taken from the hydrants. Duplicate samples shall be collected from each hydrant.

C. Two or more successive test samples indicating bacteriological satisfactory water shall be obtained before facility is placed into operation.

D. If contamination is shown to be still present in the water supply, the disinfection procedure shall be repeated.

E. All testing costs shall be paid by Contractor.

3.04 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Control: Field inspection and testing.

B. Samples for bacteriological analysis shall be collected in sterile bottles.

C. Two or more successive test samples indicating bacteriological satisfactory water shall be obtained before any system is placed into operation.

END OF SECTION 33 01 10.58

SECTION 33 05 26
UTILITY IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Marking tape.

B. Related Sections include, but are not limited to:

1. Section 01 33 00 – Submittals.
2. Section 31 23 33 – Trenching and Backfilling.
3. Section 33 31 13 – Site Sanitary Sewerage Piping
4. Section 33 31 19 – Site Water Utility Distribution Piping.

1.02 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Shop Drawings: Submit manufacturer's data on materials furnished indicating compliance with the specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Marking Tape:

1. "Terra Tape" as manufactured by REEF Industries, Inc., or Omega Marking Company.
2. Size: 3”.
3. Marking Tape Schedule and Warning Notice:

Pipeline	**Warning Notice**	**Color**
Sanitary Sewer	Caution Buried Sewer Line Below	Green
SS		
Force Main	Caution Buried Force Main Below	Green
AIR / FDD/ IMLR / VFA / RAS / SCM / WAS		
Potable Water Main	Caution Water Line Buried Below	Blue
PW		
Non Potable Water	Caution Non Potable Water Line Buried Below	Purple
NPW		
Electric	Caution Electric Line Buried Below	Red
Gas	Caution Gas Line Buried Below	Yellow
OTHERS	Caution ---------- Buried Below	TBD

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the marking tape 24" below finished grade directly above and parallel with pipelines. Marking tape shall be installed for all site piping outlined in Sections 33 31 13, 33 31 19 and the Piping Schedule and shall be labeled in accordance with this section.

B. At each manhole, bring the marking tape up to the manhole to a point approximately 24 inches below finished grade. Drill through the manhole and pull the detector tape through the manhole and label the loose end with a plastic marker. Grout hole with non-shrink grout or water stop material.

END OF SECTION 33 05 26

SECTION 33 05 33.34
MEMBRANE LINER VENTING AND DRAINAGE SYSTEM

PART 1 - DESCRIPTION

1.01 This work shall consist of providing and placing a Leak Detection and Venting System (LDVS) comprised of a solid core geo-composite, prefabricated, gas collection system (collection system) as described in the plans. *The purpose of the system is to collect gases that may accumulate under the Biosolids Treatment Basin membrane liner and vent them to the atmosphere.* The system shall be installed in accordance with these specifications and in close conformity with the locations and dimensions as shown on the plans or specified by the engineer. The quantities of materials as shown on the plans may be increased or decreased at the discretion of the engineer based on actual site conditions that occur during construction of the project. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

PART 2 - MATERIALS

2.01 The collection system shall be of a flexible, prefabricated, drainage/collection product, consisting of an inner core described in 2.01.A and an outer geotextile wrap described in 2.01.B. The outer wrap shall function only as a filter and shall not be a structural component of the core.

A. The collection system core shall be made of a high-density polyethylene. The core shall be constructed using interconnected corrugated pipes that define and provide the flow channels and structural integrity of the collection system. Perforations shall be evenly distributed on both faces of the core. The core of the collection system shall conform to the following physical property requirements.

Thickness, inches	ASTM D-1777	1.0
Outflow Rate, gpm/ft*	ASTM D-4716	29
Compressive Strength, psf	ASTM D-1621 (modified sand method)	6000
Inlet Area / sq. ft.	Cross Sectional Flow Area	>50%

* - At gradient = 0.1, pressure = 10 psi for 100 hours.

B. The collection system core shall be wrapped with a non-woven geotextile fabric. The non-woven wrap shall be of a needle-punched construction consisting of long-chain polymeric fibers composed of polypropylene, polyethylene or polyamide. The fibers shall be oriented into a multi-directional stable network whereby they retain their positions relative with each other and allow the passage of water as specified. The fabric shall be free of any chemical treatment or coating, which reduces permeability and it shall be inert to chemicals commonly found in soil. The geotextile shall conform to the following minimum average roll values.

Weight (oz/yd^2)	ASTM D-3776	4.0
Tensile Strength, lb	ASTM D-4632	100
Elongation %	ASTM D-4632	50
Puncture, lb	ASTM D-751	50
Mullen Burst, psi	ASTM D-3786	200
Trapezoidal Tear, lb	ASTM D-4533	42
Coefficient of Permeability	ASTM D-4491	.1 cm/sec
Flow Rate, gpm/ft^2	ASTM D-4491	100
Permittivity, sec^{-1}	ASTM D-4491	1.8
Apparent Opening Size	ASTM D-4751	70 Max US Std Sieve Opening
Seam Strength, lb/ft	ASTM D-4595	100
UV Stability, 500 hrs.	ASTM D-4355	70%
Fungus	ASTM G-21	No Growth

2.02 The connectors used with the collection system shall be of a snap together design. In no case shall any product be joined without the use of the manufacturer's connector designed specifically for the purpose.

2.03 Transport pipe shall be either PVC pipe meeting the requirements of ASTM D-2729 or ASTM F-949, or high-density polyethylene pipe meeting the requirements of AASHTO M252.2.4.

2.04 The liner vent and drainage system shall be the 6" Multi-Flow LDVS manufactured by Varicore Technologies, Inc. of Prinsburg, MN or approved equal.

PART 3 - CONSTRUCTION REQUIREMENTS

3.01 The collection system shall be installed in a horizontal orientation and placed directly below the liner – within a 1.2" deep by 6" wide trench as indicated on the plan drawings.

3.02 The collection system and transport pipe shall be to the lines and grades shown on the plans.

3.03 The collection system shall be securely connected to the transport pipes using connectors approved by the manufacturer.

3.04 Connectors shall be installed in accordance with the manufacturer's recommendations.

3.05 Any damaged collection system or transport pipe shall be replaced or repaired by splicing in an undamaged section of like material.

END OF SECTION 33 05 33.34

SECTION 33 31 00.10
ABANDONMENT OF PIPING AND MANHOLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. This section includes abandonment in place of existing pipelines and manholes as indicated on the drawings for abandonment.

B. Related Sections include, but are not limited to:

1. Section 01 31 00 – Coordination and Meetings.
2. Section 01 33 00 – Submittals.
3. Section 01 40 00 – Quality Control.
4. Section 31 23 33 – Trenching and Backfilling.

1.02 REFERENCES

A. Reference Standards include, but are not limited to:

1. ASTM C150 – Standard Specification for Portland Cement.
2. ASTM C494 – Standard Specification for Chemical Admixture for Concrete.
3. ASTM C618 – Standard Specification for Fly Ash and raw or Calcined Natural Pozzolan for use as Mineral Admixture in Portland Cement Concrete.
4. ASTM C940 – Standard test Method for Expansion and Bleeding of Freshly Mixed grout for Replaced Aggregate Concrete in the Laboratory.
5. ASTM C1017 – Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete.
6. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (NonShrink).

1.03 DEFINITIONS

A. Abandonment. Pipeline abandonment consists of filling or plugging portions of existing pipelines with flowable fill or grout plugs, as indicated on the Drawings.

B. Bank Run Sand. Bank run sand shall be a locally available sand material to be used in abandoning existing manholes.

C. Flowable Fill. Flowable fill shall be controlled low-strength material consisting of fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in pipelines or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access. Long- term hardened strength shall be within

specified range.

D. Backgrouting. Secondary stage pressure grouting to ensure that voids have been filled within abandoned pipes. Backgrouting will only be required at critical locations indicated on the Drawings or if there is evidence of incomplete flowable fill placements.

1.04 SUBMITTALS

A. Submit flowable fill mix design report.

1. Flowable fill type and production method. Describe if fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at placement location.

2. Aggregate gradation of fill. Aggregate gradation of mix shall be used as pilot curve for quality control during production.

3. Fill mix constituents and proportions including materials by weight and volume, and air content. Give types and amounts of admixtures including air entrainment or air generating compounds.

4. Fill densities and viscosities, including wet density at point of placement.

5. Initial time of set.

6. Bleeding and shrinkage.

7. Compressive strength.

B. Submit sand gradation to be used in abandoning manholes.

C. Submit technical information for equipment and operational procedures including projected injection rate, grout pressure, method for controlling grout pressure, bulkhead and vent design and number of stages for grout application.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with Section 01 40 00.

1.06 PROJECT CONDITIONS

A. Verify all dimensions of and between existing structures and locations of existing piping and equipment required for the proper abandoning of existing piping.

B. Contractor shall be responsible for verification of location of all existing piping and structures. Potholing and or excavation to expose existing piping, conduits, etc. may be required prior to installation of new piping or connection to existing piping. Adjustments to the locations of new piping may be required due to locations of existing piping and sequencing of construction that will be required. Adjustments required shall be at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 FLOWABLE FILL

A. Design Mix Criteria. Provide design of one or more mixes to meet design criteria and

conditions for placement. Present information required by submittals, to include the following:

1. Cement: ASTM C150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 50 pounds per cubic yard.
2. Fly ash: ASTM C618, Class C or F. Volume and weight per cubic yard of fill. Provide minimum fly ash content of 200 pounds per cubic yard.
3. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.
4. Aggregate gradation: 100 percent passing 3/8-inch sieve and not more than 10 percent passing No. 200 sieve. Mix design report shall define pilot gradation based on following sieve sizes: 3/8 inch, No. 4, 8, 16, 30, 50 100 and 200. Do not deviate from pilot gradation by more than plus or minus 10 percentage points for any sieve for production material.
5. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, add at least 30 percent natural aggregate to provide workability.
6. Admixtures: use admixtures meeting ASTM C494 and ASTM C1017 as needed to improve pumpability, to control time of set and to reduce bleeding.
7. Fluidifier: Use fluidifier meeting ASTM C937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
8. Performance additive: Use flowable fill performance additive, if needed, to control fill properties.

B. Flowable Fill Requirements:

1. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
2. Placement characteristics: self-leveling.
3. Shrinkage characteristics: non-shrink.
4. Water bleeding for fill to be placed by grouting method in pipes: not to exceed 2 percent according to ASTM C940.
5. Minimum wet density: 90 pounds per cubic foot.

C. Grout Plugs

1. Cement-based dry-pack grout conforming to ASTM C1107, Grade B or C.
2. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned.

2.02 BANK RUN SAND

A. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D2487) meeting following requirements:

1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D1140. Amount of clay lumps or balls may not exceed 2 percent.
2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D4318: Plasticity index: not exceeding 7.
3. Engineer shall consider locally available materials not meeting the above criteria on a case by case basis.

PART 3 - EXECUTION

3.01 CUTTING AND CAPPING OF MAINS

A. Do not begin cut, plug, and abandonment operations until replacement pipe has been constructed and tested, all service connections have been installed, and main has been approved for use.

B. Install plug, clamp, and concrete reaction block and make cut at location shown on drawings.

C. Pipe to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on drawings.

D. After pipe to be abandoned has been cut and capped, check for other sources feeding abandoned pipe. When sources are found, notify Engineer immediately. Cut and cap abandoned pipe at point of other feed as directed by Engineer.

E. Plug or cap ends or opening in abandoned pipe in manner approved by Engineer. Install concrete around cap and over pipe to ensure it’s not penetrable by groundwater.

F. Remove and dispose of surface identifications such as cleanouts, curb boxes, and valve boxes.

G. Backfill excavations in accordance with Section 31 23 33.

3.02 PREPARATION FOR ABANDONMENT VIA FLOWABLE FILL

A. Have fill mix design reports and other submittals required by Submittals accepted by Engineer prior to start of placement. Notify Engineer at least 24 hours in advance of grouting with flowable fill.

B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.

C. During placement of fill, compensate for irregularities in existing pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

D. Perform demolition work prior to starting fill placement. Clean placement areas of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in

place if filling more than 2 percent of placement volume.

E. Remove free water prior to starting fill placement.

3.03 EQUIPMENT FOR FLOWABLE FILL

A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.

B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.04 INSTALLATION OF FLOWABLE FILL

A. Abandon existing piping underneath roadway and paved areas by completely filling pipe with flowable fill.

B. Continuously place flowable fill from end to end with no intermediate pour points.

C. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.

D. Temporarily plug pipes which are to remain in operation during pouring/pumping to keep lines free of flowable fill.

E. Pump flowable fill through bulkheads or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.

F. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill pipe from downstream end, to discharge at upstream end.

G. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.

H. Remediate placement of flowable fill which does not fill voids in pipe, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside pipe or from surface.

I. Plug each end of pipe being abandoned.

3.05 FORCE MAIN ABANDONMENT

A. Clean inside surface of force main at least 12 inches from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare exterior pipe surface if manufactured cap is to be used.

B. When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.

C. When using manufactured plug or cap, install fitting as recommended by manufacturer’s instructions, to form water tight seal.

D. Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 31 23 33.

E. Collect and dispose of excess flowable fill material off site.

3.06 ABANDONING MANHOLES

A. Contractor shall remove top slabs and first section of manholes to be abandoned and any other specified pumps or accessories prior to abandoning.

B. Contractor shall abandon manholes after piping has been grouted and abandoned.

C. Manholes shall be filled with bank run sand material and compacted in 1-foot lifts.

D. Material as specified in Section 31 05 13 shall be compacted over abandoned material and prepared for improvement as shown on the Construction Drawings.

3.07 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions as required by OSHA and applicable state and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to work.

END OF SECTION 33 31 00.10

SECTION 33 31 13
SITE SANITARY SEWERAGE PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. Furnish sewer pipe and fittings as specified in the Contract and this section. Pipe strength classifications are shown on the plans, listed in the Contract Documents or specified herein.

1.03 CERTIFICATION BY MANUFACTURER:

A. Furnish a manufacturer's certification for all pipe and fittings, certifying that the pipe and fittings meet the contract requirements.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE:

A. GENERAL

1. Furnish PVC pipe produced by a continuous extrusion process, employing a prime grade of unplasticized polyvinyl chloride. Assure the grade used is highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents and other chemicals found in sewage and industrial wastes. Assure the material meets "Rigid Polyvinyl Chloride Compounds", ASTM Designation D-1784 requirements. Assure the pipe has self-extinguishing flammability characteristics.

B. GRAVITY SEWER PIPE

1. Furnish gravity sewer pipe meeting one of the following requirements:

a. ASTM D-3034, "Standard Specifications for Polyvinyl Chloride Sewer Pipe and Fittings", with an SDR of 35 4"-15" (10 cm - 38 cm).

b. ASTM F679, T-1 wall thickness (SDR35), "Standard Specifications for PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings" 18"-27" (46 cm - 69 cm).

2. Furnish pipe having nominal 12.5 feet (3.8 meters) laying lengths, except shorter lengths may be used adjacent to manholes, or other appurtenances. Assure each pipe section is marked, as a minimum, with size, SDR, "Sewer Pipe" and Code Number.

C. PRESSURE SEWER PIPE

1. Furnish pressure sewer pipe meeting ASTM D2241, "Standard Specification for Polyvinyl Chloride Plastic Pipe (SDR-PR), with an SDR of 26 and a pressure rating of 160.

2. Use a nominal laying length of 20 feet (6.1 meters), except shorter lengths may be used adjacent to bends or other appurtenances. Assure each pipe length is marked, as a minimum, with size, SDR or pressure rating or both, ASTM designation and manufacturer's name and code.

D. PIPE JOINTING

1. Furnish each pipe length with a bell designed to provide a watertight joint when jointing the bell and spigot with a rubber ring.

2. Make a rubber gasket joint for PVC pipe and fittings using a rubber gasket compressed between the outer surface of the spigot and the inner surface of the bell. Assure the joint is completely sealed by the gasket so that the assembly remains watertight under all service conditions, including expansion, contraction, settlement and pipe deformation. Follow the manufacturer's recommendations when assembling the rubber ring joint.

E. FITTINGS

1. Assure all fittings for connecting all gravity and/or pressure piping and service lines are of the same material, construction and joint design as specified.

2.02 CONCRETE PIPE

A. GENERAL

1. Furnish concrete sewer pipe meeting ASTM Specifications C14, C76 or C655, latest revision, except as noted herein. Assure cement used to make concrete pipe is Type II A Modified, Type V, or other approved cement containing less than 5 percent Tricalcium Aluminate. The pipe strength classifications for C14, C76 or C655 specification pipe is listed in the plans or Contract Documents.

2. The maximum absorption allowed is 7 percent. For pipe sizes smaller than 12 inches (30 cm) in diameter, assure the cement proportion in the concrete mixture is not less than 6-1/2, U.S. standard 94 pound bags per cubic yard (362 kg/m3) of concrete.

3. Furnish pipe meeting the referenced ASTM specifications on permissible variations in pipe dimensions. Assure the barrel thickness is uniform to providing a constant flow area without projections across joints.

B. FITTINGS

1. Assure all fittings for connecting all gravity and/or pressure piping and service lines are of the same material, construction and joint design as specified.

C. JOINTING MATERIALS

1. Make joints for concrete pipe using flexible, watertight, rubber-type gaskets meeting to ASTM C443, with a O-ring gasket confined in the pipe tongue groove.

D. PIPE JOINTING

1. Thoroughly clean the spigot and bell ends of the pipe before joint assembly. Follow the pipe and joint manufacturer's recommendations for pipe jointing. Check the

position of the rubber gaskets and pipe assembly using a feeler gauge before backfilling the trench. Visually inspect and gauge pipe and joints from inside the pipe where pipe size permits to assure proper gasket position and joint gap tolerances.

E. MATERIALS TESTING

1. Have the pipe supplier furnish the Engineer with certified test results from an independent testing laboratory on the following: (a) crushing strength (3-edge bearing method), (b) absorption, and (c) hydrostatic test. Furnish test results for each pipe as specified in ASTM C14, C76 or C655, or a minimum 2 percent of the number of pipe supplied, whichever is greater. Cost of these tests to be borne by the pipe supplier.

2.03 HIGH DENSITY POLYETHYLENE (HDPE) PIPE:

A. PIPE

1. Furnish HDPE pipe meeting ASTM D3350, having a cell classification of PE 34-5434C. Assure dimensions and workmanship meet ASTM F714 requirements.

B. FITTINGS

1. Use wye or tee fittings for connecting service lines of the same material construction, and joint design as the main sewer pipe.

C. PIPE JOINTING

1. Heat fusion weld all field joints to meet the manufacturer’s recommendations.

D. OTHER PIPE MATERIALS:

1. Other pipe materials may be specified at the discretion of the Engineer and Owner.

2.04 MANHOLES:

A. Construct manholes from precast concrete sections having frames, covers, and steps meeting applicable Standard Drawings.

B. Precast Concrete Sections

1. Furnish manholes meeting ASTM C478; “Precast Reinforced Concrete Manhole Sections”, specifically including mandatory rejection requirements.

C. Steps

1. Furnish non-corrosive steps, 12-inches in width, of ½” steel rod encased with polypropylene. Assure steps withstand 400 lb. vertical loads and 1,000 lb. pull-out resistance.

D. Frames and covers

1. For paved areas furnish D & L Foundry A- 1178 ring and cover, or East Jordan Iron Works 3771/3772 series ring and cover, or approved equal. Assure that all covers have two pick holes, 1” minimum, 1 ¼” maximum diameter. Cover

lettering shall be “Sanitary Sewer”. For gravel areas furnish D&L Foundry A-1172 with 1” cover or East Jordan Iron Works 3772 series cover, O-ring frame or approved equal, with recessed pick holes.

E. Concrete Base

1. Furnish precast concrete bases or field poured on undisturbed earth. Use concrete meeting Section 03 30 00 – CAST IN PLACE CONCRETE

PART 3 - EXECUTION

3.01 PIPE AND SERVICE LINE INSTALLATION

A. Excavation and Backfill

1. Perform pipeline excavation and backfill meeting the applicable requirements of Section 31 23 33.

B. Responsibility for Materials

1. Be responsible for all material furnished. Replace all material found defective in manufacture or damaged in handling after delivery. This includes furnishing all material and labor required for the replacement of installed material discovered defective before final acceptance of the work or during the guarantee period.

2. Be responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.

C. Handling of Pipe

1. Deliver and distribute all pipe to the site. Load and unload pipe, fittings and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop any materials. Do not roll or skid pipe handled on skidways against pipe already on the ground.

2. In distributing the material at the site of the work, unload each piece opposite or near the place where it is to be laid in the trench. Keep the interior of all pipe and other accessories free from dirt and foreign matter at all times.

3. Handle pipe to prevent damaging coating or lining. Ifany part of the coating or lining is damaged, make all repairs in a manner satisfactory to the Engineer.

D. Laying Pipe

1. Lay and maintain all pipe to the specified lines and grades with fittings, tees and manholes at the required locations. Establish line and grade using batter boards and string line, laser equipment or other approved methods. When batter boards and string line are used, use a minimum of three batterboards at all times.

2. Install wye or tee fittings in the mainline sewer for service line connections. Furnish wye or tee fittings of the same material, design and specifications as the sewer main pipe. Joint service pipe to tee branches or main line pipe other than PVC using special joint adapters manufactured specifically for jointing the two types of pipe.

3. Use tools and equipment, satisfactory to the Engineer, for the safe and convenient prosecution of the work. Carefully lower all pipe and fittings into the trench to prevent damage to pipe materials and protective coatings and linings. Do not drop or dump any materials into the trench.

4. Take every precaution to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, close the open ends of pipe using a plug or other means approved by the Engineer. Clean and remove all sand, gravel, concrete and cement grout that has entered the lines during construction

E. Tolerances

1. Install the pipe within 1/2-inch (13 mm) of the specified alignment and within 114-inch (6 mm) of the specified grade.

3.02 MANHOLES

A. Construction

1. Construct manholes to the specified dimensions. Make invert channels smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Make changes in flow direction with a smooth curve of as large a radius as the manhole size will permit. Make changes in channel grade and size gradually and evenly. The invert channels may be formed directly in the manhole base concrete or by laying half-pipe in the concrete. Make the floor of the manhole outside the channel smooth and slope toward the channel at one inch per foot (8 cm per meter).

2. Joint all connections between manhole walls and base and between wall sections adjusting rings and frame making the manhole watertight. For all horizontal joints located below the established high groundwater elevation, install a preformed rubber gasket joint. The established high groundwater level is shown on the plans or noted in the Special Provisions. For all sewer pipe to manhole joints, use gasketed, flexible, watertight connections that will accommodate differential settlement. Acceptable options for these connections to the manhole are as follows:

a. Adjacent Joints: Bell and spigot pipe joints with rubber sealing rings located within 12 inches (30 cm) of the manhole wall.

b. Compression-Type Flexible Connector: A resilient, flexible connection, cast into manhole wall, providing 10 degrees deflection.

c. Boot-Type Flexible Connector: A flexible, watertight connection consisting of a rubber gasket or boot, metal expansion ring and a metal take-up clamp. Assure the expansion ring holds the gasket in the manhole wall, with the take-up clamp holding the gasket to the pipe.

d. Options (b) and (c) are limited to precast manhole base inverts and other installations where the flexibility of the connection is not compromised.

e. Construct manholes meeting ASTM C478, and the rejection criteria stated therein.

f. Keep manhole construction within one manhole distant behind sewer pipeline construction.

3. Install adjusting rings on each manhole to bring the manhole top elevation to match the existing or specified ground elevations. Use manhole rings with a 2-inch minimum (5 cm) and 12-inch (30 cm) maximum neight. Furnish adjusting rings reinforced with the same percentage of steel as the riser and top.

3.03 SANITARY SEWER SERVICE LINES

A. Construct service lines meeting Standard Drawing 02730-2. Install the service line to the property line. Plug the end of the service line with a stopper and gasket, using a gasket of the same type used for pipe jointing. Do not grout the plugs.

B. Mark the sanitary sewer and storm drain service line ends at the property line using a steel fence post 5 feet (1.5 m) long, buried at least 2 feet (0.6 m). Place a 2" X 2" (5cm X 5 cm) wood marker extending from the pipe invert to ground line. Wire the 2" X 2" (5cm X 5 cm) marker to the steel fence post. Where applicable, mark the concrete curb to identify the service locations. Paint sanitary sewer service markers green and storm drain service markers gray.

3.04 TESTS

A. Make all tests after backfill is completed, but before any surface restoration or street surfacing. Be responsible for finding and repairing all breaks and leaks revealed by the tests. Additionally, perform all tests in the presence of the Engineer, resident inspector, or the Owner's other designated representative.

B. Light Test (Visual)

1. After the trench has been backfilled and compacted as specified in Section 02221, perform a light test between manholes to checkhlignment and grade for pipe displacement. Excluding curved alignments shown on the plans, the completed pipeline is to permit a true circle of light to be visible from one manhole to the next. Ifalignment or grade is not that specified and displacement of pipe is found, remedy all defects.

C. Leakage Test

1. New sewer line will not be finally accepted until leakage tests are made assuring the Engineer that pipe laying and jointing are satisfactory.

D. Water Test

1. Where groundwater is at least 2 feet (0.6 m) above the sewer line, make tests by sealing off the section of lines between manholes anq measuring the actual flow by collecting or pumping the discharge into barrels or other approved methods. Continue tests at a minimum of 4 hours for each section tested. Allow time to soak lines and manholes in advance of performing tests.

2. When groundwater is not 2 feet (0.6 I11) above the pipe, test as follows: On flat slopes where the depth over the centerline of the pipe in the lower manhole of the

section being tested will be not more than 10 feet (3 m), fill the upper manhole to 2 feet (0.6 m) over the top of the pipe or 2 feet (0.6 m) above the groundwater elevation (whichever is higher), and block the lower manhole. When the above conditions cannot be met, the Engineer may order testing the line in sections between manholes. Measure the leakage by checking the water level drop in the manhole over a 4 hour period.

3. The allowable infiltration or exfiltration, including manholes, cannot exceed 200 gallons per day per mile of sewer per inch of pipe diameter (185 liters per day per kilometer of sewer per centimeter of pipe diameter). This does not exclude obvious and concentrated leaks and physical defects, such as open joints , pinched gaskets, cracked barrels or bells, etc. Make repairs on concentrated leaks, and as required to reduce infiltration or exfiltration leakage below the specified rate.

E. Air Test (Alternative)

1. As an alternate method to water testing, the Contractor may utilize low pressure air to test the sewer mains. Use the test procedure described below: Plug both ends of the pipe under test with airtight plugs and brace to prevent slippage and blowout. Furnish one plug with an inlet tap or other provision for connecting an air hose.

2. Equip the air supply hose, connected between the air compressor and the plug, with a throttling valve, an air bleed valve and a high pressure shutoff valve for control. Equip the low pressure side of the throttling valve with a tee for a monitoring pressure gauge, protected by a gauge cock. This cock is kept closed except when the pressure loss is being timed.

3. If the pipeline is submerged under groundwater, the back pressure, caused by the water head, is measured and added to the standard test pressures to compensate for the groundwater effect on the air test.

4. Apply air slowly to the pipeline until the pressure reaches 4.0 psig(27 .6 j). Throttle the air supply to maintain the internal pressure between 4.0 and psig (27.6 -24.1 j) for at least 2 minutes. During this time check the plugs with soap solution to detect any plug leakage.

5. When the pressure reaches exactly 3.5 psig (24.1 j), disconnect the air supply, start a stop watch and record the time for the pressure to drop to 2.5 psig (17.2 j). The minimum time allowed for the pressure drop is computed on an air loss rate of 3.5 cfm (5.9m 3 /min) or an air loss rate of 0.0030 cubic feet per minute (cfrn) per square foot (0.055 m 3 /min1per square meter) of inner pipe surface area under test, whichever rate yields the least time for the pressure drop. Should the time of the pressure drop between 3.5 and 2.5 psig (24.1 - 17.2 j) be less than the allowable specified time, make the necessary leakage repairs and repeat the air test.

6. Standard Drawing 02730-1 provides a nomograph which may be used to compute testing times for air testing. The nomograph computes results based upon English (U.S. Customary) units.

7. For single pipe size test sections, the length limits for minimum test times obtained

from Standard Drawing No.02730-1 entitled "Nomograph for Air Testing Gravity Sewer Mains" are contained in the following table.

TABLE 3.1

LENGTH LIMIT FOR MINIMUM TEST TIMES

Pipe Diameter, Inches (cm)	Test Section Length, Foot (m)	
	Minimum	Maximum
4 (10)	642(196)	1124(343)
6 (15)	429(131)	751 (229)
8 (20)	322(98)	564 (172)
10(25)	257(78)	450 (137)
12(30)	215(66)	376 (115)
15(38)	172(52)	300 (91)
18(46)	43(44)	1250 (76)
21(53)	123(37)	215 (66)
24(61)	107(33)	188 (57)

8. For test sections that are shorter than the minimum lengths, new test times must be calculated. This is done by multiplying the test time from the nomograph by the actual length of the test section (in feet) and then dividing the resultant product by the minimum test section length from the preceding table

9. For test sections exceeding the maximum lengths, either shorten the test section to an allowable length or use the water test.

F. Number of Tests

1. Perform the number of leakage tests directed by the Engineer to assure that materials and workmanship are acceptable. Repair defective joints using only approved methods . Replace pipe having cracked or broken barrels. Do not exceed 800 feet (240 m) of sewer line per test unless otherwise approved.

G. T.V. Inspection

1. All sewer mains shall be inspected using a television camera before final acceptance. A sewer line is deficient and unacceptable if (1) the alignment is outside the specified limits, (2) water ponds in any section are equal to or greater than 2 times the grade tolerance specified herein under Section 02730.3.E.1, or (3) the pipe has visible defects such as open joints, pinched gaskets, cracked barrels or bell, or similar defects.

2. Pay all costs incurred in any television inspection performed solely for Contractor benefit.

3. Record all television inspections in a format acceptable to the Owner. Pull the camera through the sewer at 30 feet per minute (9 meters per minute maximum). Ifthe camera is pulled by attaching to the hose of a hydraulic sewer cleaner, assure the hose is not active during the pulling process.

H. Deflection Testing

1. The Engineer may require deflection testing of all or any portion of a flexible pipe installation to assure the construction quality. Flexible pipe is pipe that will deflect at least 2 percent without any sign of structural distress.

2. Conduct deflection tests, when performed on PVC pipe, meeting ASTM D3034 and satisfy either of the following deflection limitations:

TABLE 3.2

DEFLECTION TESTING LIMITATIONS

Minimum Period Between Trench Backfilling & Testing	Minimum Mandrel Diameter as a Percent of Inside Pipe Diameter
7 Days	95.0
30 Days	92.5

3. Mandrels must have at least nine arms. Perform the mandrel test without mechanical pulling devices.

I. Material and Equipment for Testing

1. Furnish all labor, equipment and materials (including water) necessary for performing the sewer line tests at Contractor expense.

3.05 WATER AND SEWER MAIN SEPARATION

A. Horizontal and vertical separation between water and sewer mains is dictated by Montana Department of Environmental Quality.

END OF SECTION 33 31 13

SECTION 33 31 19
SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Piping Materials and Fittings
2. Polyethylene Encasement
3. Valves
4. Reaction Backing (Thrust Blocking)
5. Bedding and Backfilling
6. Ground Hydrants
7. Appurtenances
8. Pipe Installation
9. Pipe Thrust Restraint
10. Testing Gravity Lines
11. Testing Pressure Mains

B. Related Sections include, but are not limited to:

1. Section 00 95 10 – Special Provisions.
2. Section 01 31 00 – Coordination and Meetings.
3. Section 01 33 00 – Submittals.
4. Section 01 40 00 – Quality Control.
5. Section 31 05 13 – Soils for Earthwork.
6. Section 31 23 33 – Trenching and Backfilling.
7. Section 32 05 16 – Aggregates for Exterior Improvements.
8. Section 33 01 10.58– Disinfection of Utility Piping Systems.
9. Section 40 27 00 – Process Piping General

1.02 REFERENCES

A. Reference Standards include, but are not limited to:

1. ASTM A536 – Ductile Iron Castings.
2. ASTM B88 – Seamless Copper Water Pipe.
3. ASTM D3139 – Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
4. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Gray-Iron and Ductile-Iron Pipe and Fittings for Water.
5. ANSI/AWWA C105/A21.5 - Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids.
6. ANSI/AWWA C110/A21.10 - Gray-Iron and Ductile-Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids.
7. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Gray-Iron and Ductile-

Iron Pressure Pipe and Fittings.

8. ANSI/AWWA C150/A21.50 - American National Standard for Thickness Design of Ductile-Iron Pipe.
9. ANSI/AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
10. ANSI/AWWA C153/A21.53 - Ductile-Iron Compact Fittings, 3-Inch through 12-Inch, for Water and Other Liquids.
11. AWWA C509 - Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems.
12. AWWA C550 - Standard for Protective Epoxy Interior Coating for Valves and Hydrants.
13. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
14. AWWA C605 - Underground Installation of PVC Pressure Pipe and Fittings.
15. AWWA C800 - Standard for Underground Service Line, Valves, and Fittings.
16. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In., for Water.
17. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In., for Water Transmission and Distribution.
18. ASTM D1784 - Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds.
19. ASTM D1785 - Poly (Vinyl Chloride) Plastic Pipe, Schedules 40, 80, and 120.
20. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
21. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe fittings, Schedule 80.
22. ASTM F477 – Elastometric Seals (Gaskets) for Joining Plastic Pipe
23. NSF Standard No. 14, 60, and 61 - National Sanitation Foundation.
24. WW-T-779c – Federal Specifications

1.03 SUBMITTALS

A. Submit Shop Drawings per Section 01 33 00 for all pipe and fittings indicating: Name of Manufacturer, Materials, Standard Dimensions, References, Joint Data, maximum loadings, and thrust restraints.

B. Provide a list of materials and corresponding suppliers.

C. Submit Affidavit of Compliance certifying that materials furnished have been tested and are in compliance with specification requirements.

1. Submit design calculations for structural design of pipe thickness where pipe class or

thickness is not specifically called out.

D. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

E. Manufacturer’s Instructions: For valves, hydrants, and specialties, furnish in accordance with Sections 01 61 00 and 01 77 00 manufacturer’s printed instruction for delivery, handling, storage, assembly, installation, adjustment, special tool requirements, and maintenance requirements.

F. In accordance with Section 01 77 00, provide records of measured depths of water mains, service leads, valves, connections, transition couplings, adapters, thrust blocking; measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements; measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work; field changes of dimension and detail.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with Section 01 45 00.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.05 FIELD MEASUREMENTS

A. The Drawings indicate required pipe sizes and the general arrangement for major piping. Locations shall be verified in the field by the Contractor. Valves, fittings, and appurtenances shall be of such dimensions to allow for the installation of this piping substantially as shown on the Drawings. In the event it should become necessary to change the location of any of the work due to interference with other work, Contractor shall consult with the Engineer prior to making any changes and all such changes shall be made at no additional cost to the Owner.

B. Prior to roughing in any facilities or installation of piping and equipment, consult all related drawings including general, mechanical, electrical, etc., and inform self of materials, locations of structures, pipes, duct banks, electrical conduits, etc., which may impact the installation.

C. Discrepancies discovered before or after work has started, shall be brought to the attention of the Engineer immediately, and the Engineer reserves the right to require minor changes in the work to eliminate such discrepancies.

D. Pipe connections to equipment shall be subject to approval of Engineer and coordinated to meet the manufacturer’s recommendations and requirements.

E. No work that connects directly to equipment shall be installed before complete shop drawings of said equipment have been reviewed and approved by the Engineer.

1.06 PROJECT CONDITIONS

A. Verify dimensions of and between existing structures and locations of existing piping and equipment for the proper installation of all new piping and equipment.

B. Contractor shall be responsible for verification of location of all existing piping and

structures. Potholing and or excavation to expose existing piping, conduits, etc. may be required prior to installation of new piping or connection to existing piping. Adjustments to the locations of new piping may be required due to locations of existing piping and sequencing of construction that will be required. Adjustments required shall be at no additional cost to the Owner.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivered materials shall be stockpiled and stored at locations approved by the Owner until required for installation. Materials shall be transported, delivered, stored, and handled in accordance with Manufacturer's instructions and the requirements of Section 01 61 00.

B. Contractor shall inspect materials upon delivery for loss or damage in transit. Contractor shall be responsible for the replacement of damaged materials; damaged materials shall be removed from the Site.

1.08 REGULATORY REQUIREMENTS

A. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each product.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE (DIP) AND FITTINGS

A. The pipe and fittings furnished shall be of the Ductile Iron type as specified for each particular use or installation and shall be minimum Pressure Class 350 for pipe 4-12 inches and minimum Pressure Class 250 for pipe 14 inches and greater, unless otherwise noted.

B. Materials:

1. Ductile iron pipe shall conform to the requirements of AWWA C151/ANSI A21.51 with mechanical joints.

2. Mechanical or push-on joints shall conform to the requirements of AWWA C111/ANSI A21.11.

3. The weight, class, or nominal thickness and casing period shall be shown on each pipe. The manufacturer's mark, year produced, and letters "DI" or "Ductile" shall be cast or stamped on the pipe.

4. Mechanical joint fittings shall conform to the requirements of AWWA C110/ANSI A21.10 rated at 250 psi or 350 psi for sizes larger than 16 inches in diameter, and AWWA C110/ANSI A21.10 or AWWA C153/ANSI 21.53 rated at 350 psi for sizes up to and including 16 inches. No plain end fittings shall be allowed.

5. Rubber gaskets shall conform to the requirements of AWWA C111. Gaskets used for

air piping shall be EPDM.

6. All pipe joints and fittings shall have conductive gaskets with copper inserts or copper strap welded to the pipe and connected with silicone bronze bolt. The conductors shall be rated at 600 amps sustained current.

7. All ductile iron pipe and fittings shall be lined with cement mortar in accordance with AWWA C104/ANSI A21.4, unless otherwise noted. Ductile iron pipe and fittings used for air piping shall not be cement lined.

8. All ductile iron pipe and fittings shall be polyethylene encased in accordance with AWWA C105.

C. Air line piping shall not be lined with cement.

D. All exterior surfaces of pipe and fittings shall have a tar or bituminous seal coating conforming to AWWA C151. Spotty or thin seal coating, or poor coating adhesion, shall be cause for rejection of the materials.

E. Retainer glands for restrained joints shall be American, US Pipe, or EBAA Iron, Inc. Mega Lug type, ductile iron, and be designed to meet or exceed the pressure classification of the corresponding pipe. Restraint glands for mechanical joint pipe shall be EBAA Iron, Inc. Megalug, Series 1100, or equal. Push joint pipe shall be restrained using restraint harnesses EBAA Iron, Inc. Megalug, Series 1700, or equal. Joint restraint systems shall be rated for at a minimum the design pressure of the pipe with a 2 to 1 safety factor.

F. Restrained joint pipe may be used in lieu of joint restraint systems for push on and mechanical joint pipe. Restrained joint pipe shall be US Pipe TR Flex or American Flex Ring pipe, or equal.

G. Nuts, bolts, and tie rod restraints shall be 304 stainless steel. Tee bolts for mechanical joints and fittings shall be “Cor-Blue” by NSS industries, or equal.

H. See Section 33 05 26 for Utility Identification and tracer wire requirements.

2.02 POLYVINYL CHLORIDE (PVC) PIPE

A. The PVC pipe and fittings furnished shall be of the type as specified below for each particular use or type of installation.

B. Water Service Piping (1.5 to 2 inches diameter):

1. As specified in the piping schedule presented in the Construction Drawings.

2. Pipe, fittings, and valves shall be manufactured from a PVC compound which meets the requirements of Type I, Grade 1 PVC in accordance with ASTM D1784. Compound from which pipe is produced shall have a design stress rating of 2,000 psi at 23 degrees C, listed by the PPI.

3. Pipe, fittings, and valves shall be Schedule 80.

4. Pipe, fittings, and valves shall be installed in compliance with manufacturer’s recommendations and in accordance with ASTM D2274.

2.03 GAS LINE

A. Gas Line provided and installed by others, contact Northwest Energy prior to earthwork activities.

2.04 POLYETHYLENE ENCASEMENT

A. Conform to and install per ANSI/AWWA C105/A21.5.

B. Install on all underground metallic items, including: ductile iron pipe, ductile iron fittings, metal body valves, other metal pipe and fittings, fire hydrants, stainless steel couplings, transition couplings, and service and testing tapping saddles.

2.05 REACTION BACKING (THRUST BLOCKS)

A. Conform to details shown on Drawings for bends, tees, fire hydrants, dead end plug, and service tap connections.

B. 3,000 psi concrete for pipe, fittings, and plugs unless specifically shown otherwise on Drawings.

2.06 BEDDING AND BACKFILLING

A. Materials: As specified in Section 31 23 33 for backfill and pipe bedding.

B. Aggregate Bedding: Fill Type A1 for over-excavation and Fill Type A5 for standard bedding as shown on the Construction Drawings and specified in Section 32 05 16.

C. Material: Fill Type S1 or S2 as specified in Section 31 05 13.

2.07 VALVES

A. Resilient Wedge Gate Valves: 4-inch to 12-inch.

1. Minimum working pressure of 200 psi for 4-inch to 12-inch valves.
2. Valve body and rubber-encapsulated wedge constructed of ductile iron or cast iron.
3. Resilient seat gate, bubble-tight closure design.
4. Meet or exceed the ANSI/AWWA C515 standards.
5. Bronze stem and stem nut.
6. Fusion Bonded Epoxy-coated interior and exterior in accordance with AWWA C550.
7. Equipped with non-rising stem with 2-inch square operating nut, open left (counter clockwise) rotation.
8. Provide adjustable valve box, riser, and cover. Provide stem extensions for all actuators. Extension length will vary with the depth of bury for each valve and shall extend to within one (1) foot of top of valve box. Provide all necessary appurtenances for complete operation of valve.
9. Provide polyethylene encasement conforming to ANSI/AWWA C105/A21.5 for buried valves.
10. Connections: Mechanical joint.

11. Provide gaskets and stainless steel nuts and bolts.
12. Markings shall be cast on the bonnet or body of each valve and shall show the manufacturer's name or mark, year valve casting was made, size of valve, the letters "C515", and the designation working water pressure.
13. Manufacturer shall furnish an affidavit stating that the valve and all materials conform to the applicable AWWA requirements and all tests specified under the respective standard have been performed and have been met. Valves shall be NSF 61 certified.
14. Approved manufacturers:
    a. American Flow Control
    b. Mueller Company
    c. Waterous Valve Company
    d. M & H Valve Company
    e. Clow Valve Company
    f. Or approved equivalent.

B. Resilient Wedge Gate Valves, size 14" and Larger.
1. Standard: AWWA C-515, AWWA C-509, Non-rising stem.
2. Minimum rated working pressure: 250 psig for 18" and 150 psig for 30".
3. Finish: Interior and exterior fusion bonded epoxy coating meeting or exceeding requirements of AWWA C550 and complying with NSF-61.
4. Bevel Gear 6:1 Operator EXEECO IB8, or Approved Equivalent.
5. Connections: Mechanical joint.
6. Materials:
    a. Valve Body, Stuffing Box, and Bonnet: Ductile iron, ASTM A536.
    b. O-rings: Rubber.
    c. Lower Thrust Washer: Derlin.
    d. Upper Thrust Washer, Nuts, Bolts, and Flat Washer: Stainless steel.
    e. Stuffing Box Gasket: Rubber o-ring.
    f. Throat Flange Gasket: Rubber.
    g. Stem and Wedge Nut: Manganese bronze.
    h. Resilient Wedge: Ductile iron, ASTM A536 coated with rubber. The wedge shall symmetrically seal in both directions.
7. Warranty: 10 years.
8. Counterclockwise Open EPDM.

9. Approved Manufacturer:
    a. American Flow Control Series 2500.
    b. US Pipe and Foundry Company.
    c. Or approved equivalent.

2.08 GROUND HYDRANTS

A. Ground hydrants shall be self-draining, non-freezing, compression type with 2- 3/16" main valve opening. Inlet connection shall be 1.5" NPT and outlet shall be 1.5" NPT.

B. Ground hydrants shall have a cast iron box, locking lid, and 3" ductile iron riser pipe. Principal interior operating parts shall be brass and removable from the hydrant for servicing with excavating hydrant.

C. Bury depth shall be 6.0 feet minimum.

D. Hydrants shall be set in 4 cubic feet of crushed stone to allow for proper drainage of the hydrant, crushed stone shall be encased in filter fabric to prevent fouling of drain stone. Recommendation of the AWWA should be followed for installation of hydrants.

E. Ground hydrants shall be Eclipse No. 85 Box Hydrant as manufactured by John

C. Kupferle Foundry Company or Approved Equivalent.

2.09 VALVE BOXES

A. Valve boxes shall be three piece cast iron with a round base, Mueller H-10357 or Tyler Union.

B. The top of the valve boxes shall be 5 ¼ inches in diameter.

C. Valve box height shall be suitable for the burial depth of the valve and shall have sufficient length to permit at least 6-inches of adjustment above and below grade when the valve is laid to the specified depth. Adjustment shall be screw type.

D. Covers shall have the word "Potable Water" or "Non-Potable Water" or "Sewer" cast on top.

E. All buried valves shall have a full operator extension.

2.10 APPURTENANCES

A. Bolts: Stainless steel underground bolts, including all bolts on fittings, valves, and transition couplers. Tee bolts for mechanical joints and fittings shall be "Cor-Blue" by NSS industries, or equal.

B. Tie Bolts: Cretex Gasketed Pipe Joint Ties, or approved equivalent.

C. Service and Tapping Saddles:

1. All stainless steel tapped outlet, band clamps, nuts, bolts, and washers.

2. Heavy gauge type 304 stainless steel shell construction, passivated welds, double bolt type with minimum band width of 6 inches, and rubber "O"-ring gasket pad

meeting ASTM D2000.

3. Meet or exceed the ANSI/AWWA C800 standards, 200 psig.
4. Approved manufacturers:
    a. Romac Industries, Inc.
    b. Dresser Industries.
    c. The Ford Meter Box Company.
    d. Approved equivalent.

D. Tapping Sleeve:

1. Stainless steel full wrap around body.
2. All stainless steel tapped outlet, nuts, bolts, washers.
3. Gasket to provide seal around full circumference of pipe.
4. Approved manufacturers:
    a. Romac Industries, Inc.
    b. The Ford Meter Box Company.
    c. Approved equivalent.

E. Stainless Steel Couplings:

1. All type 304 stainless steel middle ring, followers, nuts, bolts, and washers construction.
2. Minimum length as required for joining cast iron pipe sizes as shown on plans.
3. Minimum rated working pressure of 250 psi.
4. Buna N rubber “O”-ring gaskets.
5. Approved manufacturers:
    a. Dresser Industries, Style 38.
    b. Approved equivalent

F. Transition Couplings:

1. Long pattern, sleeve type, ductile iron couplings, meeting the requirements of ANSI/AWWA C110/A21.10 and rated for 250 psig.
2. Epoxy or nylon coated inside and out.
3. Where pipes of dissimilar metal are joined, ensure dielectric insulation to prevent galvanic corrosion.
4. Install with stainless steel bolts.
5. Provide polyethylene encasement.
6. Approved manufacturers:

a. Power Seal
b. Ford
c. Romac
d. Approved equivalent

2.11 TRENCH INSULATION

A. Trench insulation shall be extruded rigid board material. The insulation shall have a thermal conductivity of not more than 0.28 BTU per hour per square foot per degree Fahrenheit per inch of thickness as tested in accordance with ASTM C177. The insulation shall not absorb moisture to an extent greater than 2.5 percent by volume as tested in accordance with ASTM D2127. The compression strength of the insulation shall be greater than 20 psi as tested in accordance with ASTM D1621. The density of the insulation shall be between 0.9 and 1.3 pounds per cubic feet as tested in accordance with ASTM D1622.

PART 3 - EXECUTION

3.01 GENERAL

A. Contractor shall verify location of piping and piping systems as shown on the Drawings.

B. Contractor shall be aware that it may be necessary to move a piping run a reasonable amount or shift it slightly up or down to avoid an existing obstruction or other piping runs. Contractor shall not receive additional compensation due to slight shift or movement of piping runs.

C. Not all fittings may be shown on the Drawings, the fittings shown are meant to give a graphical representation only. Additional fittings required for differences in vertical and/or horizontal alignment may be required. Contractor shall not receive additional compensation due to additional fittings required to meet vertical and horizontal alignments.

D. The Drawings show two (2) dimensional graphical representation of piping systems, Contractor shall note there may need to be additional pipe length due to the vertical elevation differences that may not be represented on the drawings.

E. All buried piping with less than six (6) feet of cover shall be insulated. Trench insulation shall be provided above the pipe with a minimum thickness of four (4) inches as shown on the drawings for all piping.

F. Contractor has ability to modify the inverts of the potable water to avoid pipe conflicts. The potable water lines have been set constant elevations throughout the site. Contractor shall have the ability to modify invert elevations as long as six (6) feet of cover has been maintained.

G. All joints shall be properly restrained in accordance with these specifications.

H. Contractor shall provide dewatering as necessary, piping shall not be laid in water or wet conditions.

I. See Section 31 23 33 for all trench excavation and backfill requirements, and piping system bedding requirements.

J. See Division 40 for all exposed process piping and valves.

3.02 PREPARATION AND STORAGE

A. Store pipe on-site on flat surface so barrel is evenly supported. Do not stack higher than 6 feet. Cover pipe with opaque material for extended storage.

B. Remove scale and dirt on inside and outside before assembly. Inspect for damage to pipe and other materials before installation.

3.03 INSTALLATION – PIPE, VALVES, AND APPURTENANCES

A. The type, kind, and class of pipe to be used shall be as shown on the Drawings. All pipes shall be laid and to the required line and grades.

B. Install all pipe and appurtenances in strict accordance with manufacturer's recommendations.

C. All foreign material or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench and it shall be kept clean by approved means during and after laying.

D. Pipe materials shall be handled carefully. Damage to protective coatings, linings, and joint fittings shall be cause for rejection of the materials. Prior to installation each pipe section, fitting, or valve shall be thoroughly inspected by the Contractor to detect damage or defects. Contractor shall inform Engineer of such damage or defects. Any defective, damaged, or gravity piping which has had its grade or joint disturbed after layer shall be replaced.

E. Cut pipe in a neat and workmanlike manner without damaging the pipe. Cutting of pipe for connections or pipe run lengths or inserting of fittings and valves shall be done in accordance with pipe manufacturer recommendations. Rough edges shall be removed and where rubber gasket joints are used, the outer edge shall be beveled by grinding or filing to produce a smooth fit.

F. Trench preparation shall proceed in advance of pipe installation only so far as can be backfilled the same day, or as permitted by the Owners specifications.

G. Excavate, and backfill excavations and trenches in accordance with Section 31 23 33.

H. Keep trenches free from surface and ground water until pipe jointing is complete.

I. All fittings shall be set on cast in place or precast concrete blocks in order to prevent the weight from being transmitted to the pipe. Before concrete is placed around fittings and appurtenances, the appurtenance and pipe shall be wrapped with polyethylene to completely isolate the concrete from the water main construction.

J. Form and place concrete for thrust blocking at each bend, tee, or change of direction. Thrust blocks shall bear on undisturbed earth.

K. Securely close open ends of pipe and fittings when Work is not in progress.

L. Pipe Installation:

1. Install piping to lines, grades, and dimensions shown on Drawings.
2. Take up and relay any pipe disturbed from its required grade or alignment.
3. Install pipe to allow for expansion and contraction without stressing pipe.
4. Install pipe such that maximum deflections from straight line or grade do not exceed manufacturer's specifications. Install bend fittings where maximum deflections are exceeded.
5. Notify Engineer and Owner at least 48 hours in advance of service disruptions and connections.

M. Prior to pipe placement the bedding conditions shall be such as to provide uniform and continuous support for the pipe. For belled pipe, bell holes shall be excavated as necessary to make the joint connections and provide proper support. Pipe shall not be laid in water or unsuitable bedding conditions. See Section 31 23 33 for bedding requirements.

N. Piping shall be carefully lowered into laying position by the use of suitable restraining devices. The pipe shall not be dropped or dumped into the trench. All foreign matter or dirt shall be removed from the inside of the pipe and fittings before they are placed into position. Pipe joints shall be kept clean prior to and during installation. The joint surface shall be inspected prior to placement to ensure that there is no foreign matter, coating blisters, projections, rough edges, or damaged gaskets that may impact the integrity of the joint connection.

O. As each length of pipe is placed in laying position the pipe shall be secured in place with approved backfill material and the appropriate compaction as specified in Section 31 23 33.

P. Bell and spigot piping shall be laid with the bell ends facing upgrade and the laying shall start at the downgrade end and proceed upgrade, unless otherwise permitted by the Engineer.

Q. When pipe laying is not in progress the open ends shall be closed by watertight plugs or other approved means. In the presence of water, the pipe end shall remain sealed until the trench has been properly drained or dewatered.

R. At connections to existing piping, Contractor shall remove all dirt and debris that is allowed to enter the existing lines.

S. Inspection: Do not cover pipe and fittings until all bedding, joints, and polyethylene wrap have been inspected.

T. Replace any pipe, fittings, or appurtenances found defective after installation has been completed.

U. PVC pipe used for force main and water main shall be installed in accordance with AWWA C605, AWWA Standard for Underground Installation of PVC Pressure Pipe and

Fittings for Water.

3.04 PIPE THRUST RESTRAINT

A. Provide all crosses, tees, bends, caps, and other thrust points in the piping system with suitable means of overcoming thrust.

B. Concrete reaction blocking and/or retainer glands or tie rods may be used subject to the Engineer's approval. All rods, nuts, bolts, and hardware shall be stainless steel. At tees, 90 degree bends, and dead ends both mechanical type joint restraint and concrete reaction blocking shall be required.

C. Concrete reaction blocking shall be placed so that pipe and fitting joints are accessible for repair, and in such a manner as to provide bearing against undisturbed earth. Pressure testing shall not proceed until concrete reaction blocking has reached its design strength. High early strength concrete may be used.

D. The following table is based upon the results of the Ductile Iron Pipe Research Association thrust restraint design program for a test pressure of 150 psig, backfill soil density of 90 pounds per cubic foot, and polyethylene wrapped pipe. The table shows the minimum length of pipe to be restrained for various types of fittings where joint retainer glands are used. The minimum concrete reaction block size is shown in parentheses under the minimum length.

Pipe Diameter (inches)	**Dead End Tee Branch 90 Degree Bend**	**Wye 45 Degree Bends or less**
4	26 LF (3.1 SF)	11 LF (2.0 SF)
6	26 LF (3.1 SF)	11 LF (2.0 SF)
8	34 LF (5.3 SF)	14 LF (3.0 SF)
10	42 LF (8.1 SF)	17 LF (4.4 SF)
12	50 LF (13.4 SF)	20 LF (6.6 SF)
14	58 LF (17.2 SF)	23 LF (9.2 SF)
16	64 LF (21.4 SF)	27 LF (11.6 SF)
18	71 LF (25.2 SF)	30 LF (15.2 SF)
20	79 LF (30.2 SF)	33 LF (18.1 SF)
24	93 LF (38.5 SF)	39 LF (26.1 SF)

30	112 LF (52.5 SF)	46 LF (34.5 SF)
36	132 LF (65.4 SF)	56 LF (40 SF)
42	167 LF (82.5 SF)	70 LF (49 SF)

3.05 POLYETHYLENE ENCASEMENT

A. Where required all piping, fittings, valves, and appurtenances shall be fully encased in polyethylene film tubing.

B. The polyethylene tubing shall be of appropriate size for the size of pipe being installed. Install polyethylene tubing prior to lowering pipe into trench.

C. Tubing length shall be long enough to provide a minimum of one (1) foot overlap at all joints, fittings, and appurtenances. After completing the pipe jointing and positioning the tubing material, the overlap shall be secured into place with plastic adhesive tape wrapped circumferentially around the pipe at least three (3) full turns.

D. The fit shall be snug over the pipe with no excess or bunched up material. Repair all rips, punctures, or other damage with taping and overlapping patching.

3.06 TESTING GRAVITY LINES

A. Gravity lines, including service connections, shall be substantially watertight and shall be tested for excessive leakage upon completion and before connections are made to the service. Each test section of the sewer shall be subjected to exfiltration testing, either by hydrostatic or air test method as described below and at the Contractor’s option. The requirements set forth for maximum leakage shall be met as a condition for acceptance of the gravity line section represented by the test.

B. If the ground water level is greater than three feet above the pipe invert elevation of the upper manhole and the Engineer so approves, infiltration testing may be allowed in lieu of the exfiltration testing, in which case the allowable leakage shall be the same as would be allowed for the Hydrostatic Test.

C. Testing shall be performed by the Contractor without any direct compensation being made therefore, and the Contractor shall provide necessary equipment and materials, including plugs and standpipes as required.

D. Air Test Method

1. Air testing shall conform to ASTM C 924 for concrete pipe and ASTM F 1417 for plastic pipe and ductile iron.

2. The pipeline shall be sealed with plug whose sealing length is greater than the diameter of the pipe and constructed in such a nature that it will not require external blocking or bracing and maintain a seal against the line's test pressure.

3. Wyes, tees, outlets or ends of laterals shall be suitably capped and braced to

withstand the internal pressures. Such caps or plugs shall be easily removable.

4. One plug shall be tapped for the air supply hose and the return air pressure hose. The air supply hose, connected from the compressor to the plug shall have a throttling valve, bleeding valve and shut off valve for control. The air pressure tap shall have a sensitive pressure gauge, 0 to 10 psi range, protected by a gauge cock and a pressure relief valve set at 10 psi.

5. In performing the test, air is added slowly to the pipeline until pressure inside the pipeline reaches 4.0 psi. If air is added too rapidly, the test accuracy will decrease because a change in temperature also has an effect on the change in pressure. When the air pressure inside the pipeline reaches 4.0 psig above external hydrostatic pressure, the supply air is stopped. A minimum two-minute time interval is allowed for the temperature difference to stabilize before the actual test is performed. If the air pressure drops below 3.5 psig during this time interval, more air will be supplied to the pipeline and throttled to maintain a pressure between 3.5 psig and 4.0 psig for a minimum of two minutes after which time the supply air will be shut off.

6. The portion of line being tested shall be accepted if the portion under test does not lose air at a rate greater than 0.0015 cfm per square foot (for PVC) or 0.003 cfm per square foot (for RCP) per internal pipe end area at an average pressure of 3.0 psig greater than any back pressure exerted by groundwater that may be over the pipe at the time of test.

7. The test shall be accomplished by determining the time in minutes for the pressure to decrease from 3.5 psig to 3.0 psig greater than the average groundwater pressure that may be over the pipe. That time shall not be less than the time shown on the given diameter in the following table:

Gravity Line Diameter (Inches)	**Minutes for DIP**
4	1.9
6	2.8
8	3.8
10	4.7
12	5.7
15	7.1
18	8.5
21	9.9
24	11.3
27	12.8
30	14.2
33	15.6
36	17.0
42	19.8

8. For pipe lengths exceeding 100 feet, the following table of times shall be used per every 100 feet of pipe. All other testing parameters and requirements shall remain:

Gravity Line Diameter (Inches)	Minutes for DIP
4	1.9
6	2.8
8	3.8
10	4.8
12	5.7
15	7.1
18	9.7
21	13.1
24	11.4
27	14.5
30	17.8
33	21.6
36	25.7
42	28.5

9. If the pipeline fails to meet the requirement of the test, the Contractor shall, at Contractor's own expense, determine the source of leakage and then repair or replace all defective material and workmanship.

10. In determining the pressure greater than the average groundwater, the groundwater height in feet above the pipeline must be measured.

11. When the water elevation has been established, the height in feet above the pipeline shall be divided by 2.31 and that pressure added to gauge pressure of test.

3.07 HYDROSTATIC TEST METHOD

A. After bulkheading the test section, the pipe shall be subjected to a hydrostatic pressure produced by a head of water at a depth of three feet above the invert elevation of the gravity line at the manhole of the test section. In areas where ground water exists, this head of water shall be three feet above the existing water table.

B. The water head shall be maintained for a period of one hour during which time it will be presumed that full absorption of the pipe body has taken place, and thereafter for an extended period of one hour the water head shall be maintained as the test period. During the one hour test period, the measured water loss within the test section, including service stubs, shall not exceed the Maximum Allowable Loss (in Gallons Per Hour per 100 Feet of Pipe) given below for the applicable Gravity Line Diameter.

Gravity Line Diameter (In Inches)	Maximum Allowable Loss* (In Gallons Per Hour Per 100 Feet)
6	0.5
8	0.6
10	0.8
12	1.0
15	1.2
18	1.4
21	1.7
24 & Larger	1.9

* Based on 100 Gallons Per Day Per Pipe Diameter Inch Per Mile

C. If measurements indicate exfiltration within a test action section is not greater than the allowable maximum, the section will be accepted as passing the test.

3.08 TEST FAILURE AND REMEDY

A. In the event of test failure on any test section, testing shall be continued until all leakage has been detected and corrected to meet the requirements. Repair work shall be subject to approval of the Engineer. Introduction of sealant substances by means of the test water will not be permitted.

B. Unsatisfactory repairs or test results may result in an order to remove and replace pipe as the Engineer considers necessary for test conformance. All repair and replacement work shall be at the Contractor' expense.

3.09 TESTING PRESSURE MAINS

A. Hydrostatic Testing of Pressure Mains

1. After the pipe has been laid, including fittings and valves and blocking, all newly-laid pipe or any valved section thereof, unless directed otherwise by the Engineer, shall be subject to hydrostatic pressure of 150 pounds per square inch. The duration of each test shall be at least two hours.

2. Each section of pipe to be tested shall be filled with water and all air expelled at the highest point. The required taps to expel air or to fill the water main shall be supplied and installed by the Contractor and shall be 3/4 inch and shall include an approved service saddle when required.

3. The test apparatus shall be applied at the lowest elevation on the section to be tested. The apparatus shall be connected to the line at a service tap or special tap location.

4. The pressure gauge shall be a standard pressure gauge. The dial shall register from 0 - 200 psi and have a dial size of 4 1/2 inches with 1 psi increments.

5. The hydrostatic test, pressure requirement for an acceptable test shall be a maximum pressure drop of 2 psi during the last hour of the two hour pressure test. If this test requirement cannot be met, the Contractor shall investigate the cause, make corrections, and retest until the pressure drop requirement can be met at no cost to Owner.

B. Operational Inspection

1. Before substantial completion of the work and in the presence of the Engineer and the Contractor, representatives of the Owner shall operate all valves, hydrants, and water services to ascertain that the entire facility is in good working order; that all valve boxes are centered and valves are opened; that all hydrants operate and drain properly; that all curb boxes are plumb and centered; and that water is available at all curb stops.

3.10 DISINFECTION OF POTABLE WATER SYSTEM

A. Flush and disinfect system in accordance with Section 33 01 10.

3.11 POTABLE WATER SEPARATION

A. Unless otherwise specified in Contract Documents, the potable water lines shall generally be placed with the minimum specified cover. However, a greater depth may be required to clear process piping, storm, and sanitary sewers and sewer services, and no additional compensation shall be provided for such adjustments.

B. In locations where sewer is in direct conflict with existing water main and water services the water main and water services shall be lowered to provide at least 18 inches of vertical distance between the top of the water main or service and the bottom of the sanitary or relocated in accordance with the Drawings. No additional compensation will be made for lowering the water main.

C. Water mains crossing above process piping, storm, or sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer. When local conditions prevent a vertical separation as described, the following construction shall be used:

1. Sewers passing over or under water mains shall be constructed of materials equal to water main standards of construction for a distance of at least 10 feet on either side of the water main.

2. Water main passing under sewers shall, in addition, be protected by providing:

a. A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main.

b. Adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking of the water mains.

c. A length of water pipe shall be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.

3. Water mains shall be laid at least 10 feet horizontally from any process piping, sanitary sewer, or storm sewer, whenever possible. When local conditions prevent a horizontal separation of 10 feet, a water main may be laid closer to a storm or sanitary sewer provided that:

a. The bottom of the water main is at least 18 inches above the top of the sewer.

b. Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure water tightness prior to backfilling.

D. No deviation shall be made from the required line or grade except with the consent of the Engineer.

3.12 FIELD QUALITY CONTROL

A. Section 01 45 00 - Quality Assurance.

3.13 DATA FOR AS-BUILT RECORDS

A. Record stationing and/or ties of all fittings, valves, and other underground appurtenances installed on sheets provided for such purposes by the Engineer. Include invert or centerline elevations.

END OF SECTION 33 31 19

SECTION 33 38 33.23
BIOSOLIDS BASIN - MECHANICALLY-TENSIONED
INSULATED FLOATING COVER

PART 1 - GENERAL

1.01 SUMMARY

A. The design, fabrication, supply, and installation of the modular insulated floating cover system to be placed on the *Biosolids Treatment Basin* shall be as specified herein.

B. The work shall include furnishing equipment, material and supplies to complete the work as specified herein.

1.02 REFERENCES

A. The publications listed below form a part of the specification to the extent referenced.

1. ASTM – American Society for Testing and Materials
2. ASTM D-6693 – Tensile Properties of Plastics
3. ASTM D-1004 – Initial Tear Resistance of Plastic Film and Sheeting
4. ASTM D-4218 – Carbon Black in Olefin Plastics
5. ASTM D-4833 – Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
6. ASTM D-5994 – Measuring Nominal Thickness of Geotextiles and Geomembranes
7. ASTM D-5596 – Microscopic evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
8. Geosynthetics Research Institute
9. GM11 – Accelerated Weathering of Geomembranes Using a Fluorescent UVA Device

1.03 QUALIFICATIONS

A. The design of the modular insulated floating cover is patented and shall be supplied by Lemna Environmental Technologies, Inc., Vadnais Heights, Minnesota or pre-approved equal. Alternative equipment manufacturers who wish to be considered must submit to the Engineer material and construction specifications and submittal drawings, equipment operation and maintenance manual, CPA audited financial data from previous (12) months, list of all installations and the name/address/contact/telephone numbers of the owners of the last (10) U.S. installations. Above information is due no later than (15) days prior to the bid opening to allow engineer adequate time to perform due diligence.

B. The modular insulated floating cover supplier shall be experienced in the manufacture, design, integration, and installation of similar covers as demonstrated by a minimum of (10) years' experience and a minimum of (25) installed similar modular insulated floating cover systems.

C. The modular insulated floating cover supplier shall be experienced in the installation of multiple floating covers over wastewater that includes sewage and/or industrial waste, where the modular cover panels are linked/fastened to each other.

D. The modular insulated floating cover supplier shall be experienced in the installation of multiple insulated covers over wastewater that includes sewage and/or industrial waste, where the modular cover panels are removably linked to each other.

E. The modular insulated floating cover supplier shall be experienced in the manufacture, design, integration, and installation of similar covers when used in conjunction with hydraulic baffles, as demonstrated by a minimum of (10) years' experience and a minimum of (25) installed floating cover/hydraulic baffle systems. (if applicable)

F. The modular insulated floating cover supplier shall be experienced in the manufacture, design, integration, and installation of similar modular insulated floating cover systems when used in conjunction with diffused aeration systems, as demonstrated by a minimum of (10) years' experience in the floating cover business and a minimum of (30) installed modular cover/diffused aeration systems. (if applicable)

G. The modular insulated floating cover supplier shall be experienced in wastewater treatment processes and shall be prepared to demonstrate the effect on the client's process through documented analysis relating to hydraulic retention time, heat retention, odor control, algae control, solids settling, and biological contact.

H. The modular insulated floating cover supplier shall have continuous documented water and wastewater treatment design and operations experience a minimum of (20) years.

1.04 SUBMITTALS

A. The modular insulated floating cover supplier shall furnish a submittal package to the engineer for approval prior to fabrication. The submittal package shall include a layout drawing; individual system component drawings; details of the integration of the modular insulated floating cover with other components, as specified herein; individual component cut-sheets; and product warranty.

B. The modular insulated floating cover supplier, shall conduct a survey of the design waterline (or high waterline). The cover supplier shall submit a fabrication layout for approval. Supplier shall verify fabrication dimensions using AutoCAD or similar design software.

PART 2 - PRODUCTS

2.01 MODULAR INSULATED FLOATING COVER SYSTEM

A. The modular insulated floating cover system shall consist of insulated cover panels, cable, fasteners, sand tubes, perimeter anchors, and pulling posts (where required).

B. The modular insulated floating cover system shall not require a gas collection system. The cover system shall be installed so that gases are not trapped beneath the cover but are allowed to escape vertically through the overlap spaces of adjacent cover panels.

C. The modular insulated floating cover system shall consist of multiple cover panels placed over wastewater that includes sewage and/or industrial waste, where the modular cover panels are removably fastened/ linked to each other.

D. The modular insulated floating cover system shall not require a rainwater collection trench or water pumping equipment. The cover system shall be designed to allow rainwater to drain through the overlap spaces of adjacent cover panels. No water shall pool on top of the cover.

E. The modular insulated cover shall allow for the liquid level within the basin to fluctuate, as specified by the engineer.

F. The modular insulated floating cover shall be designed in such a manner to support snow loads typical of the intended installed environment. The cover shall perform well in cold environments and be able to withstand freeze/thaw conditions without damage to the cover or its components.

G. The modular cover shall be designed in such a manner to withstand wind-loading conditions typical to the site environment. Supplier shall show evidence their design has been effective in performing successfully under similar wind conditions. In the event wind velocity reduction structures are required, cover supplier shall provide design options to engineer.

H. The modular cover shall be capable of covering only a portion of the water surface (if required), with one edge floating freely. The modular cover shall allow for partially covered ponds to be further covered at a later date without any modification to the existing cover or additional expense other than the additional cover and installation labor required.

I. In cover applications utilizing hydraulic baffles, the insulated cover shall be designed to allow for complete integration and attachment to the baffle(s). This integration shall prevent flow short-circuiting, baffle migration, and prevent damage to both the cover and baffle.

J. In cover applications utilizing aeration, the cover and aeration equipment shall be designed to allow for complete integration. For mechanical floating aspirators and mixers, integration consists of openings in the cover that allow aspirator(s) or mixer(s) to function normally while being fully surrounded by the cover. For diffused air systems, integration includes diffuser access panels that can be removed to allow access to submerged diffusers. The cover shall be designed to accommodate floating or submerged aeration laterals and feeder lines.

K. The modular insulated floating cover shall consist of individual modular cover panels connected by either looped geomembrane fasteners inserted through factory-drilled openings or by wedge-welded seams.

2.02 COVER PANELS

A. The cover panels and cover shall be fabricated in such a manner that each section of the modular cover can be individually displaced or removably linked with fasteners, to allow

access to the water surface.

B. With the exception of field modifications, all fabrication and welding of the modular insulated floating cover panels shall be performed in a climate-controlled building. All straight welds on the sides of cover sections shall be double-fusion wedge welds. Corner and detail welds shall be extrusion welds.

C. The modular insulated floating cover system shall consist of multiple panels placed over wastewater that includes sewage and/or industrial waste, where the panels are removably fastened/ linked to each other and each contains, but is not completely filled with, insulation material sealed inside it.

D. Each modular panel shall be secured to all adjacent panels. The entire modular insulated cover shall be secured to the sides of the basin in such a manner that allows for removal and reinstallation of the insulated cover.

E. Individual panels shall be independently buoyant, thereby requiring no additional support or buoyancy.

F. The modular insulated floating cover shall be composed of panels fabricated from two sheets of 40 mil High Density Polyethylene (HDPE) geomembrane, which shall encapsulate insulation that provides a thermal barrier and flotation. The HDPE shall meet the standards for HDPE geomembrane in accordance with ASTM D6693, D1004, D4218, D4833, D5994 and D5596.

G. The HDPE geomembrane of each panel shall have insulation sealed inside each panel by a weld. The panel is to be welded closed in such a manner that it provides a cavity in which to contain the insulation. The insulation shall be closed cell Expanded Polystyrene (EPS) with an R-rating, as noted on the drawings. The insulation shall be rectangular panels.

H. If required, walkway panels shall be provided. Walkway panels shall be constructed of 40mil textured HDPE and contain 3.9" of insulation. Walkway panels are designed to provide extra flotation to a worker needing access to in-basin equipment.

I. Individual modular panels shall not exceed 7.5 feet (width) and 52 feet (length).

2.03 FASTENERS AND FASTENER STOPS

A. Fasteners shall be fabricated of 30-mil XR-5 geomembrane with a honeycomb scrim and have a 10-year Ultraviolet resistance. Fasteners shall link adjacent panels together and each panel to anchor cables. Fasteners shall be fabricated in a manner that will allow cables to be threaded through the fastener loops on top of the panels.

B. The panels shall overlap, and the fasteners shall allow adjacent panels to be removably linked together.

C. The fasteners are placed through pairs of adjacent openings in panels.

D. Fastener stops shall consist of an HDPE disk and shall prevent fasteners from being pulled through the fastener holes of the modular panels.

2.04 CABLE

A. Cable shall anchor the linked panels over the wastewater basin, and shall be attached to perimeter anchors.

B. Cable shall be 1/8-inch diameter 7 x 19 stranded stainless steel, black PVC coated to 3/16 inch, and have a tensile strength of 1700 pounds.

C. Stainless steel cable clamps shall secure the cabling to the anchoring system and where splices and loops are required.

2.05 SAND TUBES

A. Pre-filled sand tubes shall be supplied to weight the cover perimeter and body against wind uplift. Perimeter sand tube locations shall have (2) HDPE straps welded to the modular cover, body sand tubes attached by fastener. The free ends of the HDPE straps shall be fastened to the sandtube.

B. Sand tubes shall be 10-foot long HDPE sleeves filled with sand and shall weigh between 60 and 110 lbs. The sleeves shall be wedge welded along its length and across its ends to form an enclosed tube.

2.06 PERIMETER ANCHORS

A. Perimeter anchors shall be installed along the perimeter of the basin. The perimeter anchor shall be a 30” long carbon steel earth anchor. On the lower end of the earth anchor shall be welded a 4” diameter helical screw plate. The upper end of the earth anchor shall be looped to provide an attachment point for the cover anchor cable. The perimeter anchors shall be installed so that the entire anchor is below ground to avoid interference with vehicle or foot traffic on the pond berm.

PART 3 - EXECUTION

3.01 GENERAL

A. The installer of the cover system shall furnish all materials, tools, equipment and services necessary to fabricate and install a modular insulated floating cover system.

B. Only assembly and attachment of the modular panels shall be allowed on-site. To facilitate ease of installation and removal, modular panels shall not exceed 7.5 feet in width and 52 feet in length. The panels shall be installed in an overlapping relationship to adjacent panels.

C. The modular insulated floating cover shall be capable of being installed in a basin at its high operating water depth. Modular panels shall be assembled and connected on shore and pulled into position in the basin.

D. The modular insulated floating cover panels shall be filled with rectangular shaped sections of insulation.

E. The modular insulated floating cover shall be anchored to shore using PVC coated stainless steel cable or approved alternative.

F. Each section of cover shall be individually removably linked without affecting the structural integrity of the rest of the cover system.

G. Where appropriate, multiple individual panels shall be welded together to facilitate installation and/or operation of the modular insulated floating cover.

H. The modular insulated floating cover supplier shall provide installation supervision services as a part of overall cover supply.

I. The modular insulated floating cover supplier shall provide technological wastewater treatment start-up services as a part of overall cover supply.

J. The modular insulated floating cover supplier shall provide unloading, storage, and installation manual.

K. The modular insulated floating cover supplier shall provide an operation and maintenance manual.

PART 4 - WARRANTY

4.01 The modular insulated floating cover supplier shall warrant to buyer that all components furnished will be free from defects in materials and workmanship for a period of twelve (12) months from the date of shipment. In the event of material or workmanship failure, supplier shall either repair or replace the damaged or defective components or services or refund payments to buyer for the components or services found to be defective.

4.02 The modular insulated floating cover supplier shall be responsible for guaranteeing effluent quality according to the end user's requirements, as the modular insulated floating cover is an integral part of the overall treatment process.

END OF SECTION 33 38 33.23

SECTION 33 38 35
BIOSOLIDS BASIN
FLOATING BAFFLE SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. The design, fabrication, supply, and installation of the baffle system within the *Biosolids Treatment Basin* shall be as specified herein.

B. The work shall include furnishing equipment, material and supplies to complete the work as specified herein.

1.02 QUALIFICATIONS

A. The design and supply of the baffle shall be by Lemna Environmental Technologies, Inc. or pre-approved equal. Alternative equipment manufacturers who wish to be considered must submit to the Engineer equipment specifications and submittal drawings, equipment operation and maintenance manual, CPA audited financial data from previous (12) months, list of all installations and the name, address and contact telephone numbers of the owners for the last (10) U.S. installations. Above information is due no later than (15) days prior to the bid opening to allow engineer adequate time to perform due diligence.

B. The baffle supplier shall be experienced in the manufacture, installation, and operation of specified baffles, as demonstrated by a minimum of (20) years in the baffle business and a minimum of (50) installed baffle systems.

C. The baffle supplier shall be experienced in the manufacture, installation, and operation of reverse miter baffles, as demonstrated by a minimum of (10) years in the reverse miter baffle business and a minimum of (50) installed baffle systems.

D. The baffle supplier shall be experienced in the design, integration, and installation of similar baffles when used in conjunction with insulated floating covers, as demonstrated by a minimum of (5) years experience and a minimum of (25) installed baffle/floating cover systems.

E. The baffle supplier shall be experienced in wastewater treatment processes and shall be prepared to demonstrate the effect on the client's process of the baffles supplied through documented analysis relating to flow, hydraulic retention time, and biological contact.

F. The baffle supplier shall have documented water and wastewater treatment and design experience for a minimum of twenty (20) years.

1.03 SUBMITTALS

A. The baffle supplier shall submit shop drawings to the Engineer for approval prior to fabrication. The submittal package shall include a layout drawing and drawings of individual system components, as specified herein.

B. The baffle supplier shall conduct a survey of the baffle location and submit a fabrication

drawing for approval. Supplier shall verify baffle design conforms to survey using AutoCAD or similar design software.

PART 2 - PRODUCTS

2.01 Baffle System

A. The baffle system shall consist of a baffle, cable, and anchoring as specified herein.

B. The baffle system shall be fully integratable with the specified floating cover system (outlined in Section 33 38 33.23 of these specifications) and serve as an integral part of anchoring and securing the floating cover system. The baffle manufacturer and supplier shall guarantee their product provides adequate anchoring that minimizes movement and/or shifting of the floating cover, thus preventing cover damage. The baffle supplier shall accept responsibility for damage to the floating cover caused by the baffle and shall assume all replacement costs for damaged section(s) of the cover.

C. The baffle system includes baffles fabricated with reverse miters designed to prevent short-circuiting of flow around non-window ends of baffle at berm. The reverse miter design serves as an integral part of the wastewater treatment process. The baffle supplier shall guarantee their product provides adequate berm seal and shall accept responsibility for final effluent quality according to end users' requirements.

2.02 BAFFLE

A. The floating baffle shall be a custom designed, factory prefabricated hydraulic baffle curtain. The baffle shall be manufactured and delivered on site in a state of completion such that no further fabrication, other than to connect individual completed sections, is required for installation. The floating baffle shall depend on a primary bottom-anchored design for maximum resistance to loads encountered in industrial or municipal lagoons. The baffle manufacturer shall utilize only virgin quality elastomeric geomembrane materials. All seaming shall be completed at manufacturer's facility. The floating baffle shall be designed for ease of installation in a new or operating lagoon.

B. The baffle shall be constructed from industrial grade XR-5® compounded for maximum resistance to fluids encountered in an industrial or municipal waste treatment environment and conform to the following minimum properties:

XR-5	**Test Method**	**Standard**	**Metric**
Thickness	ASTM D751	30 mils min.	0.76mm min.
Weight	ASTM D751	30 +/- 2 oz./yd2	1017 +/- 70 g/m2
Tear Strength	ASTM D4533 Trapezoid Tear	35/35 lbf min.	155/155 N min.
Breaking Yield Strength	ASTM D751 Grab Tensile	550/550 lbf min.	2447/2447 Nf min.
Low Temperature	ASTM D2136 4 hrs. – 1/8" mandrel	Pass @ -30 F	Pass @ -35 C
Adhesion Heat	ASTM D751	35 lbf/2 in. min.	15 daN/5 cm min.

Sealed Seam	Dielectric Weld		
Hydrostatic Resistance	ASTM D751 Method A	800 psi min.	5.51 Mpa min.
Adhesion – Ply	ASTM D413	15 lbf/in min. or Film Tearing Bond	13 daN/5 cm min. or Film Tearing Bond
Bonded Seam Strength	ASTM D751 Seam Strength as modified by NSF 54	550 lbf min.	2447 Nf min.

C. The floating baffle shall have an upper and a lower tension member. The upper tension member shall be a 1/4-inch (6mm) diameter vinyl-coated stainless steel cable dielectrically seamed in a hem under the flotation collar, extending from baffle anchor to baffle anchor. The lower tension member shall be a 1/2-inch (12mm) diameter hot-dipped galvanized coil-proof chain dielectrically seamed in a hem at the bottom edge of the baffle. For aeration and nitrification applications, a 5/8-inch (16mm) diameter hot-dipped galvanized coil-proof chain dielectrically sealed in a hem at the bottom edge of the baffle shall be used. The chain shall extend from one 5/16" x 1 1/4" S.S. Bolt (6mm) chain stop at one end of the baffle to another 5/16" x 1 1/4" S.S. Bolt (6mm) chain stop at the other end.

D. The baffle manufacturer shall provide exposed chain locations 20 feet (6.1m) spacing on center starting at the location of the toe of berm. Baffle bottom shall be retrievable by means of factory installed 3/8 inch (10mm) diameter polypropylene anchor lifting lines that extend from each specified bottom anchor point using a double overhand knot to a brass grommet located center point between floatation segments of the flotation collar.

E. An end connector shall be provided at each end of the baffle and consist of two 1/8 inch (3mm) thick (or 12 gauge) x 2 inch (50mm) wide x 12 inch (300mm) long stainless steel collar plates secured with 5/16 inch (7mm) diameter stainless steel bolts with lock washer and nut at 2 inch (50mm) centers unless otherwise specified. A 10-foot (3m) long, 1/4-inch (6mm) diameter stainless steel anchoring cable shall be looped through the top endplate hole and crimped with a 1/4-inch (3mm) stainless steel crimp. A 3/8-inch (10mm) polypropylene material stop, a second layer of geomembrane abrasion protection, and 1-inch (25mm) wide dielectric seams shall be provided to reinforce the end plate area.

F. The baffle flotation collar cover shall be constructed from XR-5® material. The flotation shall be provided by 6-inch (150mm) diameter closed-cell polystyrene foam logs with 1 lb/ft3 (16 kg/m3) minimum foam density providing a minimum buoyancy of 60 lb/ft3 (960 kg/m3), unless otherwise specified in the plans. The foam logs shall be dielectrically sealed in a chamber of the specified baffle material. The flotation log shall extend 6 feet (1.8m) within an 8-foot (2.4m) chamber to allow folding for efficient shipping.

G. The hydraulic baffle shall include a reverse miter on the side opposite the baffle flow-

through window. The reverse miter shall prevent short-circuiting of the normal pond flow under the non-flow-through side of the baffle due to irregularities in the pond side slope and/or loss of contact between the bottom of the baffle and the pond side slope. The baffle reverse miter shall consist of a fold in baffle material toward the upstream side of the pond. The reverse miter location shall be shown on the project plans.

H. The ballast chain shall extend through the end of the hem and be secured by a 5/16-inch (7mm) stainless steel bolt to prevent chain migration.

I. The flow-through window shall be of the size indicated on the drawings and shall be reinforced with a 2-inch (50mm) wide polyester webbing encased in the baffle material with a 2-inch (50mm) wide thermal welded seam or 1" (25mm) dielectric weld. Any windows wider than 3-feet (1m) shall be vertically supported with a 3/8-inch (10mm) diameter polypropylene rope and brass grommets located at the midpoint.

J. The floating baffles will be manufactured in the minimum number of sections required to allow convenient installation and efficient shipping in standard size crates. When a baffle exceeds the maximum practical size, the baffle shall be manufactured in sections that are joined together on site with a mechanical bolt-through connector. The connector strip shall consist of a 1/8-inch (3mm) thick (or 12 gauge) x 1-inch (25mm) wide x 8-inch (200mm) long stainless steel pressure strip enclosed in the baffle material. The strips shall be connected on-site with 5/16-inch (7mm) diameter x 1 ½-inch (40mm) fasteners at predrilled 4-inch (100mm) centers. In T-connection applications, the baffle manufacturer shall supply a mechanical bolt-through connector. The ¼-inch (6mm) under collar cable section shall be terminated at each end with loop, thimble and 2 clamps. Stainless steel quicklinks shall be provided to connect the under collar cable and the bottom ballast chain between consecutive baffle sections.

K. Baffle Markings

1. The baffle shall contain permanent ink markings located on the collar in a contrasting color.

2. The location and markings shall be as follows:

   a. Location: On each end of the baffle

      Marking: "Baffle End (A or B)"

   b. Location: Top of collar, over baffle window

      Marking: "Window"

L. Baffle connection points shall be provided at locations shown on the baffle detail drawing. These points provide a point of connection between the baffle and pond cover. A baffle connection point will consist of a 4" x 2" oval shaped hole cut through the seam that encloses the under-collar cable. This hole will expose the under-collar cable on both sides of the baffle. A 5/16" stainless steel quicklink will be attached to the approximately 4" of exposed under-collar cable. A ¼" stainless steel cable clamp will be attached to the cable on either side of the quicklink to prevent migration of the quicklink. The pond cover will be attached to the quicklink.

M. Shipping

1. The baffle shall be folded with an accordion fold and shall be tied with restraining straps of a contrasting color, to allow flotation and deployment in minimum water depths.
2. All equipment shall be boxed, crated or otherwise completely enclosed for protection during shipment, handling and storage.
3. The baffle shall be packed with end A on top (typically the window end). The width of individual crates shall not exceed 48 inches (1.22m), and the length shall not exceed 120 inches (3.0m).
4. The baffle enclosure shall be clearly marked with the following information:
    a. BAFFLE (number)
    b. END A ON TOP (typically window end)
    c. LOCATION OF BOLT THROUGH CONNECTOR
    d. (TOP/BOTTOM)

N. Baffle specifications are listed in both English and SI units. In the event of a discrepancy between corresponding numbers, the English units shall govern.

2.03 ANCHORING SYSTEM

A. Baffle anchors shall be installed in the location shown on the plans.

B. Each baffle anchor shall consist of a min. 48” long carbon steel earth anchor within a 12" diameter cast-in-place concrete setting as shown on sheet C7-19 of the project drawings. On the lower end of the earth anchor shall be welded a 6” diameter helical screw plate. The upper end of the earth anchor shall be looped to provide an attachment point for the baffle anchor cables. The baffle anchors shall be installed so that the entire anchor is below ground to avoid interference with vehicle or foot traffic on the pond berm.

C. The baffle anchors shall be located to provide reliable stability to the baffle in both lateral directions (N-S, E-W) and shall prevent the baffle from moving due to flow, wind, or wave action.

2.04 CABLES

A. Refer to plan for design size and location. Not all sizes are used.

B. Construction

1. The 1/8-inch (3.18mm) cable shall be 7 x 19 stainless steel wire rope with a minimum breaking tension of 1,700 pounds (771 kg).
2. The 3/16-inch (4.76mm) cable shall be 7 x 19 stainless steel wire rope with a minimum breaking tension of 3,900 pounds (1,769 kg).
3. The 1/4-inch (6.35mm) cable shall be 7 x 19 stainless steel wire rope with a minimum breaking tension of 6,400 pounds (2,903 kg).

4. The 5/16-inch (7.94mm) cable shall be 7 x 19 stainless steel wire rope with a minimum breaking tension of 9,000 pounds (4.082 kg).

5. A stainless steel thimble of size equal to the cable size shall be used whenever the cable is wrapped around an object smaller than 3/8-inch (9.53mm) diameter or where shown on the plans.

C. All baffle anchor cables shall be so located and shielded to prevent long-term damage to the floating cover due to movement, rubbing, abrasion or puncture.

D. Ancillaries

1. For 1/8-inch (3.18mm) cables, oval sleeves ("crimps") shall be used to secure the cable. The oval sleeves shall be in the quantity directed by the manufacturer. Oval sleeves shall be as manufactured by Newco or equal.

2. For cables greater than or equal to 3/16-inch (4.76mm) diameter, stainless steel clamps shall be used to secure the cable. The clamps shall be in the quantity directed by the manufacturer, but no fewer than two per connection. Clamps shall be as manufactured by Newco or equal.

PART 3 - EXECUTION

3.01 All fabrication and welding of the baffle shall be performed in a climate-controlled building. All straight welds shall be 2-inch (50mm) wide thermal welded seams or 1" (25mm) dielectric welded seams.

3.02 The baffle shall be installed in a basin at or near its operating water depth.

3.03 The baffle supplier shall provide installation supervision services as a part of overall baffle supply.

3.04 The baffle supplier shall provide technological wastewater treatment start-up services as a part of overall baffle supply.

PART 4 - WARRANTY

4.01 The baffle supplier shall warrant to buyer that all components furnished will be free from defects in materials and workmanship for a period of twelve (12) months from the date of shipment. In the event of material or workmanship failure, supplier shall either repair or replace the damaged or defective components or services or refund payments to buyer for the components or services found to be defective.

4.02 The baffle supplier shall be responsible for guaranteeing effluent quality according to the end user's requirements, as the baffle is an integral part of the overall treatment process.

END OF SECTION 33 38 35

DIVISION 40

PROCESS INTERCONNECTIONS

SECTION 40 05 57
ACTUATORS FOR PROCESS VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes furnishing and installation of electric valve actuators in accordance with provisions of the Contract Documents.

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures
2. Section 01 40 00 – Quality Control
3. Section 01 60 00 – Product Requirements
4. Section 01 77 00 –Closeout Procedures
5. Section 01 78 23 – Operations and Maintenance Data
6. Section 09 90 02 – High Performance Painting and Coating
7. Section 40 27 00 – Process Piping - General
8. Section 40 27 15 – Process Piping Support Systems
9. Division 26 – Electrical

1.02 REFERENCES

A. Reference Standards include:

1. AWWA C540: Power-Actuating Devices for Valves and Sluice Gates.

2. AWWA C550: Protective Epoxy Interior Coatings for Valves and Hydrants.

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit in accordance with Section 01 33 00, detailed specifications, drawings, and data covering all materials, parts, devices, equipment, and other accessories forming part of equipment for the complete operational system. Include name of Manufacturer, references, joint data, maximum loadings and thrust restraints.

B. Operations and Maintenance Data: Submit in accordance with Section 01 78 23 on all parts, devices, equipment and other accessories forming each complete operational system. Include a complete write-up of how the system is to operate and how to make adjustments.

1.04 ELECTRIC VALVE ACTUATORS

A. Actuators shall contain motor, gearing, manual over-ride, limit switches, torque switches, drive coupling, integral motor controls, position feedback transmitter (where required) and mechanical dial position indicator (where required).

B. The motor shall be specifically designed for actuator service for the particular valve to be electrically actuated. The motor will be of the induction type with class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure will be totally enclosed, non- ventilated.

C. Motors will be capable of operating on 460 volt - 3 phase - 60 hertz power except quarter-turn valves 16 inches and smaller which shall operate on 120 volt - single phase, 60 hertz power.

D. Actuator enclosure shall be NEMA 4 (watertight). All external fasteners on the electric actuator will be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed.

E. All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor.

F. Manual over-ride shall be by handwheel. Manual operation will be via power gearing to minimize required rimpull and facilitate easy change-over from motor to manual operation when actuator is under load. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation.

G. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle. One set of normally open and one set of normally closed contacts will be furnished at each end of travel where indicated. Contacts shall be of silver and capable of reliably switching low voltage DC source from the control system furnished by others.

H. Mechanically operated torque switches shall be furnished at each end of travel. Torque switches will trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque.

I. All wiring shall be terminated at a plug and socket connector.

J. Quarterturn actuators will be furnished with mechanical stops that restrict the valve/actuator travel.

K. Actuator must be capable of the following valve closing times/operating speeds: quarterturn valves - 60 second closing time, gate valves and sluice gates - 12 inches per minute operating speed.

L. Actuators will be capable of operating in an ambient temperature range of -20 to +175 degrees F (without motor controls) and -20 to +160 degrees F (with motor controls).

M. All actuators in open/close service will be furnished with integral motor controls consisting of reversing starters, control transformer, phase discriminator, monitor relay (to signal fault conditions such as thermal switch trip, torque switch tripped in mid-travel, wrong phase sequence or phase failure), "open-stop-close" pushbuttons, "local-off-remote" selector switch in addition to red and green indicating lights. An interface with the control system must be furnished with optical isolators to separate incoming voltage signals from the internal motor controls.

N. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator’s maximum rated breakaway torque.

Power gearing in modulating actuators shall have zero backlash between the motor and actuator output.

O. All actuators in modulating service will be furnished with a feedback potentiometer in addition to the following motor controls: reversing starters, control transformer, phase discriminator, monitor relay, positioner, "open-stop-close" pushbuttons, "local-off-remote" selector switch in addition to red and green indicating lights. The positioner shall be capable of accepting a 4-20mADC command signal and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail to the "open", "closed" or "last" position on loss of 4-20mADC command signal.

P. All actuators shall be manufactured by AUMA Actuators, Inc. of Pittsburgh, Pennsylvania.

PART 2 - PRODUCTS

2.01 EQUIPMENT REQUIREMENTS

The actuators shall be suitable for use on a 460 volt 3 phase 60 Hz power supply and must include motor, integral reversing starters, local controls and terminals for remote control and indication housed within a self-contained, sealed enclosure.

A. Actuator Sizing

1. The actuator shall be sized to guarantee valve closure at the specified torque and/or thrust requirement as indicated by the valve manufacturer or supplier. The actuator must be adequately sized to provide the torque required to operate the valve at 90% of the nominal voltage. The operating speed shall provide valve closing and opening at approximately 12 inches per minute for gate valves, 4 inches per minute for globe valves and as indicated in the valve list for quarter turn valves. Quarter-turn valves will be furnished with mechanical stops that restrict the valve/actuator travel.

B. Environmental

1. Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -20°F to +160°F in open/close service, up to 100% relative humidity.

C. Enclosure

1. Actuators shall be 0-ring sealed, watertight to NEMA 4X/6 (6 feet for 30 minutes). Where required, actuators for hazardous locations shall be certified explosion proof for Class I, Division 1 & 2, Groups C & D. All external fasteners shall be of stainless steel. Gear case shall be cast iron.

D. Motor

1. The electric motor shall be Class F insulated, with a duty rating of at least 15 minutes at 104°F (40°C). Motor shall be specifically designed and built by the actuator

manufacturer for electric actuator service. Commercially available motors shall not be acceptable. Electrical disconnection of the motor shall be by means of a plug and socket and motor removal shall be possible without loss of lubricant. The actuator must include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel regardless of the connection sequence of the power supply.

E. Motor Protection

The following criteria shall be provided for motor protection:

1. The motor shall be de-energized without damage in the event of a stall condition when attempting to move a jammed valve.
2. The motor shall be de-energized in the event of an over-torque condition
3. A minimum of three thermal devices imbedded in the motor windings shall be provided to de-energize the motor in case of overheating.
4. Lost phase protection

F. Gearing

1. The actuator gearing shall be totally enclosed in a grease-filled cast iron gearcase suitable for operation in any orientation. Actuator gearing shall be hardened steel with alloy bronze worm wheel. The design should permit the opening of the gearcase for inspection or disassembly without releasing the stem thrust or taking the valve out of service. Where required per application, electric actuators will be provided with worm gearboxes. The worm gearboxes shall be supplied with full 360° bronze worm wheels and end-of-travel mechanical stops on the worm shaft. Designs with segmented worm gears and end-of-travel stops in the gearbox housing will not be permitted.

G. Manual Operation

1. Manual operation shall be by handwheel. Manual operation shall utilize the actuator worm shaft/worm wheel to maintain self-locking gearing and to facilitate changeover from motor to manual operation when the actuator is under load. Actuator designs that bypass electric actuator worm gears when declutched are unacceptable. The declutching from motor operation shall be at the motor shaft to minimize declutching effort. Designs that break the valve load at the worm and worm gear are unacceptable. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation.

H. Drive Nut And Thrust Base Assembly

1. For multi turn rising stem applications, the drive nut shall be installed in a detachable thrust base. The design shall allow actuator removal from the thrust base, leaving the thrust base attached to the valve to retain valve position. Thrust bearings shall be lubricated by means of an easily accessible grease fitting.

I. Valve Position And Torque Calibration

1. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle. One set of normally open and one set of normally closed contacts will be furnished at each end of travel where indicated.
2. Contacts shall be of silver and capable of reliably switching low voltage DC source from the control system furnished by others.
3. Mechanically operated torque switches shall be furnished at each end of travel. Torque switches will trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque.

J. Wiring And Terminals

1. Internal wiring shall be tropical grade insulated stranded cable of appropriate size for the control and 3-phase power.
2. All external wiring shall terminate in a removable plug and socket head, which allows easy disconnection of all power and control voltages. Actuators furnished without plug and socket terminal connections must have power and control disconnect switches for ease of maintenance and safety.

2.02 ELECTRIC ACTUATOR CONTROL

A. Controls

1. All actuators will be furnished with integral actuators / motor controls. The integral controls shall be electrically connected to the actuator via a plug and socket connection. It shall be possible to re-position the integral controls at 90° increments, so that the push buttons and indication lights will face the operator.
2. In case the actuators have to be mounted in un-accessible positions, it shall be possible to separate the integral controls including all the electronic control elements from the actuator. A wall bracket shall be available as an option to mount the controls at a convenient position near the actuator.

B. Control components

The following components/features shall be included with the integral controls:

1. Reversing contactors (mechanically and electrically interlocked).
2. Internal power supply / transformer for control power.
3. Control and signal voltage shall be either 24V DC or 110 V as indicated, internally or externally supplied.
4. Programmable control logic
5. Automatic phase correction

6. Control system interface by one of two modes as follows:

    a. Control by contact closure / discrete input signals via OPEN- STOP-CLOSE signals (either 24 V DC or 115 V as indicated) potentially separated from actuator controls by opto-isolators.

    b. Control by analog signal via positioner board capable of accepting a 4-20mADC command signal and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail to the "open", "closed" or "last" position on loss of analog (i.e. 4- 20mADC) command signal.

C. Local controls

1. Local controls with 'OPEN - STOP - CLOSE' pushbutton type controls and a lockable selector switch with 'LOCAL - OFF - REMOTE' function. Local controls shall be supplied with indicating lights red for ‘OPEN’, yellow for ‘FAULT’ and green for ‘CLOSED’.

D. Output signals and for remote indication

1. The following output signals shall be furnished for remote indication:

    a. Output signals from selector switch when switch is in LOCAL or REMOTE positions via potential-free contacts.

    b. Signals for end-of-travel positions OPEN and CLOSED shall be via potential-free contacts.

    c. Monitor relay for collective fault signal (power failure, phase failure, thermal switch tripped and torque switch tripped in mid travel) shall be provided.

    d. Where required, 4-20 mA positoin feedback signal.

2.03 ELECTRIC ACTUATOR COMMISSIONING AND TEST REPORTS

A. Commissioning Kit

1. Each actuator will be provided with a commissioning kit consisting of a wiring diagram and installation and operation manual. No special commissioning tools or parts will be required for start-up.

B. Performance Test Documentation

1. Each actuator shall be performance tested. Test documentation must be provided if requested indicating the following:

    a. torque sensing tripping points in both the open and closed directions of travel

    b. current at the maximum torque tripping point

    c. actuator output speed

    d. high voltage test

2.04 ELECTRIC ACTUATOR MANUFACTURERS

A. All actuators shall be manufactured by AUMA Actuators, Inc. of Canonsburg, PA.

1. The electric actuator shall be a model SQ10.2/AM01.0 or pre-approved equal AUMA Actuator.

END OF SECTION 40 05 57

SECTION 40 05 58

THERMOSTATIC MIXING VALVES

PART 1 - GENERAL

1.01 FEATURES

A. Temperature control to ASSE 1069, 1070 and 1017 down to 0.5 gpm.

B. Advanced thermal actuator improves performance at low flow.

C. Lead Free cast copper silicon alloy body construction for durability and to comply with Lead Free requirements.

D. Adjustable temperature selection with lock.

E. Union connections for easy maintenance.

F. Integral checks and screen prevents cross-flow and contamination.

G. 1" with NPT connections.

PART 2 - PRODUCT

2.01 SPECIFICATIONS

A. Temperature Adjustment: SQ 120°F

B. Approach Temperature: 5°F above set point

C. Max. Operating Pressure: 125 psi

D. Max. Hot Water Temperature: 200°F

E. Max. Pressure Differential between Hot & Cold Water Supplies: 25%

F. Minimum Flow: 0.5 gpm when tested in accordance with ASSE 1017-2003

G. Check Valves: Integral

H. Construction: Lead Free Cast copper silicon alloy body

I. Listing: ASSE 1069, ASSE 1070, ASSE 1017, IAPMO cUPC, and NSF372

J. Capacity – table below

Pressure Drop Across The Valve							
(Cv) 1 psi	5 psi	10 psi	15 psi	20 psi	30 psi	45 psi	60 psi
1.79	4.0 gpm	5.7 gpm	7.0 gpm	8.0 gpm	9.8 gpm	12.0 gpm	13.9 gpm

2.02 TYPICAL SPECIFICATION

A. Thermostatic tempering valve shall be constructed using Lead Free cast copper silicon alloy material which shall comply with state codes and standards, where applicable requiring reduced lead content.

B. The valve shall feature advanced paraffin-based actuation technology and union connections for ease of maintenance.

C. All internal components shall be corrosion-resistant.

D. Valve shall feature integral checks to prevent cross- flow and inlet screens to filter out debris.

E. The valve shall be ASSE 1069, ASSE 1070, ASSE 1017 and IAPMO CUPC listed.

F. Capacity of the valve shall be 12.0 gpm at 45psi differential.

G. Valve shall perform to a minimum flow of 0.5 gpm to ASSE 1070.

H. Control temperature shall be adjustable between 80°F - 120°F.

I. The valve shall feature a vandal-resistant lockable handle to prevent tampering.

J. The valve shall be a Powers HydroGuard Model LFLM497 (1").

K. Any alternate must have a written approval prior to bidding.

END OF SECTION 40 05 58

SECTION 40 05 60
SLIDE AND WEIR GATES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to install, ready for operation and field test stainless steel gates and appurtenances as shown on the Contract Drawings and as specified herein.

B. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C561 Standard for Fabricated Stainless Steel Slide Gates as modified herein. The allowable leakage rate for the stainless steel gates in this specification shall be 1/2 the allowable leakage listed in the latest revision of AWWA C561.

C. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer.

D. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.

E. Gates supplied under this section shall be Model GH-66 Stainless Steel Weir Gates as manufactured by Golden Harvest Inc. or engineer approved equal.

1.02 SUBMITTALS

A. Provide the following information to confirm compliance with the specification in addition to the submittal requirements specified in Section .

1. Complete description of all materials including the material thickness of all structural components of the frame and slide.

2. Installation drawings showing all details of construction, details required for installation, dimensions and anchor bolt locations, general construction materials used in the gate & lift mechanism.

3. Complete engineering design calculations in compliance with AWWA standards latest edition.

4. Maximum bending stress and deflection of the slide under the maximum design head.

5. The location of the company headquarters and the location of the principle manufacturing facility. Provide the name of the company that manufactures the equipment if the supplier utilizes an outside source.

1.03 QUALITY ASSURANCE

A. Qualifications

1. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years experience designing and manufacturing water control gates. The manufacturer shall have manufactured water control gates for a minimum of 100 projects.

2. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of AWS Sections D1.1, 1.2 and 1.6.

3. The fully assembled gates shall be shop inspected, tested for operation and leakage, and adjusted before shipping. There shall be no assembling or adjusting on the job sites other than for the lifting mechanism.

4. Approved manufacturers of the weir gates and slide gates are:

   a. Rodney Hunt, Inc of Orange, MA,
   b. Plasti-Fab, (Ershigs, Inc.) of Ridgefield, WA
   c. Golden Harvest, Inc. of Burlington, WA
   d. Whipps, Inc. of Athol, MA
   e. Other manufacturers with pre-approval.

PART 2 - EQUIPMENT

2.01 GENERAL

A. Gates shall be as specified herein and have the characteristics and dimensions shown on the Contract Drawings.

B. Gate shall be designed in accordance with AWWA C561-14 Standards for fabricated slide gates.

C. Weir gates shall be of the non-rising stem design.

D. Slide gates will be either rising stem or non-rising stem as called out on the Project Drawings. Gates shall be either self-contained or non self-contained of the rising stem or non-rising configuration as indicated on the gate schedule.

E. All parts of the gate shall have a minimum thickness of ¼ inch.

F. Leakage shall not exceed 0.05 gpm/ft of wetted seal perimeter in seating head and unseating head conditions.

1. Weir and slide gates shall be substantially watertight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.10 US gallons per minute per foot of seating perimeter. Under the design unseating head, leakage shall not exceed 0.10 US gallons per minute per foot of perimeter.

G. All gate valves shall utilize self-adjusting seals. Due to the difficulty of accessing gates when they are in service, gates that utilize adjustable wedges, wedging devices or pressure pads are not acceptable.

H. All structural components of the frame and slide *shall be fabricated of stainless steel having a minimum thickness of 1/4-inch* and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

I. All welds shall be full and continuous performed by welders with AWS certification.

J. Finish: Mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale/picked & passivated. All iron and steel components shall be properly prepared and shop coated with a primer.

2.02 FRAME

A. The frame assembly, including the guide members, invert member and yoke members, shall be constructed of stainless steel plate with a minimum thickness of 1/4-inch.

1. Frame design shall allow for embedded mounting, mounting directly to a wall with stainless steel anchor bolts and grout or mounting to a wall thimble with stainless steel mounting studs and a mastic gasket material. Mounting style shall be as shown on the Contract Drawings.

2. All wall mounted or wall thimble mounted gates shall have a flange frame. Flat frame gates are not acceptable.

3. Gussets shall be provided as necessary to support the guide members in an unseating head condition.

4. Frame support of the gate:

   a. For upward-opening slide gates, the frame shall extend to accommodate the *entire height* of the slide when the slide is in the fully opened position.

   b. For downward-opening weir gates, the frame shall extend to accommodate at least ¾ of the gate height when in the fully opened position..

5. On self-contained gates, a yoke shall be provided across the top of the frame. The yoke shall be formed by a structural members affixed to the top of the side frame members to provide a one-piece rigid assembly. The yoke shall be designed to allow removal of the slide.

6. A rigid stainless steel invert member (flush bottom type) shall be provided across the bottom of the opening for upward-opening slide gates.

7. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.

8. A rigid stainless steel member shall be provided across the invert of the opening on downward-opening weir gates.

9. The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the wall or wall thimble.

2.03 SLIDE

A. The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of 1/4-inch

1. The slide shall consist of stainless steel plate reinforced to limit its deflection to L/720 of the clear opening span or 1/32 inch, whichever is smaller, under the design maximum head.

2. Reinforcing stiffeners shall be continuously welded (stitch welding will not be acceptable) to the slide and mounted horizontally. Vertical stiffeners shall be continuously welded on the outside of the horizontal stiffeners for additional reinforcement.

3. The stem connector shall be constructed of two angles or plates. The stem connector shall be continuously welded to the slide. A minimum of two bolts shall connect the stem to the stem connector.

2.04 SEALS

A. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements listed in this specification.

1. All gates shall be equipped with UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.

2. Slide Gates:

a. The seat/seals shall extend to accommodate at least 1-1/2 x the height of the slide when the slide is in the fully closed or fully opened position.

b. Guides shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.

3. Weir Gates:

a. The seat/seals shall extend to accommodate the entire height of the weir when weir is in the fully closed or fully open position.

b. Guides shall be of such length as to retain and support at least three-quarters (3/4) of the vertical height of the weir in the fully open position.

4. All slide and weir gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member or the bottom of the slide and it shall be held in place with stainless steel attachment hardware.

5. The seal system shall be durable and shall be designed to accommodate high velocities and frequent cycling without loosening or suffering damage.

6. All seals must be bolted or otherwise mechanically fastened to the frame or slide.

7. The seals shall be mounted so as not to obstruct the water way opening.

8. Gates that utilize rubber “J” seals or “P” seals are not acceptable.

9. Seals shall be fully adjustable.

10. The seal system shall have been factory tested to confirm negligible wear (less than 0.01”) and proper sealing. The factory testing shall consist of an accelerated wear test comprised of a minimum of 25,000 open-close cycles using a well-agitated sand/water mixture to simulate fluidized grit.

11. When required for isolation of a pipe or structural opening, a horizontal top spigot and neoprene top seal shall be supplied.

2.05 STEM

A. A threaded operating stem shall be utilized to connect the operating mechanism to the slide.

B. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator or motor actuator. On non-rising stem gates; the threaded portion shall engage the nut on the slide.

1. The threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches. Stem extension pipes are not acceptable.

2. The stem shall be constructed of solid stainless steel bar for the entire length, the metal having a tensile strength of not less than 90,000 psi for stems that are 3 inches or less in diameter. Stems that are in excess of 3 inches in diameter shall have a tensile strength of 85,000 psi.

3. The stem shall be threaded to allow full travel of the slide unless the travel distance is otherwise shown on the Contract Drawings.

4. Maximum L/R ratio for the unsupported part of the stem shall not exceed 200.

5. In compression, the stem shall be designed for a critical buckling load caused by a 40 lb effort on the crank or handwheel with a safety factor of 2, using the Euler column formula.

6. For *upward-opening slide gates*, the stem shall be designed to withstand the tension load caused by the application of a 40 lb. effort on the crank or handwheel without exceeding 1/5 of the ultimate tensile strength of the stem material.

7. For *downward-opening weir gates*, the operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lb effort on the crank or handwheel.

8. The threaded portion of the stem shall have threads of Acme type with a 16 microinch finish or better.

9. Stems of more than one section shall be joined by stainless steel or bronze couplings. The coupling shall be threaded and bolted to the stems.

10. Stems shall be provided with adjustable stop collars to prevent over-closing or over-opening of the gate.

11. Gates having a width equal to or greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.

12. Stem Cover

    a. Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents and a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

2.06 STEM GUIDES

A. Stem guide shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.

1. Stem guide brackets shall be fabricated of stainless steel and shall be outfitted with UHMW or bronze bushings.
2. Adjustable in two directions.

2.07 WALL THIMBLES

A. Wall thimbles shall be provided when shown on the Contract Drawings.

1. The wall thimble depth shall be equal to the thickness of the concrete wall in which the thimble is to be mounted.
2. Wall thimbles shall be fabricated stainless steel construction of adequate section to withstand all operational and reasonable installation stresses.
3. Wall thimbles shall be constructed of 1/4-inch minimum thickness stainless steel and the front face shall have a minimum thickness of 1/4–inch.
4. The fabrication process shall ensure that the wall thimble is square and plumb and the front face is sufficiently flat to provide a proper mounting surface for the gate frame.
5. The face of the wall thimble shall only be machined if recommended by the gate manufacturer. If the wall thimble is to be machined, the front face shall have a minimum thickness of 1/4-inch after machining.
6. A water stop shall be welded around the periphery of the thimble. Wall thimbles shall be designed to allow thorough and uniform concrete placement during installation.
7. Studs and nuts shall be stainless steel. Water stop may be stitch welded.
8. A suitable gasket or mastic shall be provided to seal between the gate frame and the wall thimble.

2.08 MATERIAL OF CONSTRUCTION

Frame Assembly and Retainers:	Stainless Steel, Type 304L, ASTM A240
Slide and Stiffeners:	Stainless Steel, Type 304L, ASTM A240
Stem:	Stainless Steel, Type 304, ASTM A276
Fasteners, Nuts and Bolts:	Stainless Steel, Type 304, ASTM A276

Invert Seal (Upward Opening Gates Only):	Neoprene ASTM D-2000 or EPDM
Seat/Seals and Facing:	Ultra-High Molecular Weight Polyethylene ASTM D4020
Lift Nuts:	Bronze ASTM B584
Pedestals and Wall Brackets:	Stainless Steel, Type 304L, ASTM A276
Operator Housing:	Cast aluminum or ductile iron

2.09 MANUAL OPERATORS

A. Unless otherwise shown on the Drawings, gates shall be operated by a manual handwheel or a manual crank-operated gearbox. The operator shall be mounted on the yoke of self-contained gates or on the pedestal of non-self-contained gates.

1. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated with no more than a 40 lb effort when the gate is in the closed position and experiencing the maximum operating head.

2. Operators of the types listed in the schedule shall be provided by the gate manufacturer. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lb on the crank or handwheel, and shall be able to withstand, without damage, an effort of 80 lb.

3. An arrow with the word “OPEN” shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate.

4. Weir gates operated by a 2" operating nut shall open in the counterclockwise direction and close in the clockwise direction.

5. Handwheel operators shall be fully enclosed and shall have a cast aluminum housing.

   a. Handwheel operators shall be provided with a threaded cast bronze lift nut to engage the operating stem.

   b. Handwheel operators shall be equipped with roller bearings above and below the operating nut.

   c. Positive mechanical seals shall be provided above and below the operating nut to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.

   d. Operating handwheels shall be removable and shall have a minimum diameter of 15 inches.

6. Crank-operated gearboxes shall be fully enclosed and shall have cast aluminum or ductile iron housing.

   a. Gearboxes shall have either single or double gear reduction depending upon the lifting capacity required.

   b. Gearboxes shall be provided with a threaded cast bronze lift nut to engage the operating stem.

c. Gearboxes shall be provided when required to maintain the operating force below 40 lb.

d. All bearings and gears shall be totally enclosed in a weather tight housing.

e. Operator housing shall be cast steel or cast iron.

f. The operating shaft shall be fitted with a 2 inch square operating nut and removable crank.

g. The crank shall be fitted with a corrosion-resistant rotating handle.

h. Bearings shall be provided above and below the flange on the operating nut to support both opening and closing thrusts.

i. Gears shall be steel with machined cut teeth designed for smooth operation.

j. The pinion shaft shall be stainless steel and shall be supported on ball or tapered roller bearings.

k. Positive mechanical seals shall be provided on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.

l. The crank shall be cast aluminum or cast iron with a revolving nylon grip.

m. The crank shall be removable.

7. Pedestals (where required or specified) shall be constructed of stainless steel. Aluminum pedestals are not acceptable.

a. The pedestal height shall be such that the handwheel or pinion shaft on the crank-operated gearbox is located approximately 36 in above the operating floor.

b. Wall brackets shall be used to support floor stands where shown on the Drawings and shall be constructed of stainless steel.

c. Wall brackets shall be reinforced to withstand in compression at least two times the rated output of the operator with a 40 lb effort on the crank or handwheel.

d. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the ENGINEER. The gate manufacturer shall supply the bracket, anchor bolts and accessories as part of the gate assembly.

e. The yoke, to support the operating bench stand, shall be formed by two structural members welded at the top of the guides to provide a one piece rigid frame.

f. Self-contained gates shall be provided with a yoke to support the operating bench stand. The yoke shall be formed by two structural members welded at the top of the guides to provide a one piece rigid frame. The maximum deflection of the yoke shall be L/360 of the gate's span.

g. Non-self contained gates shall be provided with pedestal mounted lifts. Pedestal shall be mild steel that is prepped per SSPC-05 and provided with industrial grade powder coating. Stainless steel pedestals and/or wall brackets shall be supplied where specified in the gate schedule.

8. Rising-stem slide gate operators shall be equipped with polycarbonate plastic stem covers.

a. The top of the stem cover shall be closed.

b. The bottom end of the stem cover shall be mounted in a housing or adapter for easy field mounting.

c. Stem covers shall be complete with indicator markings to indicate gate position.

d. When shown on the Contract Drawings, provide 2-inch square nut, mounted in a floor box, with a non-rising stem.

e. The square nut shall be constructed of stainless steel.

f. The floor box shall be constructed of stainless steel or cast iron and shall be set in the concrete floor above the gate as shown.

g. Provide one aluminum or stainless steel T-handle wrench for operation.

2.10 ANCHOR BOLTS

A. Anchor bolts shall be provided by the gate manufacturer for mounting the gates and appurtenances.

1. Quantity and location shall be determined by the gate manufacturer.

2. If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.

3. Anchor bolts shall have a minimum diameter of 1/2-inch

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of the gates and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.

B. The CONTRACTOR shall review the installation drawings and installation instruction prior to installing the gates.

C. The gate assemblies shall be installed in a true vertical plane, square and plumb.

D. The CONTRACTOR shall fill the void in between the gate frame and the wall with non-shrink grout as shown on the installation drawing and in accordance with the manufacturer's recommendations.

E. The CONTRACTOR shall add a mastic gasket between the gate frame and wall thimble

(when applicable) in accordance with the manufacturer's recommendations.

3.02 FIELD TESTING

A. After installation, all gates shall be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured, and shall not exceed the maximum operating effort specified above. Electric motor actuators shall function smoothly and without interruption. Each gate shall be water tested by the CONTRACTOR, at the discretion of the ENGINEER and OWNER, to confirm that leakage does not exceed the specified allowable leakage.

END OF SECTION 40 05 60

SECTION 40 05 71.33
TELESCOPING VALVE

PART 1 - GENERAL

1.01 Telescoping valves will be used primarily for scum removal in the reactor basins, and are considered to be fully open when in the lowermost position.

A. The slip tube travels inside a cast iron or ductile iron riser pipe as shown in the plan drawings.

B. The nominal riser pipe diameter determines the valve tube diameter.

C. All telescoping valves shall be provided with a flared intake as shown on the plan drawings.

1.02 SCOPE OF WORK

A. The contractor shall furnish all labor, materials, equipment and incidentals required for installation of telescoping valves.

1.03 QUALITY ASSURANCE

A. The manufacturer shall have experience 10 years manufacturing telescoping valves and shall show evidence of satisfactory operation in at least 5 installations. The manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirement of the latest edition ASME, Section IX. The manufacturer must also be an ISO 9001:2008 certified company.

1.04 SUBMITTALS

A. The manufacturer shall submit drawings requiring critical dimensions, general construction, and materials used in the valve, mounting and lift mechanism.

PART 2 - PRODUCT

2.01 STATIONARY TUBE

A. Stationary tubes shall be manufactured from seamless metal pipe or tube. Tube lengths shall be as shown or noted on the drawings and must be of sufficient length to facilitate valve travel and maintain an appropriate insert depth when fully closed. Valve tubes are to be a minimum 1/8" thick and are attached to connecting stems by use of a lifting bail.

2.02 SEAL FLANGE

A. A cast iron or stainless steel companion flange and neoprene slip seal gasket shall be provided by the valve manufacturer. The gasket must be a minimum 1/4" thick. The inside diameter of the gasket is to be 1/8" smaller than the outside diameter of the valve tube to provide a friction seal. The gasket is to be sandwiched between the riser pipe flange and the companion flange. The gasket and companion flange shall include a 125# standard drilling pattern to match the riser pipe.

2.03 LIFTING BAIL

A. The bail shall be the same material as the tube and be rigidly welded to the tube.

2.04 LIFT AND STEMS

A. Lifts shall be non-rising stem, handwheel type, with UHMW polyethylene thrust bearings along with a stub acme threaded type 304 or 316 stainless steel stem to provide automatic self-locking, infinite valve positioning. Where conditions require, a V-keyed shaft, with torque plate, shall be used to prevent valve tube rotation. Handwheels shall be a minimum of 12" in diameter and shall include a clear plastic Butyrate stem cover with a mylar strip type position indicator, calibrated in ¼ inch increments to illustrate valve position. The mylar strip, provided by the manufacturer, will be affixed by the contractor after installation *to provide a true and accurate indication of the tube elevation by comparing it to the liquid levels for all reactor basin cycles*. Stainless steel anchor bolts shall be provided for all pedestals and mounting brackets. Cleaning and shop prime coat of lift housing and handwheel will be manufacturer's standard and supplemented by final coating in accordance with Division 09 of this Specification package.

2.05 SLIP TUBE

A. The slip tube material shall be stainless steel (304 or 316).

B. The slip tube will be supplied with a *flared top* to enhance scum removal capabilities.

2.06 GREASE FITTING

A. When required, slip tubes shall be equipped with a grease fitting to allow the operator to apply grease to the slip tube from the operator level**.** The fitting shall be used when flange is often exposed to dry air, or in a dry application completely.

2.07 FLANGE

A. The slip tube gasket shall be BUNA-N and replaceable without removal of the slip tube assembly from the riser pipe, lift rod or actuator. The gasket retainer shall be stainless steel and the flange shall be cast iron, unless otherwise specified.

2.08 SAFETY LOCK OPERATORS

A. Non-Rising Stem

1. The operator shall be a non-rising stem style with a hand wheel and linear position indicator, calibrated in 1/4" increments, incorporated in the stainless steel floor stand. A stainless steel traveling torque tube and stainless steel anti-rotation plate shall be incorporated to prevent the slip tube from rotating. All fasteners are to be 304 stainless steel.

2.09 The telescoping valve shall be machined, assembled, and tested in the USA for quality assurance.

2.10 Manufacturer shall show proof of ISO 9001:2008 certification.

2.11 Where required, the manufacturer shall provide valve operating stems, stem guides, and operators as specified in the valve schedule or plans.

2.12 Telescoping Valve and accessories shall be manufactured by Troy Valve or

approved equal.

2.13 TUBE

A. Stainless steel tubes shall be of schedule 40, type 304 or 316 pipe as per project specifications. Tube length shall be as shown on plan drawing, or be of such a length as to include both required valve travel and a minimum of 6” insert into riser pipe. Valve tubes shall be attached to the operating stem by means of a stainless steel lifting bail. Plastic valve (slip) tubes shall be of PVC pipe. Tube length shall be as shown on plan drawing, or be of such a length as to include both required valve travel and a minimum of 6" insert into riser pipe when fully closed. Valve tubes shall be attached to the operating stem by means of a stainless steel lifting bail, and shall include either bushings or a stainless steel inner reinforcing ring, to prevent bolt hole elongation on the PVC tube.

2.14 SEAL ASSEMBLY

A. A seal flange and retainer plate made of type 304 stainless steel (unless project specifications require other material) and two (2) Buna-N slip seal gaskets shall be provided by the valve manufacturer. The slip seal gasket ID shall be 1/8” smaller than slip tube OD. The seal flange and retainer plate shall be 1/4” thick; the slip seal gaskets 1/4” thick each. Slip seal gaskets shall be “dovetailed” in order to facilitate easy replacement in the field without disassembly of valve. The gaskets shall be sandwiched in between the seal flange and the retainer plate, which are to be bolted to the riser pipe flange. The gaskets, sealing flange and retainer plate are to be supplied with standard class 125# drilling pattern to match the riser pipe flange.

2.15 LIFTING BAIL

A. On stainless steel and PVC valve tubes, lifting bail shall be of stainless steel construction and be fastened to the valve tubes with stainless steel bolts. On stainless steel tubes, bail material shall be the same as the valve tube. On PVC tubes, bail material shall be 304 stainless steel unless otherwise required by the project specifications.

2.16 OPERATORS (RISING STEM VALVES)

A. Unless otherwise shown on the drawings, manual operators shall be handwheel non-rising stem style. Operators shall be mounted to a pedestal or offset pedestal as required. Pedestal shall be of cast 316 stainless steel. Fabricated pedestals are not acceptable. A threaded stainless steel operating stem shall be used to connect the operating mechanism to the valve tube lifting bail. On rotary operated valves, provisions shall be made to prevent rotation of the valve tube. Operators shall be supplied with clear plastic stem covers (where applicable), vented cover cap and Mylar position indication tape.

2.17 STEM ACCESSORIES

A. Stem guides where required shall be of cast 316 stainless steel or cast ductile iron epoxy coated with bronze bushings. Stem guides shall be adjustable in two directions to assist in proper stem installation and alignment. Wall brackets for offset pedestals shall be of cast 316 stainless steel or cast ductile iron epoxy coated.

2.18 MANUFACTURER

A. Telescoping Valves shall be as manufactured by Troy Valve of Troy, Pennsylvania or approved equal.

PART 3 - EXECUTION

3.01 SHIPPING, HANDLING, DELIVERY AND STORAGE

A. The Contractor shall assume all responsibility for packaging, shipping, unloading, unpacking and storage to prevent any damage to the telescoping valves prior to installation.

B. The telescoping valves shall be stored in a manner that does not cause damage to the factory-applied coatings, seals or gaskets.

3.02 INSTALLATION

A. The Contractor shall furnish the services of competent factory representative familiar with this installation and equipment to supervise installation.

B. All materials and equipment shall be clean and free of oil, grease and/or chemical contaminations prior to installation.

C. The concrete surface upon which the telescoping valve mounting brackets will be installed, shall be solid, smooth, flat, clean and free from surface contamination, rock pockets, oils or efflorescence.

D. Floor Stands and Handwheels: Shall be oriented for accessibility and operability as approved by the OWNER's representative. Do not install valves in a position or orientation where operation of the handwheel or reading of the position indicator is interfered with by other features of the reactor basin or appurtenances.

E. Setting of Valves: A suitably-sized and firmly-affixed mounting bracket shall be provided for every valve as specified on the plan sheets. The floor stand shall be centered and plumb over the operating stem and slip tube of the valve, as directed by the ENGINEER.

F. Cleaning: All valves and appurtenances shall be flushed clear of all foreign material after installation.

G. If required by the ENGINEER, the CONTRACTOR shall furnish the service of factory authorized service person to instruct and check out the operation/calibration of all telescoping valves.

3.03 START UP

A. Upon startup of the scum removal system within the reactor basins, all telescoping valves shall be exercised over the full operating range to confirm their ability to perform as intended. Field test all valves and appurtenances for proper operation, proper adjustments and settings, freedom from workmanship. All defects shall be corrected to the satisfaction of the Engineer.

END OF SECTION 40 05 71.33

SECTION 40 05 74.01
SERIES 75 MANUALLY OPERATED PINCH VALVES

PART 1 - GENERAL

1.01 SUBMITTALS

A. Submit product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, sleeve trim design, elastomer characteristics, flow data, and pressure ratings.

B. Upon request, provide shop drawings that clearly identify the valve dimensions including all supplied accessories.

1.02 QUALITY ASSURANCE

A. Supplier shall have at least ten (10) years experience in the manufacture of pinch style valves, and shall provide references and a list of installations upon request.

PART 2 - PRODUCTS

2.01 MANUALLY OPERATED PINCH VALVES

A. Valves are to be of the full cast metal body, mechanical pinch type with flange joint ends on both the body and the sleeve trim. The valve shall have face-to-face dimensions of standard gate valves, in accordance with ANSI B16.10 up to 12” size. Sizes 14” and larger shall have a face to face dimension no longer than twice the nominal valve port diameter. The flanges shall be drilled to mate with ANSI B16.1, Class 125/ANSI B16.5, and Class 150 flanges.

B. The sleeve trim shall be one piece construction with integral flanges drilled to be retained by the flange bolts. The sleeve trim shall be reinforced with calendared nylon or calendared polyester fabric to match service conditions. The sleeve trim shall be connected to the pinch bar by tabs imbedded in the sleeve trim-reinforcing ply. All internal valve metal parts are to be completely isolated from the process fluid by the sleeve trim. To promote laminar flow. The interior surface of the sleeve shall be smooth. Sleeves manufactured with interior arches or folds shall not be permitted.

C. For full port and reduced port sleeves, the port areas shall be 100% of the full pipe area at the valve ends. For Cone and Variable Orifice sleeves the inlet port area shall be 100% of the full pipe area, reducing to a smaller port at the outlet.

D. The steel mechanism shall be double acting with pinching of the sleeve trim occurring equally from two sides. ACME threads shall be used on all valve mechanisms. There shall be no cast parts in the operating mechanism. To prevent pitting, corrosion, seizing or jamming. The pinching mechanism and side-rails shall be fully enclosed within the valve body. Side-rails that slide through bushings or protrude through the valve body shall not be permitted. The stem shall be non-rising and have a non-rising handwheel. The handwheel shall be constructed of welded, tubular steel and be connected to the stem

by means of a single retaining bolt. The handwheel shall be fitted with a lubrication fitting to allow lubrication of the stem. A valve position indicator rod shall pass through the center of the stem, retaining bolt, and handwheel to provide visual position indication. Bevel gear operators shall be provided on all valves over 8" size. Lifting eyelets shall be provided on the top of the valve body where applicable.

2.02 FUNCTION

A. Rotating the handle clockwise lowers a pinch bar above the sleeve, while raising a pinch bar below the sleeve simultaneously, pinching the sleeve closed at the center of the valve. Turning the handle counter-clockwise separated the two pinch bars to open the valve.

2.03 MANUFACTURER

A. All valves shall be of the Series 75 as manufactured by the Red Valve Co., Inc. of Carnegie, PA 15106 or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

3.02 MANUFACTURER'S CUSTOMER SERVICE

A. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valves.

B. Manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valves.

END OF SECTION 40 05 74.01

SECTION 40 05 74.02
AIR OPERATED PINCH VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. The air operated pinch valve will be located on the grit pump in the grit handling building and will be operated each time the grit pump is activated. The air compressor in the grit building will provide the air supply for the valve.

1.02 SUBMITTALS

A. Submit product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, sleeve trim design, elastomer characteristics, flow data, and pressure ratings.

B. Upon request, provide shop drawings that clearly identify the valve dimensions including all supplied accessories.

1.03 QUALITY ASSURANCE

A. Supplier shall have at least ten (10) years of experience in the manufacture of pinch style valves, and shall provide references and a list of installations upon request.

PART 2 - PRODUCTS

2.01 AIR OPERATED PINCH VALVES

A. Valves are to be of the pneumatically operated jacket pinch type with flanged joint ends. Port area shall be 100% of the mating pipe port area through the entire valve length. Valve body shall be drilled and tapped for a pressure connection on top and bottom of the housing. Valve shall be two piece split body construction. The two halves shall be sealed by diamond shaped cross section rubber gasket permanently locked by a groove in the valve body. Company name and location shall be cast onto the valve body.

B. All internal valve metal parts are to be completely protected from the process fluid by a flexible elastomer pinch tube. The elastomer pinch sleeve shall be one piece construction with flanges drilled to be retained by the flange bolts. The pinch tube shall be reinforced **EPDM** material. Valve shall be manufactured in the USA.

C. Air to the valve will be regulated with an explosion-proof ASCO model EF8320G172 120/60 Solenoid Valve which will be controlled as a function of the operation of the grit pump.

2.02 FUNCTION

A. The valve will be used to stop flow on the discharge forcemain from the grit pump which pumps from the grit removal basin to the grit washer.

B. To close the valve, air or hydraulic pressure is applied to the outside of the sleeve via the NPT connection tapped into the valve body. Required pressure is calculated as follows:

Line Pressure + 25 psi = Total Closing Pressure Required. With no pressure applied, valve will return to full open position.

2.03 MANUFACTURER

A. All valves shall be of the Type A as manufactured by the Red Valve Co., Inc. of Carnegie, PA 15106 or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

3.02 MANUFACTURER'S CUSTOMER SERVICE

A. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

B. Manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

END OF SECTION 40 05 74.02

SECTION 40 27 00
PROCESS PIPING - GENERAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:

1. Pipe, fittings, wall pipes, and connections associated with interior Work.

B. Related section include:

1. Section 01 10 00 – Summary of Work
2. Section 01 33 00 – Submittal Procedures
3. Section 01 40 00 – Quality Control
4. Section 01 60 00 – Product Requirements
5. Section 09 90 02 – High Performance Painting and Coating
6. Section 40 27 05 – Process Piping Support Systems
7. Section 40 27 10 – Process Piping Specialties
8. Section 40 27 20 - Process Valves
9. Section 40 42 13 – Process Piping Insulation
10. Section 40 71 13 – Magnetic Flow Meter

1.02 REFERENCES

A. Reference Standards include:

1. American National Standards Institute (ANSI)
2. American Society of Mechanical Engineers (ASME)
3. American Society for Testing Materials (ASTM)
4. American Water Works Association (AWWA)
5. American Welding Society (AWS)
6. National Sanitation Foundation (NSF)
7. ANSI/AWWA C104/A21.4: Cement-Mortar Lining for Gray-Iron and Ductile-Iron Pipe and Fittings for water.
8. ANSI/AWWA C105/A21.5: Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for water and other liquids.
9. ANSI/AWWA C110/A21.10: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water.
10. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe

and Fittings.

11. ANSI/AWWA C115/A21.15: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
12. ANSI/AWWA C150/A21.50: Thickness Design of Ductile-Iron Pipe.
13. ANSI/AWWA C151/A21.51: Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sand Lined Molds for water or other liquids.
14. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings.
15. ASME B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
16. ASME B16.26: Cast Copper Alloy Fittings for Flared Copper Tubes.
17. ASTM B 88: Seamless Copper Water Tube.
18. ASTM D-1784: Rigid Poly(Vinyl Chloride) Compounds and Chlorinated
19. Poly(Vinyl Chloride) Compounds.
20. ASTM D-1785: Poly(Vinyl Chloride) (PVC) Plastic Pipe, schedules 40, 80, 120.
21. ASTM D-2464: Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
22. ASTM D-2467: Socket Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
23. ASTM D-2564: Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
24. ASTM D-2855: Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
25. AWWA C600: Installation of Ductile-Iron Water Mains and Their Appurtenances.
26. AWWA C606: Grooved and shouldered type joints.
27. AWWA C651: Standard for Disinfecting Water Mains.
28. AWWA C653: Disinfection of Water Treatment Plants.
29. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In., for Water.
30. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In., for Water Transmission and Distribution.
31. NSF Standards No. 60 and 61 – National Sanitation Foundation.

1.03 QUALITY ASSURANCE

A. Welding Materials and Procedures: Conform to ANSI/AWS D.1.1.

B. Employ certified welders.

C. Piping modifications subject to Engineer's review. No additional compensation allowed

for modifications required to suit equipment furnished by Contractor.

1.04 SUBMITTALS

A. Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures for all pipe and fittings indicating: Name of Manufacturer, Materials, Standard Dimensions, References, and Joint Data.

B. Submit Affidavit of Compliance for ductile iron pipe and fittings.

C. Submit design calculations for structural design of pipe thickness where pipe class or thickness is not specifically called out.

D. Submit detailed piping layout drawings showing piping and connections to equipment and appurtenances.

1.05 COATING AND IDENTIFICATION SYSTEMS

A. All material and equipment in this section shall be factory primed. Primer shall be compatible with finish coats of paint provided under Section 09 90 02 – High Performance Painting and Coating.

B. The Contractor shall refinish and restore to the original appearance all equipment that has sustained damage to the manufacturer's finish or prime coats of paint or enamel.

C. Finish painting of all materials and equipment in this Section shall be the responsibility of the Contractor, and shall be as described Section 09 90 02 – High Performance Painting and Coating, unless otherwise specifically indicated.

D. All *interior* ductile iron pipe (DIP) shall be either:

1. Installed with no asphaltic varnish coating (only red primer) and coated in accordance with System 2 of Section 09 90 02 of these specifications;

2. Installed with asphaltic varnish coating (properly cleaned) and coated in accordance with 09 90 02 D.1.f of these specifications.

1.06 REGULATORY REQUIREMENTS

A. All Products that may come into contact with water intended for use in a Public Water System shall meet ANSI/NSF International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

PART 2 - PRODUCTS

2.01 PIPE SCHEDULE

A. Process Piping:

1. Ductile Iron.

2. Stainless Steel.

3. PVC.

B. Other Piping:

1. CPVC.
2. HDPE.
3. Copper (to be used for *plant air within the Grit and Main Process Buildings*).
4. Steel Pipe.
5. PE Jacketed, PE Insulated Stainless Steel Pipe – *For Insulated Filtrax Piping*
6. As otherwise shown on Drawings or specified in other Sections.

2.02 DUCTILE IRON PIPE AND FITTINGS

A. Approved Manufacturers:

1. American Cast Iron Pipe Company.
2. U.S. Pipe.
3. Or approved equivalent.

B. General

1. Minimum Pressure Class (Pounds per Square Inch – PSI):
    a. Interior and exterior exposed, flanged:
        i. 12-inch diameter and smaller: 350 PSI.
        ii. 14-inch diameter and larger: 250 PSI.
2. Onsite inspection of all materials by Contractor.
3. Pipe coating:
    a. Buried and submerged: bituminous coating (asphalt coating).
    b. Interior and exposed: prime coat.
4. Bolts and nuts:
    a. Buried exposed and submerged: stainless steel.
    b. Interior and exposed: stainless steel.
5. Pipe lining:
    a. All pipelines except air lines: cement-mortar.
    b. Ductile iron pipe for air lines shall be unlined.
6. Submit design calculation for structural design of pipe thickness where pipe thickness or class is not specifically called out.
7. Pipe and fittings to match face and drill of valves.
8. All flanges shall be full-faced flanges.
9. All materials to be new and unused.

10. Pipe and fitting material: ductile iron.

C. Pipe: ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51.

D. Flanged Pipe: ANSI/AWWA C115/A21.15.

1. Minimum Class: Class 53.

E. Fittings:

1. Flanged fittings:

a. Conform to ANSI/AWWA C110/A21.10.

b. Full face gaskets, bolts, and nuts: AWWA C110, Appendix A.

c. Material: ductile iron.

2. Reducers: all reducers shall be concentric pattern unless noted otherwise on the Project Drawings.

F. Based Fittings:

1. Conform to ANSI/AWWA-C110/A21.10.

2. All side-based and flange-based fittings must be fully faced and drilled.

G. Coatings and Linings:

1. Asphaltic: ANSI/AWWA C110/A21.10 and ANSI/AWWA C151/A21.51.

2. Cement lining: ANSI/AWWA C104/A21.4.

3. Prime coat: per Section 09 90 02 – Mechanical Painting and Coating.

H. Joints - Pipe and Fittings:

1. Flanged: ANSI/AWWA C110/A21.10 and ANSI/AWWA C115/A21.15.

2. Provide type of joint as indicated on Project Drawings.

3. Use of grooved and shouldered joints is acceptable where approved by Engineer.

a. Conform to AWWA C606.

4. The Engineer will only accept Uni-Flanges or approved equivalent at locations that receive prior approval.

I. Wall sleeves: wall sleeve shall be provided where ductile iron pipe passes through concrete walls and no thrust restraint is required. Wall sleeves shall be utilized unless a wall pipe is used. Wall sleeves shall be Schedule 40 PVC or galvanized carbon steel as specified on the project drawings. Wall sleeves shall be as manufactured by Metraflex or approved equal.

J. Wall Pipe and Wall Collar: All wall pipes and collars shall be Class 53 ductile iron with the collar continuously welded around the entire circumference and shall be rated a minimum of 250 psi. All wall pipes and collars shall be fabricated such that they are suitable in all thrust restraint applications where there is a concrete penetration. Wall

pipes and collars shall be as manufactured by U.S. Pipe or approved equal.

K. Sleeve Seals: All pipes passing through wall sleeves unrestrained where indicated on the Drawings will be provided with a sleeve seal similar to the Model C Link-Seal® Modular Seal or pre-approved equal.

2.03 STAINLESS STEEL PIPE

A. ASTM A-312 stainless steel pipe, Schedule 40, Type 304 with stainless steel drilled flanges, rated for 175 psi minimum, sizes 2-inch through 6-inch. Schedule 80, Type 304 stainless steel with stainless steel drilled flanges, sizes 8-inch through 12-inch.

1. Onsite inspection by Contractor of all materials.
2. Bolts and nuts: stainless steel.
3. Pipe and fittings to match face and drill of valves.
4. All materials to be new and unused.

B. Stainless Steel Pipe for *AGS reactor basin aeration piping*

1. ASTM A-312 stainless steel pipe, Schedule 10, Type 304L
2. Size: As indicated on Construction Drawings and pipe schedule.
3. Joints: 304L stainless steel welding neck flanges conforming to ANSI B16.5.
4. Pressure: Rated for 175 psi minimum at 150°F.
5. Pipe shall be electric fusion welded.

2.04 PVC PIPE AND FITTINGS

A. PVC pipe and fittings furnished shall be of the type as specified below for each particular use or type of installation.

B. Pressure Piping (4-inches diameter through 12-inches diameter)

1. PVC pressure pipe in sizes 4 – 12 inches in diameter shall conform to all applicable requirements of ANSI/AWWA C900 or C909 as applicable or indicated in the drawings. Pipe utilized for potable water shall be NSF certified for use in the transport of potable water.
2. The pipe and fittings shall meet cast iron pipe equivalent outside diameters and shall be minimum Class 150 (DR18) or Class 200 (DR14) pipe as indicated on the drawings, and shall meet the requirements of Table 2 of AWWA C900 or C909 as applicable.
3. Flanges for connecting plain end PVC pipe to equipment shall be Uni- flange series 900, ROMAC, or equal.
4. Pipe, fittings, and valves shall be installed in compliance with manufacturer’s recommendations.

C. Pressure Piping (less than 4-inches in diameter) and Non Pressure Piping

1. Schedule 80, unless specified otherwise, conforming to ASTM D-1785.
2. Materials: ASTM D-1784, Type 1, Grade 1.
3. Pipe Coating:
    a. Buried and submerged: None
    b. Exposed and Interior: Painted as Specified in Section 09 90 02 – Mechanical Painting and Coating.
4. Fittings: ASTM D-2467, socket type; or ASTM D-2467, flange type; or ASTM D-2464, threaded type; as required or as indicated on Drawings.
5. Solvent Cement: ASTM D-2564, Primer (ASTM F656) and PVC Solvent Cement.
6. Polyvinyl chloride fittings shall be limited to a 3-inch diameter or less.

2.05 CPVC PIPE AND FITTINGS

A. Pipe, fittings, and valves shall be manufactured from a CPVC compound which meets the requirements of class 23447-B, Type 4, Grade 1 in accordance with ASTM D1784. Compound from which the pipe is produced shall have a design stress rating of 2,000 psi at 23 degrees C, listed by the Plastic Pipe Institute (PPI).

B. Fittings and valves shall meet the requirements of ASTM F439 (schedule 80 socket) or ASTM F437 (schedule 80 threaded).

C. All socket type connections shall be joined with CPVC solvent cement conforming to the requirements of ASTM F493.

D. All CPVC shall be Schedule 80.

E. Approved Manufacturers:
    1. Georg Fischer.
    2. Hayward.
    3. Asahi/America.
    4. Spear.

2.06 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. All high density polyethylene pipe shall be DR 11, unless specified otherwise, conforming to ANSI D-2239.

B. All HDPE pipe to have standard ductile iron pipe size (DIPS) dimensions.

C. All pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults. The physical appearance of the pipe having deformities such as concentrated ridges, discoloration, excessive spot roughness, pitting, varying wall thickness, etc., shall constitute sufficient basis for rejection.

D. Ductile Iron Fittings:
    1. All ductile iron fittings connecting to polyethylene pipe are required to include

stainless steel sleeve inserts inside the pipe and PE electrofusion MJ adapters as manufactured by Central Plastics Company or approved equivalent.

2. PE electrofusion fittings may be substituted for ductile iron fittings at no additional cost to Owner. Fitting and piping shall be heat fused in accordance with ASTM D2657. Butt fusion fittings shall conform to ASTM D3261.

3. Push-on or mechanical rubber gasket joints conforming to the compression gasket ring requirements of ANSI/AWWA C111/A21/11 and ASTM D3139, and as shown on Drawings.

4. Provide stainless steel nuts, bolts, and glands.

2.07 COPPER TUBE AND FITTINGS

A. Copper pipe to be used for pipe sizes less than 4 inch diameter for *plant air within the Grit Building and Main Process Building*.

B. Dielectric unions shall be used between copper water tube and dissimilar metal piping.

C. Hard Copper Tube: ASTM B88, Types L and M (ASTM B88M, Types B and C), water tube, drawn temper. Type K for underground services.

1. Copper Pressure Fittings: ASME B16.18, cast-copper alloy or ASME B16.22, wrought-copper, solder joint fittings.

2. Bronze Flanges: ASME B16.24, Class 300, with solder joint end.

3. Copper Unions: MSS SP-123, cast-copper alloy, hexagonal stock body, with ball and socket, metal to metal seating surfaces and solder joint or threaded ends.

4. Copper, Grooved End Fittings: ASTM B75 (ASTM B75M) copper tube or ASTM B584 bronze castings.

a. Copper Tubing, Keyed Couplings: Copper tube dimensions and design similar to AWWA C606. Included ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

5. Aboveground Water Piping: Use the following piping materials for each size range:

a. NPS 1-1/2 (DN 40) and Smaller: Hard copper tube, Type L (Type B); and soldered joints.

b. NPS 2 (DN 50): Hard copper tube, Type L (Type B); and soldered joints.

c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Hard copper tube, Type L (Type B); and soldered joints.

6. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

a. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.

7. Soldered Joints: Use ASTM B 813, water-fusible, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

2.08 STEEL PIPE AND FITTINGS

A. Steel Pipe, NPS 2” (DN 50) and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade A, Schedule 80, galvanized steel, threaded ends per ASME/ANSI B1.20.1.

B. Steel Pipe, NPS 2-1/2” through NPS 12” (DN 65 through DN 300): ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.

C. Steel Pipe, NPS Greater than 12”: ERW standard wall, thickness of 0.375 inch, continuous spiral welded conforming to ASTM A-53 standards.

1. On-Site inspection by Contractor of all materials.

2. Pipe Coating:

a. Epoxy Lining: NSF International Standards 60 and 61.

b. Exposed: Shop Prime Coated and finish coat as specified in Section 09 90 02 – Mechanical Painting and Coating.

3. Flanges: ASME B16.5, Class 150-lb. slip on flanges, double welded.

4. Bolts and Nuts: Stainless steel.

5. Pipe and fittings to match face and drill of valves.

6. All materials to be new and unused.

7. Mechanical couplings: Dresser Style 38 or approved equal.

8. Unions: Fed Spec. WW-U-531, Class 2, Type A (black) for ungalvanized pipe.

9. Threaded fittings: ASME B16.4, Class 125.

D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

E. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.

F. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

G. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch

(20-mm) misalignment.

H. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F (121 deg C) and pressures up to 150 psig (1035 kPa).

I. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

J. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.09 POLYETHYLENE-JACKETED, POLYETHYLENE INSULATED STAINLESS STEEL PIPE

A. The service pipe shall be Schedule 10, ASTM A-312 304L Stainless Steel. All joints shall be butt-welded for 2 1/2" and larger, and socket or butt-welded for 2" and smaller. Where possible, straight sections shall be supplied in 40-foot random lengths with piping exposed at each end for field joint fabrication.

B. The service pipe insulation shall be polyurethane foam with 2.0 Lbs./Ft.2 minimum density, 90% minimum closed cell content and initial thermal conductivity of 0.16 Btu in./Hr. ft² °F. The insulation shall completely fill the annular space between the service pipe and jacket and shall be bonded to both. Systems using open cell insulation or a non-bonded design shall not be allowed.

1. The insulation shall be a minimum of 1-inch thick for all pipe less than 4" in diameter

C. The outer protective insulation jacket shall be seamless high-density polyethylene (HDPE) in accordance with ASTM D1248, type 3, Class C. PVC or tape materials are not allowed. Minimum jacket thickness shall be 0.125-inch.

D. All fittings shall be factory prefabricated and pre-insulated. Straight tangent lengths shall be added to all ends so that all field joints are at straight sections of pipe. Elbow jackets shall be molded HDPE. Tee jackets shall be extrusion welded or butt fusion welded HDPE. Gluing, taping or hot air welding shall not be allowed.

E. Field Joints: The service pipe shall be hydrostatically tested to 150 psig or 1 1/2 times the design pressures whichever is greater. Insulation shall then be poured in place into the field joint area. All field-applied insulation shall be placed only in straight sections of pipe. Field insulation of fittings is not acceptable. The installer shall seal the field joint area with a heat shrinkable adhesive backed sleeve. Backfilling shall not begin until the heat shrink sleeve has cooled. All insulation and jacketing materials for the field joint shall be furnished by the insulated pipe system manufacturer.

F. The PE jacketed, PE insulated pipe *for the Filtrax piping shall be XTRU-THERM as manufactured by Perma-Pipe, Inc.*

2.10 PIPE CORROSION PROTECTION

A. Coatings: See Section 09 90 02 – High Performance Painting and Coating, for details of coating requirements.

B. Heat Shrink Wrap:

C. Type: Cross-linked polyolefin wrap or sleeve with mastic sealant.

D. Manufacturer and Product: Raychem; WPC or TPS, or equal.

2.11 FLANGE INSULATING GASKET KITS

A. Approved Manufacturer:

1. Advance Products & Systems.

2. Approved Equivalent.

B. Size: per diameter of flange.

C. Pressure rating: meet minimum pressure rating of attached piping.

D. Provide to meet either full-faced or raised faced portion of flange.

1. Full-Faced Gasket

a. Type E gaskets.

b. Precision cut bolt holes.

c. Material: plain face or Neoprene face phenolic.

2. Raised Face Portion

a. Type F gaskets.

b. Inside diameter of the bolt hole circle should be slightly smaller than the outside diameter of the gasket, assuring an exact, automatic positioning of the gasket.

c. Material: plain face or Neoprene face phenolic.

E. Provide insulating sleeve and washer with the single insulation sets.

1. Material: high density polyethylene (HDPE), phenolic, and Mylar.

2. Provide with each set a 1/8” thick S.A.E. electro-plated steel washer.

2.12 COUPLINGS, TAPS, AND MISCELLANEOUS JOINTS

A. Tapping saddles and tapping sleeves shall be Mueller, or equal.

B. Provide pipe repair clamps where indicated on the Drawings. Pipe repair clamps shall be suitable for potable water service with all type 304 stainless steel bolts and hardware. Contractor shall verify pipe outside diameter and necessary length before placing clamp. Pipe repair clamps shall be Mueller Series 510 XTRA-RANGE Full Seal type, or equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Make necessary field measurements to determine pipe laying lengths; fabricate pipe;

deliver pipe to site; store pipe with ends capped to prevent contamination and damage to interior; prepare pipe for installation; work pipe into place without forcing or springing.

B. Do not store or ship small diameter pipe inside larger diameter pipe.

C. Ream pipe and tube ends. Remove burrs. Repair lining at pipe cuts.

D. Remove scale and dirt, inside and outside, before assembly.

E. Remove welding slag or foreign material from pipe and fitting materials.

F. Remove temporary preservative coatings from valves, fittings, and appurtenances prior to installation.

G. Clean, repair, or replace equipment malfunctioning due to presence of foreign material left in piping during installation or entering piping after installation due to Contractor's work at no cost to Owner.

3.02 DUCTILE IRON PIPE AND FITTINGS

A. Joints:

1. Interior submerged: flanged.

2. Interior exposed: flanged, grooved and shouldered if approved by Engineer, except where indicated otherwise on the Project Drawings.

B. Flanged Joints:

1. Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

2. Care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress in the flanges when bolting flanged joints.

3. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be gradually tightened and at a uniform rate, to ensure uniform compression of the gasket.

4. Special care shall be taken when connecting piping to pumping equipment to ensure that piping stresses are not transmitted to the pump flanges. All connecting piping shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire surface of the flanges is obtained before any bolts are installed in the flanges.

C. Penetrations:

1. Install pipe straight through concrete walls or floors.

2. Provide wall sleeves where ductile iron pipe passes through concrete walls and floors, unless specified otherwise on Project Drawings.

3. Install wall pipes or sleeves as shown on Project Drawings.

4. Install embedded wall flange in center of wall or floor and grout in place when embedded wall pipe flange shown on Project Drawings.

5. Fabricate wall pipes to dimensions required.

D. Support pipe at fittings with rods; anchor and support in accordance with Section 40 27 15 – Process Piping Support Systems

E. Pipe and fittings to match face and drill of valves and appurtenances.

3.03 THREADED JOINTS

A. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs.

B. Threaded joints in plastic piping shall be made with Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint compound. Thread tape and joint compound or sealers shall not be used in threaded joints that are to be seal welded.

3.04 COMPRESSION JOINTS

A. Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past fingertight, or as recommended by the fitting manufacturer, to produce a leaktight, torque- free connection.

3.05 SOLVENT WELDED JOINTS

A. All joint preparation, cutting, and jointing procedures shall comply with the pipe manufacturer’s recommendations and ASTM D2855. Pipe ends shall be beveled or chambered to the dimensions recommended by the manufacturer. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the setting time recommended by the manufacturer. Pressure testing of solvent welded piping systems shall not be performed until the applicable curing time, as set forth in Table X2.1 of ASTM D2855, has elapsed.

3.06 PVC PIPE

A. Form solvent joints in PVC pipe and fittings to ANSI/ASTM D2855. Solvent joints are to be used only where threaded or flanged connections are inappropriate.

B. 2-inch and larger: make connections to equipment and supply lines with flanges, unless otherwise specified.

C. Under 2-inches: make connections to equipment and supply lines with solvent joints, unless otherwise specified.

3.07 DISSIMILAR PIPE CONNECTIONS

A. Provide non-conducting connections or flange insulating gasket kits wherever jointing dissimilar metals in open systems.

3.08 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines as shown.

3.09 INSULATION

A. See Section 40 42 13 - Process Piping Insulation.

3.10 TESTING

A. Hydrostatically test each entire line in accordance with AWWA C600-99.

3.11 DISINFECTION

A. Disinfect all potable water lines in accordance with Section 33 13 00 – Disinfection of Water Systems.

3.12 FIELD PREPARATION AND PAINTING

A. All material and equipment in this section shall be factory primed, excluding PVC and copper, and field finish coated. Factory coatings shall be compatible with materials provided under Section 09 90 02 – High Performance Painting and Coating.

3.13 LEAKAGE

A. See Section 40 42 80 - Process Piping Leakage Testing.

B. All joints shall be watertight and free from leaks. All leaks shall be repaired by Contractor in a timely manner and at no expense to the Owner.

C. All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed and replaced with new and acceptable materials, and the affected portion of the piping retested by and at the expense of the Contractor.

END OF SECTION 40 27 00

SECTION 40 27 05
PROCESS PIPING SUPPORT SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Pipe and equipment hangers, supports, and associated anchors.
2. Sleeves and seals.

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures
2. Section 05 50 00 – Metal Fabrications.
3. Section 09 90 02 – High Performance Painting and Coating.
4. Section 40 27 00 – Process Piping - General.
5. Section 40 27 10 – Process Piping Specialties

1.02 REFERENCES

A. Reference Standards include:

1. ANSI B 31.10: Pipe Supports.
2. ASTM A36: Structural Steel.
3. ASTM A325: High Strength Bolts for Structural Steel Joints.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00. Indicate name of manufacturer, materials, standard dimensions, references, maximum loadings, and thrust restraints for all pipe support systems.

B. Provide a list of materials and corresponding suppliers.

C. Provide pipe support location and details with piping layout drawings for piping systems 4-inches and larger.

D. Submit Affidavit of Compliance certifying that materials furnished have been tested and are in compliance with specification requirements.

1.04 QUALITY ASSURANCE

A. Welding Materials and Procedures: Conform to ANSI/AWS D.1.1.

B. Employ certified welders as necessary to complete Work.

1.05 FIELD MEASUREMENTS

A. The Drawings indicate required pipe sizes and the general arrangement for major piping.

Locations shall be verified in the field by the Contractor. Valves, fittings, and appurtenances shall be of such dimensions to allow for the installation of this piping and supports substantially as shown on the Drawings. In the event it should become necessary to change the location of any of the work due to interference with other work, Contractor shall consult with the Engineer prior to making any changes and all such changes shall be made at no additional cost to the Owner.

B. Prior to roughing in any facilities or installation of piping and equipment, consult all related drawings including general, mechanical, electrical, etc., and inform self of materials, locations of structures, pipes, ducts, electrical conduits, etc., which may impact the installation of supports.

C. Discrepancies discovered before or after work has started, shall be brought to the attention of the Engineer immediately, and the Engineer reserves the right to require minor changes in the work to eliminate such discrepancies.

PART 2 - PRODUCTS

2.01 PIPE HANGER SUPPORTS

A. In certain locations, pipe supports, anchors and expansion joints have been indicated on the Drawings, but no attempt has been made to indicate every restraint, anchor, and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping in accordance with the requirements set forth herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.

B. Concrete and fabricated steel supports shall be as indicated on the Drawings, as specified in other Sections, or, in the absence of such requirements, as permitted by the Engineer.

C. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.

D. Materials

1. Unless otherwise specified, all pipe supports shall comply with ANSI/MSS SP-58 and MSS SP-69. Materials of construction for fabricated steel supports are covered in the structural and miscellaneous metals section. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

2. Unless otherwise specified or indicated on the Drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with galvanized finish or be fabricated of stainless steel.

3. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

4. Pipe supports shall be manufactured for the sizes and types of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.

5. Unless otherwise acceptable to the Engineer, the use of supports that rely on stressed thermoplastic components to support the pipe will not be acceptable.
6. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated.
7. Concrete inserts or L-shaped anchor bolts shall be used to support piping from new cast-in-place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.
8. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints.

E. Manufacturer and Type:
1. Anvil International, Catalog PH-5.10, or approved equivalent.
a. Light welded steel bracket: Figure 194.
b. Medium welded steel bracket: Figure 195
c. Heavy welded steel bracket: Figure 199
d. Concrete Inserts: Figure 281.
e. Offset Pipe Clamp: Figure 103.
f. Adjustable Clevis Hanger: Figure 260.
g. Stainless Steel Hanger Rods.

2.02 FLOOR PIPE SUPPORTS

A. Approved Manufacturer and Type:
1. Anvil International, adjustable pipe saddle support: Figure 264.
2. Standon Model S92 Saddle Support.
3. PHD Manufacturing Inc., adjustable pipe saddle support. Figure 875
4. Or Approved Equivalent.

B. Minimum vertical adjustment: 4½ inch.

C. Provide complete with riser pipe and flange bolts for floor mounting.

D. Provide precast concrete or grout base a minimum of 1” above floor.

E. Provide as per recommended spacing, at minimum. Contractor shall install a minimum of one floor pipe support per pump discharge piping prior to the header piping.

F. Contractor may also be required to construct concrete saddle pipe supports for floor piping as indicated on the Drawings. Contractor to provide all materials, formwork, and labor to construct as detailed on Drawings.

2.03 WALL SUPPORTS

A. Steel brackets shall conform to MSS Type 31 for light duty, MSS Type 32 for heavy duty, and MSS Type 33 for heavy duty. Brackets shall be sized accordingly for full size and weight of piping system. All mounting hardware shall be stainless steel.

B. Submerged piping shall be supported with Type 316 stainless steel hangers or steel bracket supports coated with two coats of bitumastic paint.

2.04 VERTICAL PIPE SUPPORTS

A. Two bolt riser clamps shall be MSS SP 69 Type 8 galvanized or plastic coated.

B. Four bolt riser clamps shall be MSS SP 69 Type 42 galvanized or plastic coated.

2.05 SADDLES AND SHIELDS

A. Protection saddles shall be MSS SP 69 Type 39.

B. Protection shields shall be MSS SP 69 Type 40.

C. Wood insulation saddle shall be Elcen Metal Products Company, or equal.

2.06 PREFABRICATED OR FABRICATED PIPE SUPPORTS

A. Pre-engineered support systems constructed of steel products factory fabricated by firms regularly engaged in the manufacture of these items shall be used for this work. Steel pipe support systems shall be blasted to a white clean condition after fabrication and hot-dip galvanized in accordance with ASTM 123, unless support is specified to be fabricated of stainless steel.

B. Free-standing pipe connections to equipment shall be firmly attached to fabricated steel frames made of angles, channels, or I-beams. Frames shall be anchored to the structure.

C. Exterior, free-standing overhead piping shall be supported by fabricated pipe stands, made of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.

D. Special pipe supports for vertical and horizontal movement shall be as detailed on the drawings. Supports shall be fabricated by firms regularly engaged in the manufacture of these items.

2.07 SLEEVES AND SEALS

A. Wall pipes shall connect piping to concrete structure. Wall pipes shall be ductile iron meeting the requirements of AWWA C115. Provide wall pipes where indicated on Drawings.

B. Wall sleeves shall be ductile iron meeting the requirements of AWWA C151. Sleeves shall have cast waterstop collar. Cast waterstop collar shall have an outside diameter a minimum of four inches greater than the outside diameter of the wall sleeve.

C. Approved Manufacturers:

1. Sleeves for pipes through walls and floors:

a. Ductile Iron Water-Stop wall pipe.

b. Or Approved Equivalent.

2. Bolted rubber annular seal:

a. Link Seal manufactured by Thunderline Corp.

b. Or Approved Equivalent.

2.08 ANCHORS

A. Hollow Concrete Block and Brick Anchors:

1. Acceptable Manufacturer and Type:

a. HIT S 12/A Combi Fastener manufactured by Hilti Corporation.

b. Approved Equivalent.

2. Accessories: HY20 Adhesive with screen tube insert.

B. Use Type 316 stainless steel epoxy adhesive anchor bolts, Hilti 150 injection adhesive anchors, or equal, for building or structure attachments. Provide continuous concrete inserts, Unistrut P3200 series, or equal, where applicable.

C. Mechanical anchor and powder-actuated drive-pin fasteners shall be used only with prior approval from the ENGINEER.

2.09 FABRICATION

A. Size sleeves large enough to allow for installation of annular seal.

B. Design hangers to support piping without disconnection of pipe.

2.10 FINISH

A. Factory coat steel hangers and supports as specified in Section 09 90 02 – Mechanical Painting and Coating.

B. Touch up finish on exposed steel hangers and supports in accordance with Section 09 90 02 – Mechanical Painting and Coating.

PART 3 - EXECUTION

3.01 GENERAL

A. Contractor shall verify location of piping and piping systems as shown on the Drawings.

B. Pipes shall be attached to structural members when possible. When necessary to frame structural members between existing members, such members shall be provided by the Contractor at no additional cost to OWNER. Structural members shall be in accordance with the building code and the guidelines of the AISC.

C. Install hangers, supports, clamps, and attachments as required to properly support piping

in all operating conditions, including thrust, water hammer and surge conditions. Supports shall allow for free expansion and contraction of the piping, and shall prevent stress on equipment. Hangers shall have a means of vertical adjustment after installation. Hangers shall be designed so that movement of the supported pipe cannot cause them to disengage. Hanger rods shall be subject to tensile loading, only.

D. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports on the Drawings shall not relieve the Contractor of the responsibility of providing supports as required.

E. Connections to structural framing shall not induction twisting, torsion, or later bending in the framing members. Provide supplementary steel as required.

F. Adjust support and hanger sizes to account for pipe insulation.

G. Meters, valves, equipment, and other point load items shall be independently supported to prevent pipe stress. Piping shall support no meters, valves, equipment or other point load items.

H. Space supports within maximum piping span length indicated in MSS SP-69, as indicated on the Drawings, or as recommended by the pipe manufacturer, whichever spacing is less. Install additional supports at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.

I. Supports, hangers, anchors, and guides shall be designed and provided to prevent excess heat transfer to the structure or equipment, where applicable.

J. Risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping, when possible.

K. Do not support piping with wire, either temporarily or permanently. Do not support piping from other piping.

L. Piping shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the support or the effects of the support.

M. Embedded pipe supports or inserts shall be in place prior to placement of cast-in- place concrete. Continuous inserts shall be furnished with end caps and cardboard closure strips. Locate and space building attachments so that the total load and the point loads due to the pipe hanger and supports do not exceed the design capacity of the supporting structure.

N. Where it is necessary to anchor supports to hardened concrete or completed masonry use stainless steel adhesive anchors.

O. For precast concrete slabs, drill through concrete slab from below and provide stainless steel through bolts with square steel plates and stainless steel bolts. Plate shall bear directly upon the top surface of the precast concrete slab. All toppings or insulation as required shall be applied after installation of all support plate assemblies.

P. Attach to structural steel with beam clamps.

Q. Mechanical anchor and powder-actuated drive-pin fasteners shall be installed in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Non-adhesive anchors shall be only used with prior approval from the ENGINEER.

R. Piping shall be supported at least one and one-half inch out from the face of walls and at least three inches below ceilings, unless otherwise noted.

S. Pedestal supports shall be used where indicated on the drawings or when piping is installed at or near the floor level, and shall consist of galvanized floor flange, pipe, and saddle. Provide stainless steel anchor bolts. All pedestal supports shall be adjustable, and place up off of the floor with minimum 1-inch grout.

3.02 INSERTS

A. Provide and install inserts for placement in concrete formwork.

B. Provide and install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams and walls.

C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

3.03 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX HANGER/ SUPPORT SPACING	MIN HANGER/SUPPORT ROD DIAMETER
½ to 1-1/4 inch	6'-6"	3/8"
1-1/2 to 2 inch	10'-0"	3/8"
2-1/2 to 3 inch	10'-0"	1/2"
4 to 6 inch	10'-0"	5/8"
8 to 12 inch	10'-0"	7/8"
14 to 18 inch	10'-0"	1"
20 to 30 inch	10'-0"	1-1/2"
30 to 36 inch	10'-0"	1-3/4"
PVC (All Sizes)	5'-0"	1/2"

B. Install supports free standing or suspended to provide minimum ½ inch space between support and adjacent Work.

C. Place a hanger/support within 12 inches of each horizontal fitting and on each side of valves.

D. Use hangers with 1½-inch minimum vertical adjustment.

E. Support riser piping independently of connected horizontal piping.

3.04 THRUST ANCHORS AND GUIDES

A. For suspended piping, center thrust anchors as closely as possible between expansion joints and between elbows and expansion joints. Anchors shall hold pipe securely and shall be sufficiently rigid to force expansion and contraction movement to take place at

expansion joints and/or elbows and to preclude separation of joints.

B. Provide thrust anchors as required to resist thrust due to changes in diameter or direction or dead end of pipelines. The design of all anchors shall be subject to approval by ENGINEER. Anchorage shall be required wherever bending stresses exceed allowable for pipe. Wall pipes may be used as thrust anchors.

C. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with the recommendations of the National Association of Expansion Joint Manufacturers.

3.05 INSERTS AND ANCHORS

A. Furnish and install inserts or anchors for placement in concrete.

B. Furnish and install inserts or anchors for suspending hangers from reinforced. concrete slabs and sides of reinforced concrete beams and walls.

C. Utilize support assemblies designed for the appropriate loads. Contractor shall verify design conditions of each piping system.

D. Mechanical anchor and powder-actuated drive-pin fasteners shall be installed in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Non-adhesive anchors shall be only used with prior approval from the ENGINEER.

3.06 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Extend sleeves through floor three inches above finished floor level.

C. Where piping penetrates floor, ceiling, or wall, close off space between pipe and sleeve with link seal.

D. Wall sleeves and wall pipes shall be securely supported by form work to prevent contact with reinforcing steel and tie wires. Sleeves shall be set in formwork prior to pouring concrete.

E. For precast concrete panels openings shall be provided of such size to allow at least three inches clearance around the outside of the sleeve. After installation of sleeve, grout shall be tamped into place making a watertight joint.

3.07 COATING

A. Prime coat non-galvanized steel or non-stainless steel hangers and supports.

B. Finish coat all hangers and supports, except galvanized and stainless steel hangers and supports, under provisions of Section 09 90 02 – Mechanical Painting and Coating.

END OF SECTION 40 27 05

SECTION 40 27 10
PROCESS PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:

a. Couplings.

b. Flanged Coupling Adapters.

c. Quick Connect Couplings

d. Buried Flange Adapters.

e. Mechanical Joint Restraint Gland.

f. Filler Flanges.

g. Rubber Expansion Joints.

h. Flexible PVC Wire Reinforced Hose.

i. Wye Strainers.

j. Filters

k. Basket Strainers

l. Spray Nozzle Eductors

m. Fire Hose

n. Fire Hose Spray Nozzle

o. Rubber Garden Hose

B. Related Sections include:

1. Section 01 10 00 – Summary of Work.

2. Section 09 90 02 – High Performance Painting and Coating.

3. Section 40 27 00 – Process Piping - General.

4. Section 40 27 05 – Process Piping Support Systems.

5. Section 40 27 20 – Process Valves.

1.02 SUBMITTALS

A. Shop Drawings and Product Data: Submit, Under Provisions of Section 01 33 00, on all materials and products specified in this Section.

B. Provide a list of materials and corresponding suppliers.

C. Submit Affidavit of Compliance certifying that materials furnished have been tested and are in compliance with specification requirements.

PART 2 - PRODUCTS

2.01 SPECIALTIES CONNECTIONS

A. Provide pipe specialties suitable to connect to adjoining pipes as specified for pipe fittings. Diameter to match adjacent and adjoining piping.

2.02 WORKING PRESSURE

A. Working pressure of pipe specialties to be equal to working pressure of connecting pipes, unless specified otherwise.

2.03 APPROVED MANUFACTURERS

A. Mechanical Couplings
   1. Manufacturer and Type:
      a. Dresser “Style 38”.
      b. Smith-Blair “441 or 411 Flexible Coupling”.
      c. Romac “Style 501” Coupling.
      d. Or Equal.

B. Quick Connect Couplings
   1. Manufacturer and type:
      a. OPW, Kamlock.
      b. Ryan Herco, 1300 series.
      c. Or Equal.

C. Flanged Coupling Adapters
   1. Manufacturer and type:
      a. MegaFlange Series 2100 by EBAA Iron, Inc.
      b. Smith Blair 912
      c. Or Equal.

D. Tapping Saddles and Tapping Sleeves
   1. Mueller
   2. Or Equal.

E. Pipe Repair Clamps
   1. Mueller Series 510
   2. Or Equal.

F. Rubber Expansion Joints

1. Series 230, Style 231 with limit rods and compression sleeves by Proco Products, Inc.
2. Invincible Style 501 with control rod assembly by Mercer Rubber Co.
3. Or equal

G. Flexible PVC Wire Reinforcement Hose

1. Material: PVC Hose – Heavy Duty.
2. Reinforcement: Coated or Encased Spiral Wire.
3. Strength: Capable of holding 100 pounds without elongation.
4. Finish: Interior shall be smooth.
5. Size: As shown on the drawings.
6. Use: As shown on Drawings.
7. Manufacturer:
    a. Titan Hose.
    b. Or Equal.

H. Wye Strainers, Water Service, 2 inches and Smaller:

1. Type: Bronze body, Y-pattern, 200 psi nonshock rated, with screwed gasketed bronze cap.
2. Screen: Heavy-gauge Type 304 stainless steel or monel, 20-mesh.
3. Manufacturer:
    a. Armstrong International, Inc., Model F.
    b. Mueller Steam Specialty, Model 351M.
    c. Or Equal.

I. Filters

1. Type: Cartridge filter housing and disposable filter cartridges
2. Inlet Liquid Pressure: 50-80 PSI
3. Flow Rate: 20-150 GPM
4. Usage: Effluent reuse filter
5. Cartridge Pore Size: 150 micron
6. Spare parts: provide spare disposable filter cartridges
7. Manufacturer:
    a. Hayward

b. Dayton

c. Eaton

d. Or equal

J. Basket Strainers

1. Type: Basket Strainer
2. Inlet Liquid Pressure: 50-80 PSI
3. Flow Rate: 20-150 GPM
4. Screen: Type 304 stainless steel or monel, 80-mesh.
5. Usage: Effluent reuse strainer
6. Spare Parts: provide 2 baskets for each strainer
7. Manufacturer:
   a. Hayward
   b. Eaton
   c. Or equal

K. Spray Nozzle Eductors, Chlorine Injection

1. Type: Polypropylene
2. Inlet Connection: Pipe thread inlet 1.5 inches
3. Orifice Diameter: 9/16 inches
4. Inlet Liquid Pressure: 40 PSI
5. Inlet Flow Rate: 66 GPM
6. Entrained Flow Rate: 264 ±10% GPM
7. Circulation Rate: 330 ±10% GPM
8. Manufacturer:
   a. Spraying Systems Co.
   b. Or equal

L. Fire Hose

1. Type: Rubber covered lay flat
2. Size: 1.5 inches
3. Length: 50 ft
4. Bowl Size:1-13/16 inches
5. Inlet Liquid Pressure: 80 PSI

6. Quantity: 4
7. Manufacturer:
    a. Fire Hose Direct.
    b. Or equal

M. Fire Hose Spray Nozzle
1. Type: Assault fire hose nozzle with pistol grip
2. Inlet Connection: Pipe thread inlet 1.5 inches
3. Inlet Liquid Pressure: 80 PSI
4. Quantity: 1
5. Manufacturer:
    a. Akron Brass Co.
    b. Or equal

N. Rubber Garden Hose
1. Type: Commercial/Industrial rubber hose
2. Size: 5/8 inches
3. Length: 50 ft
4. Quantity: 1
5. Manufacturer:
    a. Apex Commercial Model 8695-50
    b. Or equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment in locations shown on the Drawings.

3.02 MECHANICAL COUPLINGS

A. A space of at least ¼-inch, but not more than 1-inch, shall be left between the pipe ends.

B. Pipe and coupling surfaces in contact with gaskets shall be clean and free of dirt and other foreign matter during assembly.

C. All assembly bolts shall be gradually tightened and at a uniform rate, so that the coupling is free from leaks and all parts of the coupling are square and symmetrical with the pipe.

D. The interior surfaces of the middle rings shall be prepared for coating in accordance with the instructions of the coating manufacturer and shall then be coated with liquid epoxy in

accordance with ANSI/AWWA C210. The remaining components shall be cleaned and shop primed with universal primer.

E. Repair and damaged areas of shop coatings on the pipe and coupling to the satisfaction of the Engineer.

F. Provide steel tie-bolts, diametrically opposite, which extend across the joint from lugs welded to the pipe on either side of the joint to provide restraint.

3.03 FLANGED COUPLING ADAPTERS

A. After the pipe is in place and bolted tight, the proper locations of holes for anchor studs or lock pins shall be determined and the pipe shall be field-drilled.

B. The inner surfaces of the couplings shall be prepared for coating in accordance with the instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining surfaces, except the flange mating surfaces, shall be cleaned and shop primed with universal primer.

3.04 FILLER FLANGES

A. Ductile iron conforming to the requirements of AWWA C115, maximum 250 psi working pressure.

B. Match filler flange to adjoining pipe working pressure class.

3.05 RUBBER EXPANSION JOINTS

A. Install expansion joints and control rod units per manufacturer’s recommendation.

END OF SECTION 40 27 10

SECTION 40 27 20
PROCESS VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Furnishing and installation of the following, in accordance with the provisions of the Contract Documents.

a. Actuators.
b. Plug Valves.
c. Check Valves.
d. Duckbill Check Valves.
e. Butterfly Valves.
f. Ball Valves.
g. Gate Valves.
h. Globe Valves.
i. Mud Valves.
j. Air Release Valves.
k. Pressure Reducing Valve.
l. Wye Strainers.
m. Corporation Stops.
n. Telescoping Valves

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures
2. Section 01 40 00 – Quality Control
3. Section 01 60 00 – Product Requirements
4. Section 01 77 00 –Closeout Procedures
5. Section 01 78 23 – Operations and Maintenance Data
6. Section 09 90 02 – High Performance Painting and Coating
7. Section 22 13 29.16 – Submersible Sewage Pump Station
8. Section 40 27 00 – Process Piping - General
9. Section 40 27 15 – Process Piping Support Systems
10. Division 26 – Electrical

1.02 REFERENCES

A. Reference Standards include:

1. AWWA C504: Rubber-Seated Butterfly Valves.

2. AWWA C509: Resilient-Seated Gate Valves for Waterworks Service, 2 inches through 24 inches NPS.

3. AWWA C512: Air-Release, Air/Vacuum, and Combination Air Valves for

Waterworks Service.

4. AWWA C540: Power-Actuating Devices for Valves and Sluice Gates.
5. AWWA C550: Protective Epoxy Interior Coatings for Valves and Hydrants.
6. AWWA C800: Underground Service Line Valves and Fittings.

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit in accordance with Section 01 33 00, detailed specifications, drawings, and data covering all materials, parts, devices, equipment, and other accessories forming part of equipment for the complete operational system. Include name of Manufacturer, references, joint data, maximum loadings and thrust restraints.

B. Operations and Maintenance Data: Submit in accordance with Section 01 78 23 on all parts, devices, equipment and other accessories forming each complete operational system. Include a complete write-up of how the system is to operate and how to make adjustments.

1.04 REGULATORY REQUIREMENTS

A. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each product.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

B. Unless otherwise indicated, use valves suitable for 150 psi minimum working pressure.

2.02 VALVE CONNECTIONS

A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use full port size valves.

B. Thread pipe sizes 1-1/2 inches and smaller unless indicated otherwise.

C. Flange pipe sizes 2 inches and larger unless indicated otherwise.

2.03 ACTUATORS

A. Manual Geared Actuators:

1. Type: Gear with cast iron housing. Provide chain-wheel on all valves with centerline located 6 feet and higher. Provide hand-wheel on all others requiring a manual operator.

2. Equip with adjustable open and closed position stops.
3. Provide manual gear/hand wheel actuator on all valves unless indicated otherwise on the Drawings or the valve schedule. The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body shall have cast thereon the word “OPEN” and an arrow indicating the direction to open.
4. Provide riser stem and floor mounted base as indicated on the Drawings.
5. Provide position indicator.
6. Hand wheels:
    a. Hand wheels shall be cast iron.
    b. Maximum wheel diameter shall be 12 inches.
    c. Maximum hand wheel pull shall be 80 pounds.
7. Chain wheels:
    a. Chain wheels shall be galvanized, shrouded pocket hand wheels.
    b. Provide shearidized chains.
    c. Maximum wheel diameter shall be 12 inches.
    d. Bolt to hand wheel type chain wheels will not be acceptable.
    e. Maximum chain wheel pull shall be 80 pounds.
    f. Each chain wheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be looped to extend within 4 feet of the floor below the valve.
8. Hand Levers:
    a. Provide hand levers where indicated on the Drawings, or in these specifications.
    b. Hand levers shall be directly connected to the shaft and rotate 90 degrees from full closed to full open.
    c. Levers shall be provided with a locking device to assure positive position in full open, full closed and a minimum of five intermediate positions around the 90 degrees of rotation. Indication of valve position shall be provided.
    d. In any building or structure containing lever operated valves, at least two operating levers shall be provided for each size and type of lever operated valve.
9. Manual Nut Operators:
    a. Provide 2-inch AWWA-certified operating nut where indicated on the Drawings, or in these specifications.

10. The housing of traveling-nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.

11. Manufacturers:

    a. Pratt.

    b. DeZurik.

    c. Clow

B. Electric Motor Actuators:

1. See Section 40 05 57 for electric actuator requirements.

2.04 PLUG VALVES

A. Type of Valve: Eccentric plug valve.

B. Body: Flanged, ASTM A126, Class B cast iron body. Bolted bonnet. Flanged valve shall be fully faced and drilled in accordance with ANSI B16.1, Class 125.

1. Exterior Coating: Red oxide primer. Finish coat per Section 09 90 02.

2. Interior Coating: Epoxy suitable for potable water service or fully neoprene rubber lined.

C. Minimum Valve Classification:

1. 12 Inch and Smaller: 175 psi, C.W.P., non-shock working pressure rating.

2. When plug valve is in full open position, plug geometry and body waterway contours shall provide port area equal to 80 percent of the adjacent pipe nominal diameter and no cavities where debris can collect.

D. Resilient Plug Facing: Neoprene. Provide dead-tight shutoff pressure in either direction.

E. Seat: One piece welded nickel, or AISI 304L Stainless Steel.

F. Stem Seal Packing: Nitrile-butadiene (Buna) filled PTFE U-ring seal or meet AWWA C504.

G. Bearings: Stainless steel, permanently lubricated radial bearings. Non- adjustable thrust bearings.

H. Manual Actuators:

1. Type: Hand wheel, or gear with cast iron housing.

2. Provide chain wheel on all valves located with centerline 6 feet and higher.

3. Equip with adjustable open memory stop.
4. Provide position indicator.

I. Manufacturers:

1. DeZurik.
2. Pratt
3. Milliken.
4. Clow.
5. GA Industries.

2.05 CHECK VALVES

A. Check Valves:

1. Manufacturer and Type:
    a. Series 100SR Rubber Flapper Swing Check Valve by Apco.
    b. Surgebuster Swing Flex check Valve by Val-Matic.
    c. Milliken Flex Check.
    d. Crispin.
    e. GA Industries.
2. Design: Full body, flanged type, with removable cover for removal of rubber flap disc without removal of valve from process line.
    a. Body and Cover: Cast Iron.
    b. Disc: Buna-N w/steel and fabric reinforcement.
    c. Interior and Exterior coating shall be fusion bonded epoxy.
    d. Exterior Hardware: Stainless steel bolts, nuts, and washers.
3. The valve shall have full flow equal to the nominal pipe diameter at any point, through the valve. Disc stroke shall be 35 degrees. Top access port shall be full size.
4. Provide a disc accelerator or spring return for rapid closure.
5. Provide a screw type backflow actuator to allow opening of the valve during no flow conditions.
6. Refer to Drawings and Valve Schedule for installation locations and sizes.

2.06 DUCKBILL CHECK VALVES

A. Duckbill check valves shall be flanged Tide-Flex Series 35-1, as manufactured by Red Valve Co., or approved equal.

B. Design: One-piece, fabric reinforced elastomer matrix, with flanged end. The valve shall have a 100% full round opening on the inlet, and shall taper down to a flattened duckbill

on the other end, designed to allow flow in the forward direction, and block flow in the reverse direction. The valve shall be equipped with stainless steel retaining flange rings. Flanged valve shall be fully faced and drilled in accordance with ANSI B16.1, Class 125. Company name, plant location, valve size, and serial number shall be bonded to the check valve.

C. Elastomer selection shall be appropriate based on application requirements and as specified herein. Valves contacting raw sewage or sludge shall use Buna N elastomer. Valves involved in chemical applications shall be Viton, Butyl, Hypalon, or other Engineer approved material based on chemical and application compatibility. Contractor shall submit documentation of material compatibility with wastewater.

D. Valve shall start opening when upstream pressure exceeds downstream pressure, allowing flow through the valve. If downstream pressure is greater than upstream pressure, the valve shall close (or remain closed), blocking flow.

E. Refer to Drawings and Valve Schedule for installation locations and sizes.

2.07 BUTTERFLY VALVES – SERVICE TYPE: LIQUID

A. Standard: AWWA C-504, Standard for Rubber Seated Butterfly Valves.

B. Type of Body: Flanged short body. Flanged valves shall be fully faced and drilled in accordance with ANSI Standard B16.1, Class 125.

C. Minimum Valve Classification: 150B.

D. Shaft: One piece Type 304 stainless steel and supported on Teflon coated stainless steel or inert nylon bearings.

E. Shaft Seal: Self-adjusting Chevron “V”-type.

F. Body: ASTM A126, Class B cast iron. Body wall thickness shall meet AWWA C504. Coated or plated disks are not acceptable.

G. Seats: Acrylonitrile-butadiene material. One-piece construction and attached to valve body or disc.

H. Disc: One piece design. ASTM A126, stainless steel. Shaft shall pass through disc. Disc shall be retained by stainless steel pins or bolts that shall extend through the full diameter of the shaft. Disc stops within the flow stream shall be rejected.

I. Approved Manufacturer:

1. Pratt.
2. DeZurik.
3. Milliken.
4. American R/D.
5. GA Industries.

2.08 BUTTERFLY VALVES – SERVICE TYPE: AIR

A. Low Pressure Air Service Butterfly Valve (2” to 48”)

1. Service:
    a. Low Pressure Air (<20 psi)
    b. Temperatures to 250 degrees F
    c. Modulating or Open/Close function
2. Features:
    a. General:
        i. High Performance Butterfly Valve
        ii. Pressure Rating: ANSI Class 150 (285 psi), drop tight
    b. Body:
        i. Full lug style, designed to fit between ANSI B 16.5 Class 150 flanges, suitable for dead-end service in either direction.
        ii. Carbon steel (ASTM A216 WCB) with baked on epoxy powder coating.
    c. Disc:
        i. 316 stainless steel (ASTM A351-CF8M)
        ii. Provide valve with double-offset disc design with 2-piece stem to provide uninterrupted 360-degree seating.
    d. Shaft:
        i. Two-piece.
        ii. 17-4 stainless steel.
    e. Seat:
        i. Valve seat shall be retained in the valve body and replaceable without removing disc or stem.
        ii. RTFE/stainless steel
3. Manufacturers and Products:
    a. Henry Pratt Company: Series 400
    b. Tyco/Keystone; Figure F362, Trim Code 123
    c. Or equal

2.09 BALL VALVES

A. Manual ball valves for use with metallic pipe systems:

1. Manufacturer and type: Series B-6000 ball valve as manufactured by Watts Regulator Company, or approved equivalent.
    a. Body: Bronze.

b. Ball: AISI Stainless Steel.

c. Stem: AISI Stainless Steel.

d. Valve Seats: Durafill.

e. Connection: Threaded.

B. Manual ball valves for use with PVC pipe systems:

1. Manufacturer and type:

a. Watts Regulator Company.

b. Hayward.

c. Spears.

d. George Fisher Inc (GF).

2. Material: PVC.

3. Seats: Teflon.

4. Seals: Viton “O” rings.

5. Stem: Blow out proof.

6. Connector: True union.

2.10 GATE VALVES

A. Approved Manufacturer:

1. DeZurik.

2. Mueller.

3. Clow

4. Approved Equivalent.

B. Gate valves 2-inches to 48-inches in diameter shall be resilient wedge type gate valves rated for 250 psi working pressure with all ferrous components ductile iron in accordance with ASTM A536. Gate valves 3-inches to 36-inches in diameter shall be in full compliance with the requirements of AWWA C515.

C. Manufacturer shall provide an affidavit stating that the valve and materials conform to the applicable AWWA requirement and test specified under the respective standard have been performed and met. Valves shall be NSF 61 certified.

D. The wedge shall be cast or ductile iron encapsulated with polyurethane rubber. The polyurethane shall be permanently bonded to the wedge.

E. The interior of the body and bonnet shall be coated with a fused epoxy coating meeting the requirements of AWWA C550.

F. Valves shall be non-rising stem with a 2-inch square operating nut, unless noted otherwise. All valves shall open right unless noted otherwise.

G. Stems shall be cast bronze with integral thrust collars. The stuffing box shall be the P-ring seal type with a triple O-ring seal. The rings shall be replaceable with the valve fully open at full rated working pressure.

H. There shall be two (2) low torque thrust washers or bearings located above and below the integral stem collar. The stem nut shall be separate and shall be of solid bronze or copper alloy.

I. Markings shall be cast on the bonnet or body of each valve and shall show the manufacturer's name, year valve casting was made, size of valve, the letters and numbers "C515", and the designated working water pressure.

J. Valves shall be equipped with indicators to show the position of the gate in relation to the water way.

K. Valves shall be suitable for exposed service. All nuts, bolts, and hardware shall be stainless steel.

1. Provide geared operators, unless noted otherwise. Gears shall be steel, housed in a heavy-duty cast iron grease case.

2.11 AIR RELEASE VALVES (ARV)

A. Air release valves shall allow entrained air in pipelines to escape through an air release orifice. After releasing entrained air, the orifice shall close by a needle mounted upon a compound lever mechanism actuated by a float. The orifice shall remain closed until more air accumulates and the cycle is repeated.

B. Valves for sewage or sludge shall contain flushing and drain connections.

C. Acceptable Manufacturers:

1. Water Valves:

a. Apco

b. Crispin

c. Val-Matic

d. GA Industries.

2. Sewage or Sludge Valves

a. Apco

b. Crispin

c. Val-Matic

d. GA Industries.

2.12 PRESSURE REDUCING VALVE

A. Valve Operation: Valve shall automatically reduce higher inlet pressure to a steady lower pressure downstream regardless of changing flow rate or varying inlet pressure. The valve shall be pilot operated capable of holding pressure to a predetermined limit. The

main valve and pilot valve shall close drip-tight if the downstream pressure exceeds the pressure setting of the control pilot. A check feature shall be provided. Should a pressure reversal occur, the downstream pressure shall be admitted in the main valve cover chamber closing the valve to prevent return flow.

B. Refer to Valve Schedule in the Drawings for installation locations and sizes.

C. Adjustment Range: 15 to 150 psi.

D. Temperature Range: Water to 180 degrees F.

E. Main Valve Materials:

1. Body and Cover: Cast Iron; 125-pound flanges.
2. Disk Retainer & Diaphragm Washer: Cast Iron.
3. Trim (Disc guide, seat, and cover bearing): Bronze.
4. Disc: Buna N Rubber.
5. Diaphragm: Nylon reinforced Buna N.
6. Stem, Nut, and Spring: Stainless Steel.

F. Pilot System Materials:

1. Pilot Control: Bronze.
2. Trim: Stainless Steel Type 303.
3. Rubber: Buna N Synthetic Rubber.

G. Acceptable Manufacturer:

1. Cla-Val.
2. Singer Valve Company.
3. Ross Valve.
4. GA Industries
5. Or Equal

2.13 PRESSURE REDUCING VALVE – CHEMICAL FEED TYPE

A. Operation: Valve shall automatically reduce higher inlet pressure to a steady lower pressure downstream regardless of changing flow rate or varying inlet pressure.

B. Material: all thermoplastic diaphragm Pressure Relief Valve for protecting against over-pressure in chemical feed systems. Valves shall be capable of reducing pressure to the following range with adjustable spring: 10 – 150 psi

1. BODY: PVC, CPVC, PP, or PVDF
2. DOME: Molded NORYL™
3. Adjustment screw with slot.

4. 304 stainless steel bolting
5. PTFE/EPDM Diagram
6. FNTP Threads

C. MANUFACTURERS;
1. Hayward Flow Control
2. Or Equal

2.14 CORPORATION STOPS

A. Bronze, Brass, or Stainless steel construction, inlet and outlet openings same size as the valve.

B. AWWA ball valve type.

C. Insta-tite or compression connections.

D. Meet or exceed the ANSI/AWWA C800 standards, 150 psi.

E. Approved Manufacturers:
1. A.Y. McDonald Manufacturing.
2. Mueller
3. Fork Meter Box
4. Or Approved Equivalent.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted (does not apply to plug valves).

B. Install valves in the locations and configurations shown on Drawings.

C. Provide adequate structural support of installed valves as required.

D. Install valves per manufacturer's recommendations.

3.02 STARTING AND ADJUSTING

A. Furnish Owner and Engineer with a written report prepared by equipment supplier certifying that equipment:
1. Has been properly installed.
2. Is in accurate alignment.
3. Is free from an undue stress imposed by connecting piping, anchor bolts, etc.
4. Has been operated through at least two complete open/close cycles.
5. Checked for leakage

3.03 CLASSROOM AND DEMONSTRATION TRAINING

A. Provide minimum four (4) hours classroom and demonstration training on the proper operation and maintenance of equipment. Training to be completed after completion of starting and adjusting.

3.04 PAINTING

A. All material and equipment in this section shall be factory primed. Primer shall be compatible with finish coats of paint provided under Section 09 90 02 – Mechanical Painting and Coating.

B. Finish painting of all materials and equipment in this Section that are not concealed shall be the responsibility of the General Contractor, and shall be as described in Section 09 90 02 – High Performance Painting and Coating, unless otherwise specifically indicated. The Contractor shall, however, refinish and restore to the original appearance, all equipment that has sustained damage to the manufacturer's finish or prime coats of paint or enamel.

END OF SECTION 40 27 20

SECTION 40 27 60
PROCESS IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Pipe markers.
2. Equipment, valve, gate, flow meter, and instrument markers.
3. The methods and materials specified herein apply to all piping and equipment in Divisions 40 and Division 46.

B. Related Sections include:

1. Section 01 33 00 – Submittals.
2. Section 09 90 02 – High Performance Painting and Coating.
3. Division 46 – Equipment.
4. Division 23 – HVAC
5. Division 26 – Electrical

1.02 REFERENCES

A. Reference Standards include:

1. Ten States Standards - 2.14 Piping Color Code.
2. ANSI A13.1 - 1981: Schemes for Identification of Piping Systems.

1.03 SUBMITTALS

A. Submit color schedule under provisions of Section 01 33 00.

B. Submit location drawing and shop drawings on markers under provisions of Section 01 33 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Pipe Marker Manufacturers:

1. W.H. Brady Co.
2. Seton Nameplate Corp.
3. Chemelex Div., Raychem Corp.
4. Koibi Industries, Inc.
5. John P. Nissen Jr. Co.

6. Zippertubing Co.
7. Emedco.

2.02 PIPE MARKERS

A. All pipes, regardless of material, shall receive pipe markers.

B. All process and drainage piping within the Grit Building, Main Process Building, and Blower Building regardless of content, shall have labels every ten feet with a minimum of two labels in each room, closet, or pipe-chase.

C. Pipe Size ¾ inch through 6 inch Diameter:

1. One piece, snap around and completely encircle pipe with substantial overlap and permanent tension to grip pipe firmly without adhesives.
2. Provide with flow arrows every 10’.
3. Clearly indicate pipe size and service code on line.
   a. Example: 4-WAS
4. Size of Legend Letters and Numbers:

Outside Diameter of Pipe or Pipe Covering	Size of Legend Letters and Numerals
3/4" to 1-1/4"	1/2"
1-1/2" to 2"	3/4"
2-1/2" to 6"	1-1/4"

5. Comply with ANSI Standard A13.1 – 1996.
6. Material: Pre-formed acrylic/vinyl plastic.
7. Working printed in a “repeat and reverse” pattern.
8. Adhesive markers will not be allowed.

D. Pipe Size 8 inch Diameter and Larger:

1. After process pipe has been finish coated per Section 09 90 02 – Mechanical Painting and Coating, apply pipe name with painted on stenciling.
2. Clearly indicate pipe size and service code in stencil.
   a. Example: 8-RAS
3. Provide each label with flow arrow adjacent to text.
4. Size of Legend Letters and Numbers:

Outside Diameter of Pipe or Pipe Covering	Size of Legend Letters and Numerals
8" to 10"	2"
Over 10"	3"

5. Paint on each pipe at 120 or 180 degree intervals based on pipe size and location. Arrange so labeling of similar pipe runs are spaced and oriented the same. Coordinate label placement with Owner and Engineer.
6. Stack stencil wording were applicable. Center flow arrow between words in vertical direction.
7. Coordinate and maintain consistent spacing and stencil locations from filter to filter, between flanges, and within plant walls and penetrations for neat appearance.
8. Stencil paint color to be selected by Engineer to provide required contrast between process pipe coating and stencil identification.
9. All sticker or wrap pipe labels shall meet the minimum quality requirements as those manufactured by ComplianceSigns of Chadwick, Illinois.

2.03 CONTROL DEVICE MARKERS

A. After process pipe, equipment, valves, flow meters, and other appurtenances have been finish coated per Section 09 90 02 – Mechanical Painting and Coating, apply metal nametag for all pieces of equipment, valves, gates, flow meters, and instruments.

1. Metal tag shall include the full tag including building following the examples below:

a.	Equipment:	AGS-BLW#1
b.	Valves / Gates:	WAS-AGS#1
c.	Instrument:	UVI-FE1

B. Material: Stainless Steel.

C. Size: 3 inch diameter, round shape, 0.025-inch thickness

D. Provide with holes for hanging.

E. Stamp tag with appropriate name or number. See the equipment schedule, valve schedule, and instrument schedule in the construction drawings for equipment, valves, flow meters, gates, and instruments.

F. Provide metal tags as required. Contractor shall verify number of valves, flow meters, equipment, and instruments requiring tags.

2.04 RFID TAGS

A. All equipment, valves, gates, flow meters, and instruments shall also receive RFID tags which shall allow operators to look up asset information in the field and linked to the facility asset management system. Contractor shall provide tags and coordinate integration with facility asset management system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All process piping 1/2” or greater shall be scheduled for painting and identification. Marker colors shall be yellow with black lettering unless indicated otherwise.

B. Pipe Markers:

1. Install on all piping systems at the following locations or at Engineer's direction:

a. Adjacent to each valve.

b. Each branch and riser at take-off.

c. At each pipe passage through wall or floor.

d. At not more than 20 feet spacing on straight pipe runs.

e. At each change in direction.

2. Provide number and copy indicated in schedule below.

C. Painting:

1. Finish painting of all materials and equipment shall be the responsibility of the General Contractor, and shall be as described in Section 09 90 02 – High Performance Painting and Coating.

2. Colors: As indicated in schedule below and coordinated with Engineer.

a. Owner and Engineer reserve the right to change color selections during shop drawing review based on available color chart options. Where applicable, Contractor shall field verify and match existing pipe colors.

3. All PVC carrier piping shall be painted according to chemical tubing carried.

4. Provide 2-inch bands at 30 inch intervals where banding is required. Provide 2-inch width with straight edges and neat appearance. Contractor also has the option to use colored electric tape for identification banding in lieu of painting bands.

D. Control Device Markers

1. Attach with a corrosion resistant material.

2. Attach at all process valves, flow meters, equipment, pressure transducers, and ultrasonic level transducers.

3.02 PIPE COLOR CODE SCHEDULE

Water Lines:

Type of Line	Color	Tnemec Color / Band Color
Raw (INF/AEI/FCI)	Olive Green	110GN Clover
Settled (UVI/EFF)	Aqua	10GN Aqua Sky
Potable (POT/PW/CW)	Dark Blue	11SF Safety Blue
Plant Water / Non-Potable (NPW/EFR)	Violet	16SF Rec Water Purple

Fire Protection	Red	06SF Safety Red
Plant Effluent (SBRE)	Clay	07RD Terra Cotta
Chlorine (CL)	Yellow	02SF Safety Yellow
Polymer	Orange with Green Band	04SF Safety Orange 09SF Safety Green

Waste Lines:

Waste / Sewer (D. / PDN)	Dark Grey	34GR Deep Space

Sludge Lines:

Sludge (WAS/RAS/SLG/TF)	Medium Brown	61BR Fencepost
Scum, Grit, Foam Decant (SCM/GRT/FDD)	Light Brown	68BR Twine
Digested Sludge (DGS)	Brown	07BR Caramel
Thickened Sludge (JAF)	Dark Brown	84BR Weathered Bark

Gas Lines:

Natural Gas (GAS/G)	Red	28RD Monterrey Tile

Other:

• Compressed Air (AIR)	Dark Green	91GN Balsam
• Other Lines (VNT)	Light Gray	32GR Light Gray
• Fire Protection	Red	06SF Safety Red
• Hoists / Trolleys	Yellow	02SF Safety Yellow

Contractor shall confirm all color selections for piping with Engineer.

END OF SECTION 40 27 60

SECTION 40 42 13
INSULATION FOR EXPOSED PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies thermal and sound insulation for exposed piping, related equipment and appurtenant surfaces.

B. Related Sections: Not used.

C. Performance Requirements:

1. Temperature Classes:

a. Insulation for exposed piping and equipment is classified for the following temperature ranges: low, medium; high, and very high.

b. Low temperature class insulation shall be suitable for an operating temperature range of -100 to +100 degrees F.

c. Medium temperature class insulation shall be suitable for an operating temperature range of 100 to 800 degrees F.

d. High temperature class insulation shall be suitable for an operating temperature range of 800 to 1200 degrees F.

e. Very high temperature class insulation shall be suitable for an operating temperature range of 1200 to 1800 degrees F.

2. Service Classes:

a. Insulation of exposed piping is provided for one or more of the following services: condensate control (CC), personal protection (PP), freeze protection (FP), and energy conservation (EC). All piping systems listed in the Insulation Thickness Schedule at the end of this section shall be insulated for the insulation service class listed in the schedule.

b. Pipe insulation for CC shall be provided for all piping and appurtenances that are designated as system CC and are 3 inches and smaller.

c. Pipe insulation for PP shall be provided on all equipment and piping and piping appurtenances

i. on the Main Process Building blower discharge piping that is within 8 feet of a floor slab, stair landing, or other type of accessible walkway and are contained within the facility structure where the equipment is located.

d. Pipe insulation for EC shall be provided on all piping and pipe appurtenances that are designated as EC.

1.02 QUALITY ASSURANCE

A. Referenced Standards: This Section incorporates by reference the latest revisions of the following documents. They are part of this Section. In case of conflict between the requirements of this Section and the listed documents, the Contractor shall point out the conflict to the Project Representative; lacking a definitive answer otherwise, the requirements of the Contract Specifications shall prevail.

Reference	Title
ASTM 8209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C552	Cellular Glass Thermal Insulation
ASTM E96	Water Vapor Transmission of Materials
FEDSPEC L-P-535E Chloride)	Plastic Sheet (Sheeting) "Plastic Strip" Poly (Vinyl and Poly (Vinyl Chloride-Vinyl Acetate), Rigid
FEDSPEC HH-l-558B(3)	Insulation, Blocks, Boards, Blankets, Felt Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)

1.03 SUBMITTALS

A. Procedures: Section 01 33 00.

B. Items to be Submitted for this Specification:

1. Manufacturer's descriptive literature, including insulation and jacket thickness, heat transfer coefficient, and methods of installation.

2. Samples of each insulation material type and thickness along with typical jackets and covers for fittings, valves and appurtenances. Provide a 6 inch long, full diameter segment for each insulation sample.

3. Certification of jacket ratings for water vapor transmission and puncture and stiffness as specified.

1.04 WARRANTY

A. For the work of this Section, provide all warranties as described in the General Conditions,

Section 01 70 00, and provide all normal commercial warranties available as described in the General Conditions.

PART 2 - PRODUCTS

2.01 GENERAL

A. Piping insulation shall be tubular type or the flexible blanket type.

B. Insulation for valves, strainers, fittings, expansion joints, flanges and other connections shall be segmented sections, molded, or blanket type coverings of the specified type and thickness of pipe insulation, or the flexible blanket type.

C. Equipment insulation shall be flexible blanket type or rigid board type cut to fit the surface.

2.02 INSULATION

A. General:

1. Low temperature class insulation shall be of the unicellular elastomeric thermal, cellular glass, or fiberglass type.

2. Medium temperature class insulation shall be of the cellular glass or fiberglass type.

3. High temperature class and very high temperature class insulation shall be of the calcium silicate type or the flexible blanket type. Piping and equipment subjected to vibration (such as engine exhaust) shall be insulated with flexible blanket type.

B. Unicellular Elastomeric Thermal Type: Unicellular elastomeric thermal type insulation shall conform to the requirements of ASTM C534, Type I.

C. Cellular Glass Type: Cellular glass type insulation shall conform to the requirements of ASTM C552, Type II.

D. Fiberglass Type: Fiberglass type insulation shall conform to the requirements of FEDSPEC HH-15588.

1. Shall be in compliance with ASTM C547, ASTM C1136, ASTM C795.

2. Shall be equal to or exceed the qualities of Owens-Corning SSL II

E. Calcium Silicate Type: Calcium silicate type insulation shall conform to the requirements of ASTM C533, Type II, Class C.

F. Flexible Blanket Type:

1. High Temperature Class:

a. High temperature insulation shall be removable 1- or 2-inch-thick blanket-type insulation designed for continuous 1200 degree F service.

b. The blanket shall be a custom sewn, flexible, reusable jacket, custom designed to closely fit the piping or the equipment housing.

c. Blanket shall be custom fitted to not restrict access to any instrumentation or equipment.

d. Insulation shall not compact or shake down in vibrating service.

e. Blanket insulation shall consist of a noncombustible silica cloth jacket and nonasbestos white ceramic fiber insulation.

f. Acceptable manufacturer:

i. Thermazip Hi-Temp blanket Style 2000-60-3000 by Accessible Products Company.

ii. Hitco AIM.

iii. Advanced Thermal Products.

iv. SEI Temp-Set 1200.

v. Approved equal.

2. Very High Temperature Class:

a. Very high temperature insulation shall be removable 1- or 2-inch-thick blanket-type insulation designed for continuous 1800 degree F service.

b. The blanket shall be a custom sewn, flexible, reusable jacket, custom designed to closely fit the piping or the equipment housing.

c. Blanket shall be custom-fitted to not restrict access to any instrumentation or equipment.

d. Insulation shall not compact or shake down in vibrating service.

e. Blanket insulation shall consist of a noncombustible silica cloth jacket and high purity alumina and silica nonasbestos white ceramic fiber insulation.

f. Acceptable manufacturer:

i. Thermazip Hi-Temp blanket Style 2000-61-3000 by Accessible Products Company.

G. Mandrel-Wound Pipe Section Type:

1. Shall comply with the properties outlined in ASTM C547

2. The insulative and durability properties shall equate to or exceed those of:

a. Rockwool ProRox PS 960 or;

H. *The stainless steel Main Process Building blower discharge piping shall be insulated with either Mandrel-Wound as outlined in 2.02.G or Fiberglass as outlined in 2.02.D above.*

2.03 INSULATION JACKETS

A. Laminated Jackets: Laminated jackets shall consist of aluminum and white kraft paper. Jackets shall have a perm rating for water vapor transmission of not more than 0.02 in accordance with procedure A of ASTM E96.

B. Aluminum Jackets:

1. Aluminum jackets shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Jackets shall be 0.016 inch thick.

2. Sheet metal screws shall be aluminum or stainless steel.

3. Jackets shall be secured with 0.020 by 3/4-inch Type 304 stainless steel expansion bands.

2.04 INSULATION COVERS

A. Polyvinyl Chloride (PVC) Covers: Polyvinyl chloride covers shall be one piece, premolded polyvinyl chloride conforming to FEDSPEC L-P-535E, Composition A, Type II, Grade E4.

B. Aluminum Covers: Aluminum covers shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Covers shall be 0.016 inch thick. *The insulated aeration blower discharge piping in the Main Process Building shall be provided with aluminum covers for all piping within 8 vertical feet of the floor surface.*

C. Soft Covers: Soft covers shall be of the reusable type with TFE-coated fiberglass covers and liner.

2.05 SHIELDS

A. Unless otherwise indicated, thermal pipe hanger shields shall be provided at pipe supports. Thermal hanger shields shall be as specified in Section 40 27 05.

2.06 FLASHING

A. Flashing shall include aluminum caps, sealant and reinforcing. Aluminum caps shall be 20 gage thick and shall be cut to completely cover the insulation. Sealants shall be as recommended by the insulation manufacturer.

B. Reinforcement in flashing heated up to 370 degrees F shall be nylon fabric. Reinforcement in flashing for hotter surfaces shall be wire mesh or as recommended by the insulation manufacturer.

2.07 ADHESIVES

A. Adhesive products used for the work of this Section shall conform to the manufacturer's specifications for each particular pipe insulation system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Apply insulation over clean, dry surfaces. Double layer ·insulation, where specified or required to achieve the specified surface temperature, shall be provided with staggered section joints.

B. Pipe Supports and Shields: Unless otherwise indicated, the Contractor shall supply thermal pipe hanger shields and install them during pipe support installation. Where thermal pipe hanger shields are used, apply the following to all butt joints:

1. On hot pipe systems, apply 3-inch-wide vapor barrier tape or band over the butt joints.

2. On cold water, chilled water, or refrigerant piping, apply a wet coat of vapor barrier lap cement on all butt joints and seal the joints with a minimum 3-inch-Wide vapor barrier tape or band.

C. Protection: Protect insulation and jackets from crushing, denting, and similar damage during construction. Vapor barriers shall not be penetrated or otherwise damaged. Remove any insulation, jacket, and vapor barriers damaged during construction and install new material.

D. Piping Insulation:

1. General

a. Pipe:

i. Insulate piping continuously along its entire length including all in-line devices such as valves, fittings, flanges, couplings, strainers and other piping appurtenances. Unless otherwise indicated, provide piping insulation with laminated jackets as specified within this Section. Insulation shall be butted firmly together and jacket laps and joint strips provided with lap adhesive. Install jackets with their seams located on the underside of pipe.

ii. Do not use PVC covers specified in this Section with medium-, high-, or very high- temperature class insulation. Removable flexible blanket-type insulation need not be jacketed.

b. Fittings, Connections, Flanges and Valves: Provide fitting, connection, flange and valve insulation with covers as specified within this Section. Secure insulation in place with 20-gage wire and a coat of insulating cement'. Covers shall overlap the adjoining pipe insulation and jackets. Install covers with_their seams located on the underside of fittings and valves.

2. Low Temperature Class:

a. Pipe: Seal off ends of insulation with a vapor barrier coating.

b. Fittings, Connections, Flanges and Valves:

i. Except where soft covers are specified, provide insulation for pipe sizes 2 inches and less with rigid PVC covers as specified within this Section. Seal covers at edges with vapor barrier adhesive. Secure the ends of covers with vinyl tape. The tape shall overlap the jacket and the cover at least 1 inch. Do not penetrate vapor barrier.

ii. Except where soft covers are specified, provide insulation for pipes 2-1/2 inches and larger with rigid aluminum covers as specified within this Section. Mechanically secure covers using corrosion-resistant tacks pushed into the overlapping throat joint.

3. Medium, High, and Very High Temperature Class:

a. Pipe: Except for flexible blanket type insulation, seal ends of insulation with end joint strips and use waterproof adhesive to hold them in place.

b. Fittings, Connections, Flanges and Valves: Except where soft covers are specified, provide rigid insulation with rigid aluminum covers as specified within this Section. Mechanically secure covers using corrosion-resistant tacks pushed into the overlapping throat joint.

4. Outdoor Piping:

a. Pipe: Provide rigid insulation with aluminum jackets as specified within this Section. Design flexible blanket-type insulation for outdoor, weather-exposed service. Where piping emerges from soil without concrete or asphalt overtop, extend the insulation a minimum of 12 inches below the finished ground level. Where piping emerges from concrete or asphalt, extend the insulation to within 1 inch of the finished surface. Do not push insulation into contact with the finished concrete or asphalt surface.

b. Insulation Over Heat Tracing: Provide heat tracing in specified locations on the drawings, in particular on the back flow preventer valves for potable and fire water services that are located in insulated fiberglass vaults. Do not install insulation over the top of any piping that is heat traced inside these vaults. For all other piping, install insulation over the top of heat tracing according to the specifications of the heat trace tape and insulation manufacturers.

c. Fittings, Connections, Flanges and Valves: Provide rigid insulation with rigid aluminum covers as specified within this Section. Design flexible blanket type insulation for outdoor, weather- exposed service.

E. Mechanical Equipment Insulation:

1. General:

a. Unless otherwise specified, fit insulation to the contours of equipment and secure it with 1/2-inch by 0.015-inch galvanized steel bands. Weld pins or stick clips with washers may be used for flat surfaces and spaced a maximum 18 inches apart. Stagger joints and fill voids with insulating cement. Unless otherwise specified, provide insulation with laminated jackets as specified within this Section.

b. Unless specifically specified to be uninsulated, insulate all equipment connected to insulated piping.

2. Outdoor Equipment: Provided insulation with a coat of weatherproof mastic and a layer of open- weave glass cloth embedded into a wet tack coat. Overlap seams at least 2 inches. Provide a finish coat of weatherproof mastic. The total coating thickness shall be a minimum of 1/8 inch..

3. Low Temperature Class:

a. Where joints, breaks, and punctures occur in the insulation, seal them in

facing with fire- retardant vapor barrier adhesive reinforced with 4-inch tape.

b. Provide insulation with a layer of open-weave glass cloth embedded into a wet coat of fire- retardant adhesive. Overlap seams at least 2 inches. Provide a finish coat of fire-retardant adhesive.

4. Medium Temperature Class: Cover joints and cement them in place with 4-inch-wide strips of the same material as the laminated jackets as specified within this Section.

5. High and Very High Temperature Class: Cover high and very high temperature equipment with custom-fitted removable blanket-type insulation or hinged sleeve insulation with protective jacketing. Secure blanket-type insulation with stainless steel wire lacing and hooks. Overlap ends of blanket segments to prevent gaps and voids when the piping and equipment are heated. Secure blankets snugly under nuts and bolt heads to assure complete coverage during operation and to prevent vibration-induced gaps or voids. Secure blankets in strict accordance with the manufacturer's instructions.

F. Flashing:

1. Provide flashing at jacket penetrations and terminations. Provide clearance for flashing between insulation system and piping supports.

2. Trowel a heavy tack coat of sealant over the insulation, extending it over the jacket edge 1 inch and over the pipe or protrusion 2 inches. Stretch reinforcement over the tack coat after clipping to fit over pipe and jacket. Strap clipped reinforcing with a continuous band of reinforcing to prevent curling. Then trowel sealant over the reinforcement to a minimum thickness of 1/8 inch.

3. Form aluminum caps to fit over the adjacent jacketing and to completely cover coated insulation. Hold cap in place with a jacket strap.

3.02 INSULATION THICKNESS SCHEDULE

A. The insulation dimensional tolerances shall comply with the specified standards. Equipment insulation shall match thickness of attached piping. The minimum insulation thicknesses, exclusive of jacket, shall be as shown in the schedule at the end of this section.

3.03 TESTING

A. In addition to any testing herein, perform all testing for this product or system consistent with the requirements of Section 01660, the applicable codes, and the manufacturers' current quality assurance program.

Insulation Thickness Schedule

Piping Service	Service Type	Temperature Class	8" Pipe
Blower Discharge Piping	PP	High	1" thick insulation

END OF SECTION 40 42 13

SECTION 40 42 80
PROCESS PIPING LEAKAGE TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Performing of the following, as indicated, in accordance with the provision of the Contract Documents:

a. Leakage testing of process piping.

B. Related Sections include:

1. Section 01 33 00 – Submittals.
2. Section 01 40 00 – Quality Control.
3. Section 01 60 00 – Product Requirements.
4. Section 01 75 00 – Starting and Adjusting.
5. Section 01 77 00 – Closeout Procedures.
6. Section 01 78 23 – Operations and Maintenance Data.
7. Section 40 27 00 – Process Piping - General.
8. Section 40 27 05 – Process Piping Support Systems.
9. Section 40 27 20 – Process Valves.

1.02 SUBMITTALS

A. Informational Submittals:

1. Testing Plan: Submit prior to testing and include at least the information that follows.

a. Testing dates.

b. Piping systems and section(s) to be tested.

c. Test type.

d. Method of isolation.

e. Calculation of maximum allowable leakage for piping section(s) to be tested.

2. Certifications of Calibration: Testing equipment.
3. Certified test report.

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Chlorine Institute (2001 L Street N.W., Washington D.C. 28036): Pamphlet 6, Piping Systems for Dry Chlorine.
2. AWWA C600-99.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 PREPARATION

A. Notify Engineer in writing 5 days in advance of testing. Perform testing in presence of Engineer.

B. Hydrostatically test in accordance with AWWA C600-99.

C. Pressure Piping:

1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
2. Wait 5 days minimum after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.
3. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
4. Chemical Piping: Test, dry, and clean in accordance with requirements of Chlorine Institute Pamphlet 6.
5. New Piping Connected to Existing Piping:
    a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.
    b. Test joint between new piping and existing piping by methods that do not place entire existing system under test load, as approved by Engineer.
6. Items that do not require testing include: Piping between wetwells and wet well isolation valves, Equipment seal drains, tank overflows to atmospheric vented drains and tank atmospheric vents.
7. Test Pressure: As specified in specifications or as specified by equipment manufacturer.

D. Test section may be filled with water and allowed to stand under low pressure prior to testing.

E. Gravity Piping:

1. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.
2. Determine groundwater level at time of testing by exploratory holes or other method

acceptable to Engineer.

3. Pipe 42 Inches Diameter and Larger: Joint testing device may be used to isolate and test individual joints.

3.02 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

B. Exposed Piping:

1. Perform testing on installed piping prior to application of insulation.

2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.

3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.

4. Maintain hydrostatic test pressure continuously for 30 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.

5. Examine joints and connections for leakage.

6. Correct visible leakage and retest as specified.

7. Empty pipe of water prior to final cleaning or disinfection.

3.03 HYDROSTATIC TEST FOR GRAVITY PIPING

A. Testing Equipment Accuracy: Plus or minus 1/2 -gallon water leakage under specified conditions.

B. Maximum Allowable Leakage: 0.16 gallons per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.

C. Gravity Sanitary and Roof Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.

D. Exfiltration Test:

1. Hydrostatic Head:

a. At least 6 feet above maximum estimated groundwater level in section being tested.

b. No less than 6 feet above inside top of highest section of pipe in test section, including service connections.

2. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 30 feet of water column.

E. Infiltration Test:

1. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.

F. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

G. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.

3.04 PNEUMATIC TEST FOR PRESSURE PIPING

A. Do not perform on:

1. PVC or CPVC pipe.

2. Piping larger than 18 inches.

3. Buried and other non-exposed piping.

B. Fluid: Oil-free, dry air.

C. Procedure:

1. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections; examine for leakage.

2. Correct visible leaks and repeat preliminary test until visible leaks are corrected.

3. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.

4. Maintain pneumatic test pressure continuously for minimum of

5. 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.

6. Correct visible leakage and retest as specified.

D. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

E. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

3.05 PNEUMATIC TEST FOR GRAVITY PIPING

A. Equipment:

1. Calibrate gauges with standardized test gauge provided by Contractor at start of each testing day. Engineer will witness calibration.

2. Install gauges, air piping manifolds, and valves at ground surface.

3. Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 6 psi or less.

4. Restrain plugs used to close sewer lines to prevent blowoff.

B. Procedure:

1. Require that no person enter manhole where pipe is under pressure.
2. Slowly introduce air into pipe section until internal air pressure reaches 4 psi greater than average back pressure of groundwater submerging pipe.
3. Allow 2 minutes minimum for air temperature to stabilize.

C. Allowable Leakage: Test section will be considered defective when time required for pressure to decrease from 3.5 to 2.5 psi greater than average back pressure of groundwater submerging pipe is less than that computed utilizing values from following table:

TABLE 1*

A Pipe Diameter (Inches)	B Time per Foot up to Length in Col C (Seconds)	C Test Length (Feet)	D Test Time for any Length Between Col C & E (Min:Sec)	E Length at Which Time in Col F Applies (Feet)	F Time per Foot for Total Length (Seconds)
4	0.18	636	1:54	1,114	0.10
6	0.40	424	2:50	743	0.23
8	0.71	318	3:47	557	0.41
10	1.11	255	4:43	446	0.63
12	1.60	212	5:40	371	0.91
15	2.50	170	7:05	297	1.42
18	3.62	141	8:30	248	2.06
21	4.92	121	9:55	212	2.81
24	6.42	106	11:20	187	3.67

EXAMPLE: 15-inch diameter pipe:
For 150 feet, T = 2.50 sec (Col B) x 150 ft = 375 sec = 6:15 For 250 feet, T = 7:05 (Col D)
For 500 feet, T = 1.42 sec (Col F) x 500 ft = 710 sec = 11:50

*Based on 0.003 cfm per square foot with a minimum significant loss of 2 cfm and a maximum loss of 3.5 cfm.

D. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

E. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.

3.06 FIELD QUALITY CONTROL

A. Test Report Documentation:

1. Test date.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.

5. Remarks, including:
    a. Leaks (type, location).
    b. Repair/replacement performed to remedy excessive leakage.
6. Signed by Contractor and Owner’s Representative to represent that test has been satisfactorily completed.

END OF SECTION 40 42 80

SECTION 40 61 93
PROCESS CONTROL SYSTEM INPUT/OUTPUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section covers all work necessary for interfacing Process Instrumentation and Control (I & C) System for the Whitefish Wastewater Treatment Plant.

B. The work for this project includes providing wiring and control interface for both the Aqua Aerobics Control System and City of Whitefish SCADA System.

C. Aqua Aerobics Systems, Inc. (AASII) who is providing a large portion of the process equipment will provide a PLC (in the AASII Main Control Panel in the Electrical Room of the Main Process Building) as well as a computer and for oversight along with other process instruments (Located within the Administration Building). The Contractor is to provide and install all wiring between process instruments and equipment as shown in the Electrical Drawings, Process and Instrumentation Diagrams, and Wiring Diagrams Provided by AASII. This work includes all materials and labor for the complete I & C system in accordance with this specification and the Construction Drawings.

D. The Owner's Control Contractor will provide PLC Panels to interface with equipment that is not provided by AASII and interface with the AASII Control System. This will include a primary PLC and computer system within the Administration Building. The Contractor is to provide and install all wiring and between process instruments and equipment as shown in the Electrical Drawings and Process and Instrumentation Diagrams. This work includes all materials and labor for the complete I & C system in accordance with this specification and the Construction Drawings.

E. Major constituents of this system include, but are not limited to, all materials, equipment, and labor necessary to provide a functional system as described by this specification. The Contractor will be required to meet and discuss wiring with both AASII and the Owner's Control Contractor.

1.02 SUBMITTALS

A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.

1. Shop drawings and catalog material for ancillary control panels and enclosures anticipated by the Contractor.

2. Manufacturer's Data Sheets and shop drawings for any equipment proposed that is not shown or specified in the Contract Drawings.

3. Record Drawings: The Contractor shall provide one set of record drawings (electronically) for the following:

a. Panel Elementary Diagrams.

b. Interconnecting Wiring Diagrams.

1.03 QUALITY ASSURANCE

A. The System Installer/Integrator shall have unit responsibility for a complete, functional system for process instruments provided in this Contract, including the process instruments specified in other Technical Specifications and as shown in the Drawing. Unit responsibility for items provided by the Contractor include:

1. A complete system in accordance with the intent of these Contract Documents.
2. Coordinating the work required under all Sections of this Specification that affect the work covered in this section. This effort is required to assure that the project construction proceeds in an appropriate and timely manner. This includes coordination with the Owner's Control Contractor and AASII.
3. Furnishing and installing all incidental items not actually shown or specified, but which are required by code or good practice to provide complete functional systems.
4. Connecting, and interfacing with new process instruments.
5. Connecting, interfacing, and proofing connections to/from electrical switchgear.

1.04 GENERAL PROJECT COORDINATION

A. Work in this Section will require coordination with Aqua Aerobics Systems (AASII) who is providing a large portion of the process equipment will provide a PLC (in the AASII Main Control Panel in the Electrical Room of the Main Process Building) as well as a computer and for oversight along with other process instruments (Located within the Administration Building). All PLC programming will be provided by AASII.

B. Work in this Section will require coordination with the Owner's Control Contractor to interface with the SCADA System. The Owner will provide the PLC's (panels). This specifically includes the Main Lift Station PLC, Grit Building PLC, Main Process Building PLC, and Blower Building PLC. The Owner's Control Contractor will provide a PLC and Computer in the Administration Building. All programming will be provided by the Owner's Control Contractor.

C. Work in this Section will require coordination with several equipment manufacturers. At a minimum this will include the Pump Control Panel for the Main Lift Station, the Pump Control Panel for the Side Stream Lift Station, The Control Panel for the Grit Removal System, the Control Panel for the Grit Washer, the Control Panels for the Chemical Feed System, and control for the UV Equipment. The project will require the Contractor to interface with numerous process instruments, VFD's, and other panels and devices.

D. The Work in this Section will also require the Contractor to interface with the existing Screening Panel in the existing Screening Building.

1.05 INTENT OF DRAWINGS

A. The control diagrams for the equipment are diagrammatic and are intended to show the desired operation. The Contractor shall install exactly as shown unless the operation will cause failure of the equipment due to unique operating characteristics of the supplied equipment unknown to the Engineer. The Contractor shall notify the Engineer of such

conflicts with a thorough explanation and receive written resolution before proceeding with the Contract work. Any damage to the Contractor-supplied equipment arising due to improper control shall be the responsibility of the Contractor. The drawings may not show all items required. It is the responsibility of the Contractor to ensure that all contacts and items are provided with the suitable sized contactors or power sources.

B. Make requests for approval of substitutions or alternates in writing to the Engineer. Provide sufficient material or data to allow evaluation of the proposed substitution or alternate, and determination of compliance with these Contract Documents. List any deviations from these Contract Documents associated with the substitution or alternate. List cost or savings to Owner for all proposed changes.

1.06 WARRANTY

A. The materials, equipment and workmanship specified herein shall be guaranteed to the Owner against defects for a period of 1 year from the date of Substantial Completion.

PART 2 - MATERIALS

2.01 GENERAL

A. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service. All items included in this section shall comply with the National Electric Code, NEMA, IEEE, EIA, and FCC.

B. Environmental Conditions: Unless otherwise noted, equipment shall be suitable for the following environmental conditions:

Temperature	20 to 105 Degrees F
Relative Humidity	10 to 80 percent
Enclosure Rating	NEMA Type 4. NEMA 12 in Electrical Room. Grit Washer Room will require panels rated for Classified Areas per the Electrical Drawings and Specifications.
Classification	Nonhazardous With the following Exceptions: All locations except the Grit Washing Room and in the Reactors including 18-inches above the High Water Level as noted in the Electrical Drawings and Specifications.
Process Water Temperature	32 to 100 Degrees F

2.02 I/C CABLE

A. Instrumentation cable shall meet all requirements of interfacing equipment. Wire shall be Type THWN. Instrumentation cable must be installed inside conduit (when installed outside of enclosure) 4 inches or more from power wiring.

B. Wiring:

1. All electrical wiring shall be in accordance with the applicable requirements of the ELECTRICAL SPECIFICATIONS. Instrumentation cable and power conductors shall meet the requirements state therein.
2. Wiring for signal circuits and 24VDC shall not be smaller than No. 18 AWG and be separated at least 18 inches from any 120 VAC power wiring.
3. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. All wires shall be color coded and be identified by permanent plastic number tags placed within 2 inches of each termination.
4. Wiring run in panels shall be run in covered wiring duct with identified by permanent plastic number tags within two inches of entering and leaving the duct.

C. Terminal Blocks:

1. Terminal blocks shall be one-piece molded plastic blocks with screw type terminals and barriers rated for 300 volts. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits. Terminals shall be numbered and have permanent, legible identification, clearly visible with the protective cover removed.

PART 3 - EXECUTION

3.01 PROTECTION DURING CONSTRUCTION

A. Throughout this Contract, the Contractor shall provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Specific storage requirements shall be in accordance with the Engineer-approved manufacturer's recommendations.

3.02 CORROSION PROTECTION

A. All control panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, shall be protected from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, the capsules shall be provided within the shipping containers and equipment as recommended by the capsule manufacturer. During the construction period, the capsules shall be replaced periodically in accordance with the capsule manufacturer's recommendations. All capsules shall be replaced by the Contractor just prior to Owner's final acceptance of the equipment. The corrosion-inhibiting vapor capsules shall be Northern Instruments Model Zerust VC or Hoffman Model A-HCI.

3.03 INUPUTS/OUTPUTS TO OWNER PROVIDED PLC’s.

A. The tables below show a partial list of the wiring inputs and outputs to be installed as part of this Contract. The tables below include ONLY THOSE INPUTS to the City SCADA System and do not include those required for control of items provided by AASI or those required between Contractor provided Equipment and Control Panels. The Contractor is required to install wiring as recommended by Equipment Manufacturer's to provide a system which operates as described in these specifications or as shown on the Drawings. Some installations are based on the wiring requirements of a specific brand of equipment which could vary. All wiring required to provide this system shall be installed by the Contractor at no additional cost to the Owner. The inputs below shall be run and terminated within the enclosures with labels.

MAIN LIFT STATION PLC INPUT TABLE

Number	*Description*	*TYPE*	*From*	*To*
1	PUMP 1 RUNNING	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
2	PUMP 2 RUNNING	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
3	PUMP 3 RUNNING	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
4	PUMP 1 VFD FAULT	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
5	PUMP 2 VFD FAULT	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
6	PUMP 3 VFD FAULT	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
7	PUMP 1 MOTOR HIGH TEMP	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
8	PUMP 2 MOTOR HIGH TEMP	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
9	PUMP 3 MOTOR HIGH TEMP	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
10	HIGH WATER ACTIVATED / RUNNING ON BACK-UP TRANSDUCER	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
11	PUMP CONTROL PANEL PHASE FAILURE	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
12	LOW WATER CUT-OUT	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
13	PUMP PANEL CONTROL POWER CONFIRMATION	DISCRETE INPUT	MAIN LIFT STATION MFR PANEL	
14	SCREEN PANEL CONTROL POWER CONFIRMATION	DISCRETE INPUT	EXISTING SCREEN PANEL (SCREENING BUILDING)	
15	SCREENING SYSTEM ALARM (COMMON ALARM)	DISCRETE INPUT	EXISTING SCREEN PANEL (SCREENING BUILDING)	
16	SCREEN RUNNING	DISCRETE INPUT	EXISTING SCREEN PANEL (SCREENING BUILDING)	
17	SCREENING CHANNEL HIGH WATER LEVEL	DISCRETE INPUT	EXISTING SCREEN PANEL (SCREENING BUILDING)	
18	GENERATOR RUNNING*	DISCRETE INPUT	EXISTING GENERATOR RUN RELAY	
19	POWER FAIL	DISCRETE INPUT	EXISTING ATS	

GRIT BUILDING PLC INPUT/OUTPUT TABLE

Number	*Description*	*TYPE*	*From*	*To*	*NOTES*
1	INFLUENT WASTEWATER FLOW	ANALOG IN	16-INCH INFLUENT FLOW METER		
NA	GRIT MIXING MOTOR RUNNING	EHTERNET	FROM GRIT PANEL MFR PLC		GRIT PANEL PLS, VIA EHTERNET
NA	GRIT MIXING MOTOR FAIL	EHTERNET	FROM GRIT PANEL MFR PLC		GRIT PANEL PLS, VIA EHTERNET
NA	GRIT PUMP RUNNING	EHTERNET	FROM GRIT PANEL MFR PLC		GRIT PANEL PLS, VIA EHTERNET
NA	GRIT PUMP FAIL	EHTERNET	FROM GRIT PANEL MFR PLC		GRIT PANEL PLS, VIA EHTERNET
NA	GRIT PUMP RUNNING	EHTERNET	FROM GRIT PANEL MFR PLC		GRIT PANEL PLS, VIA EHTERNET
2	GRIT WASHER READY / POWER ON	DISCRETE INPUT	GRIT WASHER CONTROL PANEL		
3	GRIT STIRRER RUNNING	DISCRETE INPUT	GRIT WASHER CONTROL PANEL		
4	GRIT STIRRER FAULT	DISCRETE INPUT	GRIT WASHER CONTROL PANEL		
5	GRIT SCREW RUNNING	DISCRETE INPUT	GRIT WASHER CONTROL PANEL		
6	GRIT SCREW FAULT	DISCRETE INPUT	GRIT WASHER CONTROL PANEL		
7	ORGANICS VALVE OPEN	DISCRETE INPUT	GRIT WASHER CONTROL PANEL		
8	ORGANICS VALVE FAULT	DISCRETE INPUT	GRIT WASHER CONTROL PANEL		
9	START CHEM FEED PUMP ONE	DISCRETE OUTPUT		CHEMICAL FEED PANEL 1	PROMPTED BY AQUA PLC, VIA ETHERNET
10	CHEMICAL FEED PUMP ONE SPEED COMMAND	ANALOG OUTPUT		CHEMICAL FEED PANEL 1	PROMPTED BY AQUA PLC, VIA ETHERNET
11	CHEMICAL FEED PUMP ONE RUNNING	DISCRETE INPUT	CHEMICAL FEED PANEL 1		REPORTED TO AQUA PLC, VIA ETHERNET
12	CHEMICAL FEED PUMP ONE SPEED FEEDBACK	ANALOG INPUT	CHEMICAL FEED PANEL 1		REPORTED TO AQUA PLC, VIA ETHERNET
13	CHEMICAL FEED PUMP ONE FAIL	DISCRETE INPUT	CHEMICAL FEED PANEL 1		
14	START CHEM FEED PUMP TWO	DISCRETE OUTPUT		CHEMICAL FEED PANEL 1	PROMPTED BY AQUA PLC, VIA ETHERNET
15	CHEMICAL FEED PUMP TWO SPEED COMMAND	ANALOG OUTPUT		CHEMICAL FEED PANEL 1	PROMPTED BY AQUA PLC, VIA ETHERNET
16	CHEMICAL FEED PUMP TWO RUNNING	DISCRETE INPUT	CHEMICAL FEED PANEL 1		REPORTED TO AQUA PLC, VIA ETHERNET
17	CHEMICAL FEED PUMP TWO SPEED FEEDBACK	ANALOG INPUT	CHEMICAL FEED PANEL 1		REPORTED TO AQUA PLC, VIA ETHERNET
18	CHEMICAL FEED PUMP TWO FAIL	DISCRETE INPUT	CHEMICAL FEED PANEL 1		
19	START CHEM FEED PUMP THREE	DISCRETE OUTPUT		CHEMICAL FEED PANEL 1	PROMPTED BY AAS PLC, VIA ETHERNET
20	CHEMICAL FEED PUMP THREE SPEED COMMAND	ANALOG OUTPUT		CHEMICAL FEED PANEL 1	PROMPTED BY AAS PLC, VIA ETHERNET
21	CHEMICAL FEED PUMP THREE RUNNING	DISCRETE INPUT	CHEMICAL FEED PANEL 1		REPORTED TO AAS PLC, VIA ETHERNET
22	CHEMICAL FEED PUMP THREE SPEED FEEDBACK	ANALOG INPUT	CHEMICAL FEED PANEL 1		REPORTED TO AAS PLC, VIA ETHERNET
23	CHEMICAL FEED PUMP THREE FAIL	DISCRETE INPUT	CHEMICAL FEED PANEL 1		
24	START CHEM FEED PUMP FOUR	DISCRETE OUTPUT		CHEMICAL FEED PANEL 2	PROMPTED BY AAS PLC, VIA ETHERNET
25	CHEMICAL FEED PUMP FOUR SPEED COMMAND	ANALOG OUTPUT		CHEMICAL FEED PANEL 2	PROMPTED BY AAS PLC, VIA ETHERNET
26	CHEMICAL FEED PUMP FOUR RUNNING	DISCRETE INPUT	CHEMICAL FEED PANEL 2		REPORTED TO AAS PLC, VIA ETHERNET
27	CHEMICAL FEED PUMP FOUR SPEED FEEDBACK	ANALOG INPUT	CHEMICAL FEED PANEL 2		REPORTED TO AAS PLC, VIA ETHERNET
28	CHEMICAL FEED PUMP FOUR FAIL	DISCRETE INPUT	CHEMICAL FEED PANEL 2		
29	ALUM TANK LEAK DETECTED	DISCRETE INPUT	ALUM TANK LEAK DETECTOR		
30	SIDESTREAM LS PUMP 1 RUN	DISCRETE INPUT	SIDESTREAM LS CONTROL PANEL		
31	SIDESTREAM LS PUMP 2 RUN	DISCRETE INPUT	SIDESTREAM LS CONTROL PANEL		
32	SIDESSTREAM PUMP 1 FAULT	DISCRETE INPUT	SIDESTREAM LS CONTROL PANEL		
33	SIDESTREAM PUMP 2 FAULT	DISCRETE INPUT	SIDESTREAM LS CONTROL PANEL		
34	SIDESTREAM PUMP 1 HIGH TEMP	DISCRETE INPUT	SIDESTREAM LS CONTROL PANEL		
35	SIDESTREAM PUMP 2 HIGH TEMP	DISCRETE INPUT	SIDESTREAM LS CONTROL PANEL		
36	SIDESTREAM HIGH WATER TRANSDUCER LEVEL	DISCRETE INPUT	SIDESTREAM LS CONTROL PANEL		
37	SIDE STREAM LOW WATER CUT-OUT FLOAT	DISCRETE INPUT	SIDESTREAM LS CONTROL PANEL		
38	SIDE STREAM LIFT STATION FLOW	ANALOG INPUT	6-INCH FLOW METER		
39	REACTOR 1 INFLUENT VALVE OPEN/CLOSE	DISCRETE OUTPUT		REACTOR 1 INFLUENT ACTUATOR	CONTROLLED BY AAS PLC VIA ETHERNET
40	REACTOR 1 INFLUENT VALVE STATUS	DISCRETE INPUT	REACTOR 1 INFLUENT ACTUATOR		CONTROLLED BY AAS PLC VIA ETHERNET
41	REACTOR 1 INFLUENT VALVE FAIL ALARM	DISCRETE INPUT	REACTOR 1 INFLUENT ACTUATOR		CONTROLLED BY AAS PLC VIA ETHERNET
42	REACTOR 2 INFLUENT VALVE OPEN/CLOSE	DISCRETE OUTPUT		REACTOR 2 INFLUENT ACTUATOR	CONTROLLED BY AAS PLC VIA ETHERNET
43	REACTOR 2 INFLUENT VALVE STATUS	DISCRETE INPUT	REACTOR 2 INFLUENT ACTUATOR		CONTROLLED BY AAS PLC VIA ETHERNET
44	REACTOR 2 INFLUENT VALVE FAIL ALARM	DISCRETE INPUT	REACTOR 2 INFLUENT ACTUATOR		CONTROLLED BY AAS PLC VIA ETHERNET
45	REACTOR 3 INFLUENT VALVE OPEN/CLOSE	DISCRETE OUTPUT		REACTOR 3 INFLUENT ACTUATOR	CONTROLLED BY AAS PLC VIA ETHERNET
46	REACTOR 3 INFLUENT VALVE STATUS	DISCRETE INPUT	REACTOR 3 INFLUENT ACTUATOR		CONTROLLED BY AAS PLC VIA ETHERNET
47	REACTOR 3 INFLUENT VALVE FAIL ALARM	DISCRETE INPUT	REACTOR 3 INFLUENT ACTUATOR		CONTROLLED BY AAS PLC VIA ETHERNET
48	DRYING BED OPEN COMMAND	DISCRETE OUTPUT		DRYING BED ACTUATOR	
49	DRYING BED VALVE OPEN STATUS	DISCRETE INPUT	DRYING BED ACTUATOR		
50	DRYING BED VALVE CLOSED STATUS	DISCRETE INPUT	DRYING BED ACTUATOR		
51	DRYING BED FLOW	ANALOG INPUT	DRYING BED MAG METER		

MAIN PROCESS BUILDING PLC INPUT/OUTPUT TABLE

Number	*Description*	*TYPE*	*From*	*To*	*NOTES*
1	UV SYSTEM FAIL	ETHERNET	UV CONTROL SYSTEM		
2	UV BANK 1 INTENSITY	ETHERNET	UV CONTROL SYSTEM		
3	UV BANK 2 INTENSITY	ETHERNET	UV CONTROL SYSTEM		
4	UV BANK 3 INTENSITY	ETHERNET	UV CONTROL SYSTEM		
5	UV BANK 4 INTENSITY	ETHERNET	UV CONTROL SYSTEM		
6	UV TRANSMITTANCE	ETHERNET	UV CONTROL SYSTEM		
7	NPW PUMP 1 RUNNING	DISCRETE INPUT	MAIN BUILDING MCC NPW VFD 1		
8	NPW PUMP 2 RUNNING	DISCRETE INPUT	MAIN BUILDING MCC NPW VFD 2		
9	NPW PUMP 1 FAIL	DISCRETE INPUT	MAIN BUILDING MCC NPW VFD 1		
10	NPW PUMP 2 FAIL	DISCRETE INPUT	MAIN BUILDING MCC NPW VFD 2		
11	NPW PUMP 1 LOW WATER CUT-OUT	DISCRETE INPUT	FLOAT / EXTERNAL STOP TO VFD		
12	NPW PUMP 2 LOW WATER CUT-OUT	DISCRETE INPUT	FLOAT / EXTERNAL STOP TO VFD		
13	SLUDGE RECIRC PUMP 1 START	DISCRETE OUTPUT		MAIN BUILDING MCC RECIRC VFD 1	
14	SLUDGE RECIRC PUMP 2 START	DISCRETE OUTPUT		MAIN BUILDING MCC RECIRC VFD 2	
15	SLUDGE PUMP 1 FAIL	DISCRETE INPUT	MAIN BUILDING MCC RECIRC VFD 1		
16	SLUDGE PUMP 2 FAIL	DISCRETE INPUT	MAIN BUILDING MCC NPW VFD 2		
17	SLUDGE RECIRC PUMP 1 SPEED CONTROL	ANALOG OUTPUT		MAIN BUILDING MCC RECIRC VFD 1	
18	SLUDGE RECIRC PUMP 2 SPEED CONTROL	ANALOG OUTPUT		MAIN BUILDING MCC RECIRC VFD 2	
19	SLUDGE RECIRC PUMP 1 SPEED FEEDBACK	ANALOG INPUT	MAIN BUILDING MCC RECIRC VFD 1		
20	SLUDGE RECIRC PUMP 2 SPEED FEEDBACK	ANALOG INPUT	MAIN BUILDING MCC RECIRC VFD 2		
21	EFFLUENT FLOW METER	ANALOG INPUT	EFFLUENT MAG METER		
22	NPW FLOW METER	ANALOG INPUT	NPW MAG METER		
23	POWER FAIL	DISCRETE INPUT	ATS		
24	GERNERATOR RUNNING	DISCRETE INPUT	GENERATOR RUN RELAY		

BLOWER BUILDING PLC

Number	*Description*	*TYPE*	*From*	*To*	*NOTES*
1	BLOWER 1 START	DISCRETE OUTPUT		BLOWER BLDG MCC BLOWER 1 VFD	
2	BLOWER 2 START	DISCRETE OUTPUT		BLOWER BLDG MCC BLOWER 2 VFD	
3	BLOWER 1 SPEED CONTROL	ANALOG OUTPUT		BLOWER BLDG MCC BLOWER 1 VFD	
4	BLOWER 2 SPEED CONTROL	ANALOG OUTPUT		BLOWER BLDG MCC BLOWER 2 VFD	
5	BLOWER 1 SPEED FEEDBACK	ANALOG INPUT	BLOWER BLDG MCC BLOWER 1 VFD		
6	BLOWER 2 SPEED FEEDBACK	ANALOG INPUT	BLOWER BLDG MCC BLOWER 2 VFD		
7	POWER FAIL	DISCRETE INPUT	BLDG POWER		

3.04 EQUIPMENT / PANEL DESCRIPTIONS

A. A brief description of the work is included below

1. EXISTING MECHANICAL SCREEN: Provide wiring between the existing Screening Panel (located in existing Screening Building) to the Main Lift Station PLC to alert operators of the Status and Alarm Conditions (Power Confirmation, Screen Run Status, Screen Alarm, High Water Level.

2. MAIN LIFT STATION GENERATOR: Provide wiring between existing generator and automatic transfer switch to the Main Lift Station PLC to indicate a Power Failure and indication of the generator run status.

3. MAIN LIFT STATION PUMP CONTROL PANEL: A Pump Control Panel will be provided by the Pump Manufacturer to control the three (3) self-priming pumps in this location. Reference Specification Section 43 23 13 for these pumps and associated Liquid Level Control System. Make all connections between these pumps and level control devices as indicated by the manufacturer and Electrical Drawings. Provide wiring from the Main Lift Station Pump Control Panel to the Main Lift Station PLC for all inputs/outputs listed above, including Speed Command, and Speed Feedback from each VFD (reference Electrical and Mechanical Drawings).

4. INFLUENT FLOW METER: A 16-inch magnetic flow meter will be located within the Grit Building (reference specification for this meter). Provide analog input to the Grit Building PLC to indicate the influent wastewater flow.

5. SIDE STREAM LIFT STATION FLOW METER: A 6-inch magnetic flow meter will be located within the Grit Building (reference specification for this meter). Provide analog input to the Grit Building PLC to indicate the flow from this lift station.

6. GRIT REMOVAL CONTROL PANEL: A Panel will be provided with the Grit Removal Unit to control the grit removal system, Grit Pump, and pneumatic pinch valve (Reference Grit Removal Equipment specification). Make all connections between this equipment and the Grit Removal Control Panel per manufacturer instruction and Electrical Drawings. This Grit Removal Control Panel is to be provided with an Allen Bradley PLC capable of interfacing through an Ethernet connection with the Grit Building PLC (provided by Owner). Provide the alarms and status conditions listed as inputs above to from this panel relative to the Grit Removal Equipment and Grit Pump.

7. REACTOR INFLUENT ACTUATED VALVES: The Grit Building PLC will communicate with the AASI PLC through and Ethernet connection to control each of the three 20-inch valves located in the Grit Building. Provide wiring between the Grit Building PLC and valve actuators (open command, open status, and closed status for each valve).

8. GRIT WASHER CONTROL PANEL: A Panel will be provided with the Grit Washer to control this equipment. Make all connections between this equipment and the Grit Washer Control Panel per manufacturer instruction and Electrical Drawings.

Provide wiring between the Grit Washer Control Panel and Grit Building PLC to provide the status and alarm conditions shown in the tables above.

9. SIDESTREAM LIFT STATION PUMP CONTROL PANEL: A Pump Control Panel will be provided by the Pump Manufacturer to control the two (2) submersible pumps in this location. Reference Specification Section 22 13 29.16 for these pumps and associated Liquid Level Control System. Make all connections between these pumps and level control devices as indicated by the manufacturer and Electrical Drawings. Provide wiring from the Sidestream Lift Station Pump Control Panel to the Grit Building PLC to provide the inputs listed in the table above.

10. ALUM TANK: A double-walled chemical tank for alum storage with a Leak Detection Probe is to be provided. Provide all wiring necessary to provide a discrete input to the Grit Building PLC for an "Alum Tank Leak Detected" status.

11. CHEMICAL FEED SKID 1 PANEL and CHEMICAL FEED SKID 2 CONTROL PANEL. Provide wiring between the Chemical Feed Control Panels and skids per manufacturer recommendation and as shown in the Electrical Drawings. Skid One Pump One will deliver alum to Reactor#2, Skid One Pump 2 will deliver alum to Reactor #3. Skid Two Pump Two will deliver Alum to Reactor #1. Skid Two Pump Two will deliver alum to the Influent Splitter Box. The Grit Building PLC will communicate with the AAS PLC through and Ethernet connection to control each of the four chemical pumps in the Grit Building. Provide wiring between the Grit Building PLC and Chemical Feed Control Panels for this purpose. For each pump provide a discrete "start" output, speed command analog output, speed feedback analog input, and discrete pump fail. Chemical Feed Control Panel 1 will interface with pumps to the three Reactors. Chemical Feed Control Panel two will interface with the pump to the Influent Splitter Box.

12. PROCESS BLOWERS 1, 2, 3: The AASI PLC will control the (3) blowers in the Main Process Building. AASI will provide an AERTRONICS Controller with each blower (reference AASI submittal information). The AERTRONICS Panel will interface with the VFD for each blower (located in the AASI MCC. Provide connection between the AASI PLC and AERTRONICS panel. Provide wiring between the AERTRONICS Panel and VFD for each blower per AASI.

13. BLOWER AIR INSERTION FLOW METERS: AASI to provide insertion flow meters for each of the (3) 8-inch air headers (one per reactor). Provide all wiring per AASI as required to provide an analog input to the AASI PLC from each meter.

14. AERATION HEADER 8-INCH ACTUATED VALVES: AASI to provide actuated valves on each of the (3) 8-inch aeration header controlled by the AASI PLC. Provide wiring as shown on the Electrical Drawings and as shown by AASI (reference submittal information). Wiring between AASI PLC and each actuator to have discrete signals (open command, open status, and closes status) as well as analog signals for "throttling" each valve (percent open control and percent open feedback).

15. AERATION TO WAS HEADER ACTUATED VALVES: AASI to provide actuated valves on each of the (3) 4-inch aeration pipes connected to the WAS header for each reactor. These valves are controlled by the AASI PLC. Provide wiring as shown on the Electrical Drawings and as shown by AASI (reference submittal information). Wiring between AASI PLC and each actuator to have discrete signals (open command, open status, and closed status).
16. AERATION BLOW OFF ACTUATED VALVES: AASI to provide actuated valves on each of the (3) 4-inch blow-offs at each reactor. These valves are controlled by the AASI PLC. Provide wiring as shown on the Electrical Drawings and as shown by AASI (reference submittal information). Wiring between AASI PLC and each actuator to have discrete signals (open command, open status, and closed status).
17. REACTOR HIGH WATER FLOATS: Provide and install high level float switch in each reactor per AASI. Reference Electrical Mechanical Drawings. Float to provide discrete input to AASI PLC for each Reactor.
18. REACTOR LEVEL TRANSDUCERS: AASI to provide level transducer for each reactor. Install transducer and provide wiring to provide analog input to AASI PLC per AASI (reference Electrical and Mechanical Drawings).
19. PROCESS CONTROL PROBES: AASI to provide (5) process control probes for each of the (3) reactors. These probes include dissolved oxygen, nitrate, ORP, pH, and TSS. Install transducers and provide wiring to provide data input to AASI PLC per AASI (reference Electrical and Mechanical Drawings). These probes are also connected to controllers and displays at the reactor basins (connect per AASI and Electrical Drawings).
20. "FILTRAX SAMPLER", AMMONIA, and PHOSPHORUS ANALYZERS. AASI to provide automatic sample units at each of the three reactors. AASI to provide Ammonia and Phosphorus Analyzers for each basin to be located in the Main Process Building (total of 6 analyzers). These analyzers are to interface with a display as well as deliver data to the AASI PLC. These items are to be connected per AASI, the Electrical Drawings, and Mechanical Drawings. Contractor to provide materials in addition to that provided by AASI for interconnectivity and weatherproofing as shown in the Drawings and as specified.
21. WAS/WLC ACTUATED VALVES: The AASI PLC in the Main Control Building will control each of the (3) 16-inch actuated valves for wasting sludge (one per basin) and (3) 16-inch WLC actuated valves for delivering water to the WLC basin (one per basin). AASI to provide these valves and actuators. Provide wiring between the AASI PLC and valve actuators (open command, open status, and closed status) for each valve.
22. WLC HIGH WATER FLOAT: Provide and install high level float switch in Water Level Control Basin per AASI. Reference Electrical Mechanical Drawings. Float to provide discrete input to AASI PLC.

23. WLC LEVEL TRANSDUCER: AASI to provide level transducer for the Water Level Control Basin. Install transducer and provide wiring to provide analog input to AASI PLC per AASI (reference Electrical and Mechanical Drawings).
24. WLC PUMP VFD's. AASI to provide VFD's for each of the two Water Level Control Pumps. These VFD's to be located in the AASI MCC. Provide wiring per AASI and Electrical Drawings to provide control of these VFD's and the inputs and outputs shown in the Electrical Drawings and AASI Wiring Diagrams.
25. SBB HIGH WATER FLOATS: Provide and install high level float switch in both of the Sludge Buffer Basins per AASI. Reference Electrical Mechanical Drawings. Floats to provide discrete inputs to AASI PLC.
26. SBB LEVEL TRANSDUCERS: AASI to provide level transducers for both Sludge Buffer Basins. Install transducers and provide wiring to provide analog input to AASI PLC per AASI (reference Electrical and Mechanical Drawings).
27. SBB PUMP SUCTION VALVES: AASI to provide actuated valves for sending process water to each set of SBB Pumps. These valves are 4-inch in diameter (two total) and located between each SBB Basin and each set of SBB Pumps. Valves are to be controlled by the AASI PLC. Provide wiring as shown on the Electrical Drawings and as shown by AASI (reference submittal information). Wiring between AASI PLC and each actuator to have discrete signals (open command, open status, and closed status).
28. SBB PUMP VFD's. AASI to provide VFD's for each of the four Sludge Buffer Basin Pumps. These VFD's to be located in the AASI MCC. Provide wiring per AASI and Electrical Drawings to provide control of these VFD's and the inputs and outputs shown in the Electrical Drawings and AASI Wiring Diagrams.
29. SBB TURBIDITY METERS: AASI to provide turbidity meter for each of the (2) Sludge Buffer Basins. These meters to be installed between the basin and SBB Pumps. Install turbidity probes and transmitters. Provide wiring to provide data input to AASI PLC per AASI (reference Electrical and Mechanical Drawings).
30. SBB FLOW METERS: AASI to provide magnetic flow meters on the discharge side of both sets of SBB Pumps. Install meters and transmitters. Provide wiring to provide analog input to AASI PLC per AASI (reference Electrical and Mechanical Drawings).
31. DECANT VALVES: AASI to provide actuated valves for sending Decant Process Water to the Grit Building Influent Splitter Box. These valves are 4-inch in diameter and located on the discharge side of each set of SBB Pumps (2 total). Valves are to be controlled by the AASI PLC. Provide wiring as shown on the Electrical Drawings and as shown by AASI (reference submittal information). Wiring between AASI PLC and each actuator to have discrete signals (open command, open status, and closed status).
32. TWAS VALVES: AASI to provide actuated valves for sending waste sludge to the Biosolids Treatment Basin. These valves are 3-inch in diameter and located on the

discharge side of each set of SBB Pumps (2 total). Valves are to be controlled by the AASI PLC. Provide wiring as shown on the Electrical Drawings and as shown by AASI (reference submittal information). Wiring between AASI PLC and each actuator to have discrete signals (open command, open status, and closed status).

33. EFFLUENT FLOW METER: Provide and install 20-inch magnetic flow meter upstream of the UV System. Install transmitters and provide analog outputs to the Main Process Building PLC, Effluent Automatic Sampler, and the UV System Control Panel (reference Electrical and Mechanical Drawings).

34. UV DISINFECTION SYSTEM: A UV System Control Panel along with sub-panels for will be provided by the UV System Manufacturer to control the UV system and the (4) banks of UV lights provided as part of this system. Reference the specification for the UV System, Mechanical Drawings, and Electrical Drawings. Make all connections between the equipment, subpanels, and devices as indicated by the manufacturer and Electrical Drawings. The UV System Main Control Panel will be provided with a PLC for control of the UV system. Provide Ethernet connection between the UV System provided PLC and Main Process Building PLC provide the inputs functions listed in the table above.

35. NON-POTABLE WATER (NPW) PRESSURE CONTROLLER AND PUMPS: Two vertical turbine NPW pumps with individual VFDs (located in the Main Building MCC) will operate from a pressure indicator/controller that maintains a preset (adjustable) discharge line pressure and provides automatic pump alternation. These two pumps are redundant and will not operate simultaneously. The pressure controller has its own 24 VDC power supply and will provide 24 VDC inputs to start/stop the VFDs. Operators will manually set the pump speed (VFD frequency). Each pump will have a dedicated low-level cut-out float to be connected to the "external stop" contacts of the VFD. Provide inputs to the Main Process Building PLC for Pump Run, Pump Fail, and Low-Level Float Cut-Out from each VFD (reference Electrical and Mechanical Drawings).

36. NPW FLOWMETER: Provide and install 6-inch magnetic flow meter on the discharge side of the NPW Pumps. Install transmitters and provide analog input to the Main Process Building PLC (reference Electrical and Mechanical Drawings).

37. SLUDGE RECIRCULATION PUMPS: Two sludge recirculation pumps with individual VFDs will be controlled by the Main Process Building PLC. These VFD's will be located in the Main Process Building MCC. Provide inputs/outputs to the Main Process Building PLC for Pump Start, Pump Run (status), Pump Fail, Speed Command, and Speed Feedback from each VFD (reference Electrical and Mechanical Drawings).

38. PLANT GENERATOR: Provide wiring between existing generator and automatic transfer switch to the Main Process Building PLC to indicate a Power Failure and indication of the generator run status.

39. BIOSOLIDS TREATMENT BASIN BLOWERS: Two 40 HP aeration blowers with individual VFD's will be controlled by the Blower Building PLC. These VFD's will be located in the Blower Building. Provide inputs/outputs to the Blower Building PLC for Blower Start; Blower run (status); Blower Fail; Speed Command, and; Speed Feedback from each VFD (See Electrical and Mechanical Drawings).

40. BLOWER BUILDING POWER FAIL: Provide input for Blower Building Power Fail to the Blower Building PLC (reference Electrical Drawings).

41. DIGESTED SLUDGE ACTUATED VALVE: Provide 6-inch actuated valve in Biosolids Waste to Drying Bed Control Valve Structure. This valve is to be controlled by the Grit Building PLC. Provide wiring as shown on the Electrical Drawings to provide discrete signals (open command, open status, and closed status) between actuated valve and Grit Building PLC.

42. DIGESTED SLUDGE FLOW METER: Provide and install 6-inch magnetic flow meter in the Biosolids Waste Flow Metering Structure. Install transmitters and provide analog input to the Grit Building PLC (reference Electrical and Mechanical Drawings).

3.05 PLC INTERCONNECTIVITY

A. City Owned PLC's, AASI Control Panel, and SCADA Computer Stations (Administration Building) shall be interconnected by fiber optic communications (reference Electrical Drawings). In some cases Ethernet connections are required between PLC's and between Equipment Manufacturer Provided Panels and PLC's. It is the responsibility of the Contractor to ensure that these communication systems are compatible and that equipment provided by the Contractor sends information to the SCADA System as listed to provide a complete SCADA System as described by this specification. Where Contractor provides Equipment and requires communication with the SCADA System, it is the responsibility of the Contractor to ensure compatibility and that all parts and integration is completed to communicate as described and shown in the Drawings.

3.06 ELECTRICAL POWER AND SIGNAL WIRING

A. Wiring: Wiring for signal circuits and 24 VDC shall not be smaller than No. 18 AWG, and be separated at least 18 inches from any 120 VAC power wiring. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks.

B. Control and signal wiring in control panels shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting will be around the longitudinal axis of the wire and the bend area shall be protected with a sleeve.

C. Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for any wire bundles which pass through holes or across edges of sheet metal.

D. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.

E. All wires shall be labeled.

3.07 ACCEPTANCE TESTING

A. Systems will not be accepted until they have been demonstrated to the Engineer as described above. Each system will be started up individually once final connections are made.

END OF SECTION 40 61 93

SECTION 40 63 00
PROCESS CONTROL SYSTEM EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section covers process instruments and transmitters to be installed for system monitoring, including but not limited to: float switches; pressure gauges, and Non-Potable Water pressure controller and related probes and enclosures.

B. Items specified in this section shall include all materials, equipment, and work required for implementation of completely operable instruments. Instruments shall include primary elements for process variable measurements, analog and discrete outputs, and display and control elements (where specified).

C. The Contractor shall conduct all calibration adjustments, troubleshooting, and startup to assure instruments are properly operating and interfaced with other equipment. (See Special Provisions for system testing and startup requirements.)

D. Instruments specified in this section are subject to the requirements of Section 01 60 00 – Product Requirements.

1.02 SUBMITTALS

A. In addition to the requirements of Section 01 60 00, the following documentation shall also be provided for this equipment and accompany other required submittals:

1. Electrical drawings including circuit schematics, interconnection diagrams, and all information necessary for connection of electrical power and input/output circuits.

2. Panel elementary diagrams of pre-wired panels, including identification of all switched analog signals and all auxiliary devices such as relays, alarms, fuses, and lights.

3. Interconnecting wiring diagrams to tie instruments to Owner's telemetry system where shown on the Drawings, including all component and panel terminal board identification numbers and external wire numbers. This diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, motor control centers, etc.).

4. Hydraulic characteristics and requirements for all flow-, pressure-, or level-related devices.

5. Any special options included for each instrument.

6. Submittal information for each instrument shall bear the component name and instrument tag number designation shown in the P&ID Drawings, where applicable.

7. Manufacturer's ratings for each instrument, including:

a. Certified accuracy and precision (including repeatability).

b. Scale range.

c. Environmental tolerance (temperature, humidity, electrical induction isolation, and chemical resistance).

d. UL, ANSI, or other ratings.

8. Dimensional drawings and ratings for all instrument panels and enclosures.

9. Specifications, ratings, and power requirements for any heating or ventilating devices installed in instrument enclosures.

B. Spares Parts:

1. The Contractor shall provide a list of the manufacturer's recommended spare parts and quantities to sustain equipment provided under this section. Unit and total costs for the recommended parts inventory shall be included.

C. Operating and Maintenance Manuals: Manufacturer's O & M manuals shall be provided for each electrified instrument per Section 01 60 00 – Product Requirements.

D. Record Drawings: The Contractor shall provide one set of record drawings in both hard copy and electronic format for any field-wired interconnects between instruments or controllers.

1.03 RESPONSIBILITY FOR COMPLETE SYSTEM

A. Unit Responsibility for Process Instruments:

1. Unit responsibility for the Process Instruments shall be provided by the Contractor.

2. See Filter Specifications for specific requirements for non-potable water control and pump manufacturer's control panel.

B. The Contractor shall be responsible for coordination of the work to ensure that:

1. All components provided under this section are properly installed.

2. The proper type, size, and number of control wires with their conduits are provided and installed.

3. Proper electric power and control circuits are provided for all components and systems.

4. Instrumentation cable, power conductors, and conduits, and the installation thereof shall be provided and installed to meet the requirements of Division 26 – Electrical.

PART 2 - MATERIALS

2.01 GENERAL

A. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

2.02 EQUIPMENT SPECIFICATIONS

A. Unless superseded by other specifications herein or the manufacturer's standard ratings for a referenced instrument brand and model, all instruments shall be capable of the following minimum accuracy and precision:

1. Accuracy: plus-or-minus 1.0% of full scale
2. Precision: plus-or-minus 0.5% of full scale

B. Environmental Conditions: Unless otherwise noted, equipment shall be suitable for the following environmental conditions:

1.	Temperature	32 ˚to 120˚ F
2.	Relative Humidity	10 to 90 percent
3.	Enclosure Rating	NEMA Type 1/2 (panel-mounted instruments); NEMA 4X (instruments outside panels)
4.	Classification	Hazardous (Class I, Division 1, 2) not required
5.	Process Water Temperature	32˚ to 100˚ F

C. Wiring:

1. All electrical wiring shall be in accordance with the applicable requirements of Section 16 - Electrical. Instrumentation cable and power conductors shall meet the requirements stated therein.
2. Wiring for signal circuits and 24VDC shall not be smaller than No. 18 AWG, and be separated at least 18 inches from any 120 VAC power wiring.
3. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. All wires shall be color coded, and be identified by permanent plastic number tags placed within 2 inches of each termination.
4. Wiring run in panels shall be run in covered wiring duct identified by permanent plastic number tags within two inches of entering and leaving the duct. Wiring duct shall be covered, constructed of plastic and be of a snap-in slot type design.

D. Terminal Blocks:

1. Terminal blocks shall be one-piece molded plastic blocks with screw type terminals and barriers rated for 300 volts. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits. Terminals shall be numbered and have permanent, legible identification, clearly visible with the protective cover removed.
2. Wires shall be terminated at the terminal blocks of one of the following ways:
    a. Crimp type, pre-insulated, forked-tongue lugs for screw post terminals.
    b. Bared wire ends for clamp-type terminals.
3. Lugs shall be of the appropriate size for the terminal block screws and for the

number and size of the wires terminated.

2.03 INSTRUMENT SPECIFICATIONS

A. Float Switches and Level Alarm Panels

1. Where shown on the Drawings, high and/or low level alarm panels with float switches and accessories shall be installed in the clearwell, in the filter reject sump, and in the non-potable water sump. Level alarm panels shall be self-contained units, including float switches by the panel manufacturer.

2. Level alarm panels shall be NEMA 3R non-metallic enclosures with 85 db alarm buzzer and red alarm beacon. Units shall be UL listed. Separate test and silence buttons shall be provided, and alarms shall reset automatically. Panels shall have a 5A, 120V auxiliary alarm contact. Units shall operate on 120 VAC, and shall have a two-year limited warranty.

3. Float switches for alarm panels shall be hermetically sealed, stainless steel mercury switch floats with 15' water and oil resistant cables and narrow angle NO or NC contacts, as required for the application.

4. Floats shall be furnished with zinc-plated cast iron cord weights by the float manufacturer.

5. Low Level alarm panels shall include (6) auxiliary contacts to be wired through 24VDC "pump enable" circuits from/to pump VFDs to prevent pumping if an empty sump condition exists (Filter Supply and NPW pumps).

6. High Level alarm panels shall include a single pair of auxiliary contacts to be wired to the building alarm dialer.

7. Both high and low level alarm panels shall include a red beacon mounted atop the panels and an alarm horn with "silencing" feature.

8. Level alarm and float switch systems shall be Conery Manufacturing model 10A500-(6)C3 for low level alarm/pump enable panels and model Observer 400 for high level alarm panels, all with 'C10' cord weights, '1FB' float brackets, and 'G1' cord grips, or equal.

B. Pressure Gauges

1. Pressure Gages:

a. Shall be Bourdon tube actuated pressure gauges. Gauges shall be metal cased and silicone liquid filled. Gauges shall be stem mounted with minimum 2 1/2-inch dial size, unless otherwise noted. Gauge shall be ANSI Grade 2A with accuracy of plus or minus 1/2 percent of span.

b. The sensing element shall be phosphor-bronze, unless otherwise noted.

c. Pressure gauges for all but clean water or NPW applications shall be furnished with diaphragm seals, and pressure gauges with integral diaphragm seals are acceptable. Diaphragm seals are to be compatible with municipal wastewater or

specific chemicals according to their installed location. Diaphragm seals shall be Ashcroft capsule type, or approved equal.

d. All pressure gauge assemblies shall include an isolation valve between the pressure gauge (or diaphragm seal) and the carrier pipe. Isolation valves for wastewater shall be bronze body ball valves with standard or full port Teflon seats, and shall be rated for min. 600 psi water pressure. Isolation valves for chemical service shall be PVDF body ball valves rated for 230 psi pressure.

e. Units shall be Ashcroft 'Duragauge', Robert Shaw 'Acragauge', Marshall, or equal.

C. NPW Pump Pressure Controller:

1. The pressure controller for NPW Pumps #1 and #2 shall be an electronic indicating pressure controller in a NEMA 4X housing. Controller shall have a two-line backlit display, external buttons to access a programming menu, two SPDT relays, and a 4-20 MA output. Programming features shall include two setpoints settable to alternate two pumps in service, a 0-60 second time delay, and a "test mode" to simulate input over the controller range without pressure to enable switch testing. Relay contacts shall be 5A rated at 120/240V. Wetted materials and the ¼" process connection shall be 316 stainless steel.

2. Pressure controller shall be powered by 24 VDC.

3. Pressure controller shall be Dwyer Gage/Mercoid model 'EDA', or equal.

4. A NEC Class 2 DC power supply shall be provided for pressure controller, and rated at 2.5A output at 24 VDC using 120VAC input power. Power supply shall have a nominal efficiency of 87.5%, and an MTBF of 740,000 hours. Power supply shall be DIN rail mounted.

5. The DC power supply shall be installed in a 9"h x 7"w NEMA 4 metal enclosure with gasketed, hinged, deadfront cover and DIN rail supports. Enclosure shall be Hoffman model 'LHC252015' with 'LP2520' interior panel, or equal.

6. The DC power supply shall be electrically isolated by a 15A, 125V rated box cover unit with fuse and on/off switch, wired in series ahead of the power supply. Box cover unit shall be rated for up to ½ hp service, and furnished complete with a 5 amp screw-in fuse. Box cover unit shall be a Cooper Bussman 2¼" Handy Box, or equal. Enclosure shall be vented if/as recommended by the power supply manufacturer.

PART 3 - EXECUTION

3.01 GENERAL

A. Coordinate process instrument electrical interface, installation and startup of all process instruments.

B. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instructions, and these Contract

Documents, follow Engineer's decision, at no additional cost to Owner. Keep copy of manufacturers' instructions on the jobsite available for review at all times.

3.02 ELECTRICAL POWER AND SIGNAL WIRING

A. Control and signal wiring external to the control panels and all power wiring shall conform to the requirements of Division 26 - Electrical.

B. B. Control and signal wiring in control panels shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting will be around the axis of the wire, and the bend area shall be protected with a sleeve.

C. Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for wire bundles passing through holes or across metal edges.

D. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.

3.03 SPECIAL REQUIREMENTS FOR FLOAT SWITCHES

A. Manufacturer’s cables for float switches shall be supported and routed as shown on the Drawings, with slack cable provided in handholes or hatchways to facilitate float switch removal and replacement.

B. Cables shall be completely stress relieved. Support points and tie-off’s shall be fully cushioned to prevent cable damage, and in full accordance with manufacturer’s installation recommendations.

C. Cabling from probes shall be protected with neoprene grommets where entering conduit ends, sleeves, panels, or any sharp-edged openings in order to protect the cable.

3.04 CONTRACTOR TESTING

A. Calibrate, condition, and test all instruments in accordance with manufacturers’ recommendations prior to demonstrating instruments and placing in service.

B. Provide testing and functional demonstration of all monitoring and control functions as described in manufacturers’ submittals and the construction drawings.

C. See Special Provisions for system demonstration and testing requirements.

END OF SECTION 40 63 00

SECTION 40 71 13
MAGNETIC FLOW METER AND TRANSMITTER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including general and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This specification includes the installation of an electromagnetic flow meter and transmitter suitable for fixed-site measurement of bi-directional flow in a full pipe. The flow meter shall consist of a flow tube and a flow transmitter, which shall indicate, totalize and transmit flow. The flow tube shall use a spool piece configuration with field-interchangeable sensors containing coils and electrodes. The flow velocity measured in the flow meter is converted through a microprocessor into a flow measurement recorded in conventional English units. Both instantaneous and cumulative flow will be recorded. The system will not lose memory and recorded flows if the power is interrupted. The transmitters will send a 4 to 20 mA signal to a programmable logic controller (provided by others) located in the administration building. The following schedule shows the size of the meters, location and cable length.

Schedule for Plant Flow Meters

Location	Size	Cable Length (ft)
Influent Line	16”	25 ft
Effluent Line	20”	25 ft
NPW Pumps	6.0”	25 ft
Sidestream LS	6.0”	25ft
Biosolids Discharge	6.0”	150 ft

1.03 SUBMITTALS

A. Submit Product Materials lists of items proposed to be provided under this section.

B. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

C. Shop drawings in sufficient detail to show fabrication, installation, anchorage and interface of the work of this section with the work of adjacent trades.

D. Manufacturer's recommended installation procedures which, when approved, will become the basis for accepting or rejecting actual installation procedures used on the work.

E. Operations manuals for each part or piece of equipment, suitable to instruct the operator in the use, calibration and programming of the flow measuring equipment. Four hard copies and one electronic copy of the manual will be required.

PART 2 - PRODUCTS

2.01 METER

A. Shall be a velocity sensing electromagnetic type flanged tube meter with sealed housing for 150 PSI working pressure (UM06). The meter sizes shall be as described in the schedule in the previous section 1.0 above, based on use of Ultra Mag™ MODEL UM06. The meters shall be equipped with a 9 digit digital totalizer reading in units of gpm and shall be accurate within 0.5% of actual flow. The meter assembly shall operate within a range of 0.2 FPS to 32 FPS and be constructed as follows: Meter Tube (Sensor) shall be fabricated stainless steel pipe and use 150 lb. AWWA Class “D” flat face steel flanges (UM06). The internal and external of the meter tube shall be blasted and lined with a NSF approved fusion bonded epoxy UltraLiner™, applied by the fluidized bed method. Meter tubes shall have a constant nominal inside diameter offering no obstruction to the flow. Electrodes shall be 316 stainless steel.

B. Other meter manufacturers will be considered if general compliance with these specifications can be documented and no specific changes in plant piping are required to address a different type of meter or meter with different hydraulic installation requirements.

C. Certifications

1. CE Certified (Converter only)
2. Listed by CSA to 61010-1: Certified by CSA to UL 61010-1 and CSA C22.2 No.61010-1-04
3. ISO 9001:2015 certified quality management systeM

2.02 MAG SHIELD

A. Shall be welded to the tube providing a completely sealed environment for all coils, electrode connections and wiring harness capable of NEMA 6P/IP68 operation.

2.03 SIGNAL CONVERTER

A. Shall be pulsed DC coil excitation type with auto zeroing. The converter shall indicate direction of flow and provide a flow rate indication and a totalization of flow volume for both forward and reverse directions. Both forward and reverse totalizers shall be electronically resettable. The flow meter converter shall be microprocessor based with a keypad for instrument set up and LCD displays for totalized flow, flow rate engineering units and velocity. The converter shall power the flow sensing element and provide galvanically isolated dual 4-20mA outputs. It shall be possible, in the test mode, to easily set the converter outputs to any desired value within the range. The 4-20mA scaling, time constants, pipe size, flow proportional output, engineering units and test mode values shall be easily set via the keypad and display. Four separate fully programmable alarm outputs shall be provided to indicate empty pipe, forward/reverse polarity (normally open/close), analog over-range, fault conditions, high/low flow rates, percent of range and pulse cutoff. The converter shall periodically perform self-diagnostics and display and resulting error messages. All set up and data and totalizer values may be protected by

a password. The flow transmitter shall operate on 120 VAC, 50/60 Hz line power. Typical power consumption shall be 10 W, including the sensors.

B. The converter shall be integrally mounted our remotely mounted up to 500 feet from the sensor, and shall be supplied in a rugged, watertight, dust-tight, corrosion resistant (NEMA 4X and IP67) cast aluminum, epoxy painted enclosure suitable for conduit connections. The enclosure shall include a polycarbonate window for viewing the LCD without opening the enclosure. Calibration will be completed at the manufacturer's location in accordance with customer supplied application-based requirements.

2.04 GROUNDING RINGS

A. Shall be 316 stainless steel and shall be supplied with the meter tube. For best performance grounding rings must be used.

2.05 POWER AND SIGNAL ISOLATION

A. The power supplied between the converter and the meter tube (sensor) and signal between the meter tube and the converter shall be isolated and placed in separate submersible cables.

2.06 SERVICE & SUPPORT

A. Supplier must have flow calibration laboratories and personnel to perform testing and certify calibration. Personnel must also provide instruction or training as required assuring meters are supported and maintained throughout the guarantee period. Classroom Training on the equipment shall follow the requirements in Section 01 79 00.

2.07 VOLUMETRIC TESTING

A. Testing of all meters must be performed and approved prior to shipment. The complete meter assembly and signal converter must be wet accuracy tested and calibrated. The test facility must be rigorously traceable to an accuracy of ±0.15% with the National Institute of Standards and Technology. If desired, the test shall be witnessed by the customer or their selected agent. A copy of the certified accuracy test record must be furnished at no charge to the customer.

2.08 ONE MANUFACTURER

A. Shall make all meter sizes and styles required for this contract. The meters shall be manufactured and tested in the United States.

PART 3 - EXECUTION

3.01 INSTALLATION/WORKMANSHIP

A. The meter tube, sensor and transmitter will be installed in accordance with the manufacturer's specifications.

B. Installation will be made similar to placing a short length of flanged end pipe in the line. The meter can be installed vertically, horizontally, or inclined on suction or discharge lines. The meter must have a full pipe of liquid for proper operation. Fluid must be grounded to the downstream flange of the sensor.

C. Any 90 or 45 degree elbows, valves, partially opened valves, etc. should not be placed closer than one pipe diameters upstream and zero pipe diameters downstream. All blending and chemical injection should be done early enough so the flow media is thoroughly mixed prior to entering the measurement area.

D. Meter shall be provided with a four written and one electronic copy of operating instructions.

3.02 PAINTING

A. Provide manufacturer's standard coating.

B. Finish coat under provisions of Section 09 90 02 – Mechanical Painting and Coating.

END OF SECTION 40 71 13

DIVISION 41

MATERIAL PROCESSING & HANDLING EQUIPMENT

SECTION 41 22 13.13
BRIDGE CRANE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope

1. This section specifies the Main Process Building bridge crane and Grit Building hoisting equipment.

2. Runway beams are part of the building steel package and are not included in this section. Crane runway rails (ASCE 30) are included in this package.

B. Crane Summary

1. Crane location - Main Process Building

a. Span: 40'-0"

b. Capacity: 3.0 Tons

c. Crane type: Single Girder Top Running (SGTR)

d. Classification: Crane shall be designed and constructed to CMAA Specification # 70 or #74, as applicable, for Class 1, Group C & D, Division 1.

e. Crane speed: 100 FPM, infinitely variable

f. Crane drive: Dual motor drive

g. Trolley speed: 65 FPM, infinitely variable

h. Trolley drive: Motorized

i. Bridge Speed: 100 FPM

j. Hoist speeds: 3.2 and 20 FPM, two speed

k. Hoist type: Electric wire rope

l. Hoist lift required: 29.00 Ft.

m. Control: Pendant from independent track on bridge

n. See Structural Drawings, starting at Sheet S4-7.

C. Work includes the following

1. Detailed design of completed crane system, including bridge, end trucks, trolley, hoists, cabling, controls, and all appurtenances specified hereinafter.

2. Shop drawings.

3. Fabrication of a complete crane.

4. Inspection and shop testing.

5. Documentation and schedules.

1.02 REFERENCES

A. Equipment furnished under this section shall, except as otherwise noted, comply in all respects with the requirements of the following standards:

B. OSHA Occupational Safety and Health Administration

1. Part 1926.554 - Overhead Hoists
2. Part 1910.179 – Overhead and Gantry Cranes

C. *CMAA Crane Manufacturer's Association of America

1. Specifications for Top Running Bridge & Gantry Type Multiple
2. Girder Electric Overhead Traveling Cranes - No. 70 (2004)
3. Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist - No. 74 (2004)

D. *ANSI/ASME

1. American National Standards Institute /
2. American Society of Mechanical Engineers
3. ANSI / ASME HST-4 - 1999 Performance Standard For Overhead Electric Wire Rope Hoists
4. ANSI / ASME B30.16 – 2003 Overhead Hoists (Underhung)
5. ANSI / ASME B30.2 - 2001 Overhead and Gantry Cranes
6. (Top Running Bridge, Single Or Multiple Girder, Top Running Trolley Hoist)
7. ANSI / ASME B30.11 – 2004 Monorails and Underhung Cranes
8. ANSI / ASME B30.17 – 2003 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)

E. NEMA National Electric Manufacturer's Association

F. NEC National Electric Code – 1999

1. Article 100, Article 240-1, Article 430-31, Article 430-51, Article 610-1, Article 610-31
    a. *Compliance to this standard is limited to the extent such standard is incorporated into and made mandatory by OSHA regulations.

1.03 SUBMITTALS

A. Shop Drawings And Equipment Data

1. Manufacturer's catalog data for hoist.
2. Dimensional drawings and details for bridge crane system.

3. Wiring schematics. – ship with crane

B. Operations And Maintenance Manuals (one set of Owner's manuals in paper and on CD rom)

1. Equipment function, normal operating characteristics, and limiting conditions.
2. Assembly, installation, alignment, and maintenance instructions.
3. Lubrication and maintenance instructions.
4. Guide to "troubleshooting".
5. Parts list.
6. As-built drawing.
7. Test results.

1.04 APPLICABLE STANDARDS

A. Contractor shall adhere to OSHA, state, and local safety guidelines, laws, rules, and regulations.

B. Contractor shall conform to all applicable ANSI, CMAA, and HMI specifications and/or standards.

C. Comply with CMAA specification 74 or 70, as applicable.

D. Long lead items [hoist, end trucks, drives and controls] will be ordered by contractor upon receipt of purchase order and credit approval. Steel will not be ordered until shop drawings and submittals have been approved by the customer.

E. All electric equipment shall be UL, CSA c/us or ETL labeled.

1.05 WARRANTIES

A. Provide one-year equipment warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. Bridge crane package systems shall be provided by: Anderson Service, Inc., 475 Moore Lane, Billings, MT 59101.

B. Hoist shall be R&M SPACEMASTER EX CLASS I, DIV 2 Ton electric wire rope type.

C. Identifying specific suppliers herein is not intended to limit competition, only to define an acceptable level of service and equipment quality. Pre-approval by the ENGINEER for "Or Equal" submittals will be required prior to bidding.

2.02 MATERIALS

A. Components Material

2.03 EQUIPMENT

A. Hoist And Trolley

1. Top-running and under-running single girder cranes shall utilize the Spacemaster EX low headroom or standard headroom electric wire rope hoists as manufactured by R&M Materials Handling Inc., Springfield, OH.
2. Top-running double girder cranes shall utilize the Spacemaster EX double girder trolley electric wire rope hoists as manufactured by R&M Materials Handling Inc., Springfield, OH.
3. The hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110% of the rated load.
4. Hoist and trolley motors shall be per 1.01B above, as applicable.
5. Hoisting motor(s) shall be two-speed/two winding squirrel cage type with a speed ratio of 6:1.
6. Hoisting motor(s) shall be totally enclosed with IP55 protection, minimum class F insulation, Klixon type bimetal switch for thermal protection and shall have a 60% ED rating.
7. Trolley shall be furnished with an adjustable frequency inverter drive and two- step or infinitely variable speed control for smooth acceleration and deceleration.
8. Trolley motors shall be inverter duty motors with minimum class “F” insulation and motor enclosures shall be TENV [totally enclosed non-ventilated].
9. Rotary cam type limit switch equipped with 4 micro-switches shall be provided. Limit switch shall provide upper and lower limit of hoist travel, hoist slow down prior to reaching upper limit and phase sequence supervision at upper limit. An additional block operated limit shall be included.
10. Hoist motor brake shall be DC disc type with adequate torque to stop and hold over 125% of the hoist rated load.
11. Large diameter rope drum with a minimum of 36:1 drum to wire rope diameter ratio. Groove depth shall be at least 35% of rope diameter. The rope drum shall be equipped with a rope guide to help keep the rope aligned in the grooves of the drum.
12. Wire rope shall be constructed from galvanized steel having a minimum safety factor of 5.
13. Hoist reeving shall be single reeved. Lateral hook drift shall not exceed 1/8 inch per foot of vertical travel on single reeved models.
14. The hoist nameplate is to carry a CSA c/us rating. The actual hoist control enclosure rating shall be at least equivalent to IP55 / NEMA 7 type.
15. Hooks shall be made of forged alloy steel (34CrMo4QT or 34CrNiMo6QT) and shall be fitted with a spring-loaded flipper-type safety latch.
16. Hoist shall have a duty rating suitable for the load class and load cycles of the application (reference appendix A).
17. AGMA quality class 12 machine cut, hardened and precision ground hoist gearing.

The gears inside the hoist gearboxes on models up to 5-ton capacity are lubricated by semi-fluid grease. On models over 5-ton capacity the gears inside the hoist gearbox are lubricated with semi-fluid grease or oil.

18. AGMA quality class 10, hardened and precision ground trolley drive gearing, lubricated by semi-fluid grease.
19. Trolleys shall have safety drop lugs and energy absorbing bumpers.

B. Bridge Girder

1. Bridge girder shall be per 1.01B above, as applicable.
2. Bridge girders shall be constructed from welded box girders or Structural beams, Steel, ASTM A36 or A992, as required.

C. End Trucks And Bridge Drive

1. End trucks shall be designed in accordance with CMAA specifications as applicable (reference appendix B).
2. End trucks shall be bolted to bridge girder.
3. Bridge drive shall be dual-motor (A-4 arrangement per CMAA).
4. Bridge drive shall be designed to stop the bridge within CMAA specifications.
5. End trucks shall be equipped with rail sweeps and energy-absorbing rubber bumpers.
6. Travel limit switches to be provided as necessary for safe operation.
7. Bridge shall be furnished with an adjustable frequency inverter drive and two- step or infinitely variable speed control for smooth acceleration and deceleration.
8. Bridge motors shall be inverter duty motors with minimum class “F” insulation and motor enclosures shall be TENV [totally enclosed non-ventilated].
9. AGMA quality class 10, hardened and precision ground bridge drive gearing, lubricated by semi-fluid grease.

D. Power Supply

1. Power supply for the hoist shall be 460 volt, 3 ph., 60 Hz. All power required for the operation of the hoist, trolley, and end trucks shall be developed from this source.
2. Runway electrification shall be 4-bar safety type rigid conductors as manufactured by Insul-8, Duct-O-Wire Company or Wampfler. Wall mounted disconnect switch and power to runway conductors provided by Electrical Contractor.
3. Cross bridge electrification shall be flat cable style festoon system with terminal box, multi-conductor cord, plug connectors (when available) and accessories. Cables are to be hardwired when plug connectors are not available.

E. Controls

1. Six-way operation, plug-in pushbutton pendant suspended from independent festoon track. Radio control may be quoted as an option.

2. Pendant shall include Start (momentary) button and Emergency Stop (push to maintain, turn to release) that controls a mainline contactor in the bridge control panel.
3. Pushbutton shall be clearly marked with hoist, trolley and bridge travel directions.
4. Hoist shall be 2 speed magnetic reversing type (standard) or variable frequency inverter control (optional) and the trolley and bridge controls shall be variable frequency inverter control (standard), as required per section 1.01.B.
5. Electrical control enclosures shall be IP55 or NEMA 7 type. Pushbutton enclosure shall have a rating of IP65, NEMA 7.

F. Labeling

1. Hoist and bridge beam shall be labeled with load rating.
2. A corrosion-resistant nameplate shall be fixed to the bridge with the following information:
    a. Name of manufacturer
    b. Mfg.'s model number and serial number
    c. Capacity
    d. Date of manufacture (month and year)

G. Painting

1. Hoist and trolley shall be factory painted (2-part epoxy) per manufacturer's standards with minimum 5 mil thickness.
2. Bridge shall be shop cleaned, primed, and painted per manufacturer's standards.
3. The following items shall not be painted:
    a. Rail surfaces in contact with wheels
    b. Wheel running surfaces
    c. Hoist wire rope
    d. Conductor bar, festoon cables and supports

PART 3 - EXECUTION

3.01 INSTALLATION AND INSPECTION

A. Inspect structure and crane rail erection for conformance with reviewed shop drawings and contract documents prior to installation of equipment. Bring nonconforming work to the attention of the customer prior to proceeding with crane installation. Non-conforming runway structure or installation must be corrected prior to load testing of crane system. Costs of delays or additional work due to nonconforming runway structure will be reimbursed by the Owner.

B. Bridge crane shall be installed in conformance with manufacturer's instructions and

inspected by a manufacturer's representative. Provide all necessary accessories to make bridge crane complete, usable, and capable of meeting the operating requirements specified in the Operating Requirements. Test, adjust and clean equipment for acceptance by Owner.

3.02 TESTING

A. All crane equipment shall be operated through a complete lift and lowering cycle and through a complete travel of the bridge and trolley to determine that the equipment shall perform smoothly and safely, and that pendant cable length is sufficient to permit operation from desired floor levels. All tests shall be carried out with the bridge crane equipment loaded at 125 percent of capacity. The bridge crane provider shall provide the test weight loads. Any defects shall be corrected by the bridge crane provider without any expense to the Owner.

3.03 USE BY CONTRACTOR

A. If crane is used by the Contractor, it shall be repaired, repainted, and otherwise refurbished to like new condition prior to its acceptance. The Contractor assumes all responsibility for operation and maintenance until the crane has been accepted by Owner.

3.04 CLEANUP

A. Upon completion of work, area shall be cleaned and restored to original condition, acceptable to the Owner.

3.05 WARRANTY

A. Warranty period is 12-months.

END OF SECTION 41 22 13.13

SECTION 41 65 13
TANK MOUNTED RECIPROCATING AIR COMPRESSOR

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the requirements for two tank mounted air compressors which will be installed with one located in the grit building near the garage door and one located near the garage doors in the main process building, as shown on the drawings. The compressor shall be anchored to the floor and the wall as per manufacturer's instructions.

1.02 SUBMITTALS

A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.

1. Manufacturer's data sheets and operating instructions.

PART 2 - MATERIALS

2.01 GENERAL

A. The compressor shall be splash lubricated reciprocating belt-driven compressor utilizing multi-finned cylinders, with cast iron cylinder (or liners), gasket free integral cylinder/ head to decrease the chance for oil leakage, aluminum alloy domed first stage piston, cast iron domed second stage piston, two compression rings, one oil ring, single unit disc valves, fan bladed flywheel, finned intercooler with pressure relief valve, tapered roller main bearings that support both ends of crankshaft, and centrifugal unloader for loadless starting.

B. Compressor shall be two stage, tank mounted with a 120 gallon vertical tank, and be rated for 34.8 CFM @ 175 PSIG

C. Supplier's reference for the compressor: Gardner Denver R-Series CASRSA VR10-12, or equal.

2.02 MOTOR

A. Electric motor shall be 10 HP, 1800 RPM, open drip-proof motor wired for 460 volt, 3-phase, 60 hz.

2.03 AFTERCOOLERS

A. Compressor shall be equipped with an air cooled aftercooler capable of reducing outlet air to within 20oF of ambient.

2.04 CONNECTIONS

A. Compressor shall be equipped with a discharge valve and flexible discharge connector.

2.05 RECEIVER TANK

A. Tank shall be an ASME coded air receiver rated for MAWP of 200 PSIG and shall be

equipped with pressure gauge and pressure relief valve.

2.06 CONTROLS

A. Compressor shall come furnished with the following controls/features:

1. Wall mounted Simplex controls,
2. Magnetic starter with thermal overload,
3. Oil monitor,
4. NEMA 1 Enclosure

2.07 REFRIGERATOR DRYER

A. Refrigerator Dryer shall be installed adjacent to air compressor. The Refrigerator Dryer shall be Gardner Denver GSRN40 or approved equal.

2.08 AIR FILTER

A. Air filters shall be High efficiency coalescing filter meeting the following requirements:

1. Particle removal down to 0.01 micron
2. Max. oil carryover 0.008 PPM w/w
3. Clean dry pressure drop 1.4 PSID
4. Oil saturated pressure drop 3.0 PSID
5. ISO 8573 (Class 1)

B. Air filter shall be Gardner Denver GIL70H or approved equal

PART 3 - EXECUTION

3.01 INSTALLATION/WORKMANSHIP

A. The compressors will be installed in accordance with the manufacturer's specifications. The equipment shall be adequately secured to the wall and the floor to prevent tipping during seismic events.

B. Provide Startup and Maintenance kit suitable for first year of operation including all required spare parts.

C. Equipment shall be provided with a four written and one electronic copy of operating instructions and warranty.

END OF SECTION 41 65 13

DIVISION 43

PROCESS GAS & LIQUID HANDLING, STORAGE EQUIPMENT

SECTION 43 11 33
BIOSOLIDS BASIN
ROTARY POSITIVE DISPLACEMENT BLOWERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete, ready for operation and field-test two (2) new rotary positive displacement blowers and appurtenances for the Biosolids Basin aeration system, as shown on the Drawings and as specified herein.

B. The entire blower package and its components shall comply with all applicable safety and environmental regulations.

1.02 SUMMARY

A. The Contractor shall furnish, install, connect and make functional (2) Biosolids Basin aeration blowers. The blower motors will be controlled by individual variable frequency drives (VFD's) supplied under Specification Section 26 29 23.

1.03 RELATED WORK

A. Valves, except as otherwise specified herein, are included in Division 40 – Process Interconnections - Valves and Appurtenances.

B. Instrumentation work, except as otherwise specified herein, is included in Division 40 – Process Interconnections – Instrumentation for Process Systems.

C. Electrical work, except as otherwise specified herein, is included in Division 26 - Electrical.

1. Section 01 33 00 – Submittal Procedures.
2. Section 01 40 00 – Quality Control.
3. Section 01 60 00 – Product Requirements.
4. Section 01 77 00 – Closeout Procedures.
5. Section 46 05 01 – Wastewater Equipment General Provisions

D. References

1. American Society of Mechanical Engineers
2. National Electrical Code
3. National Electrical Manufacturers Association
4. DEQ-2: Montana Department of Environmental Quality – Circular DEQ-2: Design Standards for Public Sewage Systems
5. NFPA 820: Comply with most current edition of National Fire Protection Association Standard for Fire Protection in Wastewater Treatment and Collection

Facilities for electrical equipment installed within boarders indicated on "Preliminary Site Plan.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following information:

1. Certified general arrangement drawings showing materials, details of construction, dimensions and connections.
2. Complete Blower Performance Data including:
    a. Actual Operating Speed (RPM)
    b. Capacity – scfm and icfm
    c. Design inlet conditions; pressure, temperature and relative humidity
    d. Discharge pressure
    e. dB(A) noise pressure level
    f. Blower Shaft HP, Motor HP, and Package HP
    g. Rated maximum pressure rise of blowers
3. List of recommended spare parts broken down into on hand parts and long term for 2 years operation and 3 to 5 years operation.
4. Descriptive Brochures
5. Performance Curves
6. Motor Data
7. Valves
8. ISO-1217 Factory Performance Test Results

B. Complete blower package operating and maintenance instructions professionally published, hard copy and electronic copy, shall be furnished for all equipment included under these specifications in accordance with Section 01 78 23 – Operation & Maintenance Data.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Package shall be Aerzen Generation 5 Delta Blower Model GM 35S or pre-approved equal.
2. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings.
3. The aeration blower system supplier shall warrant to buyer that all components furnished will be free from defects in materials and workmanship for a period of (24)

months from the date of shipment. In the event of material or workmanship failure, supplier shall either repair or replace the damaged or defective components or services or refund payments to buyer for the components or services found to be defective

4. The aeration blower system supplier shall be experienced in the manufacture, installation, and operation of specified aeration blower systems, as demonstrated by a minimum of (10) years in the aeration system business and a minimum of (50) installed aeration systems.
5. The blowers shall be covered by a warranty for 24 months from date of commissioning, or a maximum of 30 months from date of shipment.
6. Blowers, motors, bases, filters, gauges, valves, silencers, sound enclosures, and all other specified accessories and appurtenances shall be furnished by a single manufacturer or supplier to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components.
7. Drawing layouts, item weights and specification language for the blower assemblies are based on Aerzen. Modifications, including but not limited to, process, mechanical, electrical and structural modifications, required for other approved manufacturer's equipment may be necessary and shall be included in the Contractor's bid price.

1.06 DELIVERY, STORAGE AND HANDLING

A. All equipment shall be completely factory assembled, skid mounted, crated and delivered to protect against damage during shipment.

B. All exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

C. All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.

D. Delivered materials shall be stockpiled and stored at locations approved by the OWNER until required for installation. Materials shall be transported, delivered, stored and handled in accordance with manufacturer's instructions and the requirements of Section 01 60 00.

1.07 MAINTENANCE

A. Spare Parts

1. Furnish lubricating materials to allow for one year of operation. Lubricating materials shall be as recommended by the manufacturer.
2. Furnish the following manufacturer's recommended routine maintenance spare parts for each blower package provided:

a. Two (2) filter elements for integral inlet silencer

b. Lubrication for first year of operation

c. One complete set of matched belts

d. Two (2) fuses of each type supplied

e. Two (2) filter mats for blower control cabinet (Integrated OFC-VFD blower package)

f. One (1) tube of motor grease (40HP or larger)

3. Spare parts shall be properly bound and labeled for easy identification without opening the packaging.

1.08 WARRANTY REQUIREMENTS

A. The equipment manufacturer shall warrant the equipment being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. Warranty package components for a period of one (1) year. The warranty shall be in published form and apply to all similar units. A warranty offered by a representative will not be acceptable in lieu of the manufacturer's warranty. Multiple warranties for individual components shall not be acceptable.

B. Warranty period shall begin after completion of performance and operation testing or after written acceptance of the installation by ENGINEER, whichever occurs earlier.

PART 2 - PRODUCTS

2.01 BLOWER SYSTEM

A. The blower system shall include inlet filter, inlet silencer, inlet flex joint, blower, motor, sliding motor base, belts, sheaves, bushings, enclosure (if required), belt guard, discharge flex joint, discharge silencer, pressure relief valve, check valve, butterfly shut-off valve, discharge temperature gauge, discharge pressure gauge, filter restriction gauge which are all factory mounted to blower base as one unit. The blower system shall conform to the conditions listed below:

B. Blower System Data

1. Site Conditions

a.	Site Elevation:	3,028 ft. AMSL
b.	Maximum Air Temperature:	100 ºF
c.	Electricity:	460 volt, 3 phase, 60 Hz

2. Performance Conditions

a.	Air Flow per Blower:	1,100 scfm
b.	Discharge Pressure:	3.5 psig
c.	Sound Level:	68 dBA at 3' from unit outline – with enclosure

d. Enclosure: Yes

3. Quantities

a. Total Number of Blowers: 2

b. Number of Units: 1 at 40 hp Operational

c. Number of Units: 1 at 40 hp Standby

C. Blower packages shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and the selection of the components shall be based on a minimum useful life of 15 years and a Mean Time Between Overhauls of 5 years of continuous operation.

D. No special foundations shall be required. The blower packages will be installed directly on a concrete equipment pad without grouting the base frame. There shall only be 4 easily accessible anchor points.

E. Blower Casing

1. The blower casing shall be of one-piece construction, with separate sideplates that are bolted and pinned to the housing.

2. Materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions.

3. Minimum blower casing pressure rating shall be 36 psig.

4. Inlet and outlet shall be flanged connections.

5. The casing shall incorporate a proven means of pulsation cancellation.

6. The vibration level as measured at the blower casing, in the X/Y planes of the bearings, shall not exceed 0.5"/ sec RMS when operating at the specified maximum operating pressure and speed. The vibration level shall be checked at start-up and documented in the field start up report.

F. Factory Testing

1. Each blower stage shall be factory tested in accordance with ISO 1217 performance test to verify flow and brake horsepower at blower maximum conditions. A slip test shall not be acceptable.

2. The acceptance criteria are +5% tolerance on power and –5% tolerance on flow regardless of the size of the machine.

G. Rotors

1. Each rotor shall be of the “stiff” design with first lateral critical speed at least 120% of the maximum allowable operating speed.

2. The rotors shall be of the straight, three-lobe type, and shall operate without rubbing or liquid seals or lubrication.

3. Rotor/shaft shall be drop forged in one single piece of AISI 1045 or equivalent.

Cast, hollow rotors shall be capped, dust tight.

4. Open rotors are not acceptable.
5. The rotors shall be statically and dynamically balanced per ISO 1940 / ANSI S2.19 G6.3.

H. Bearings

1. Each rotor/shaft shall be supported by anti-friction bearings, and fixed to control the axial location of the impeller/shaft in the unit.
2. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls.

I. Timing Gears

1. The rotors shall be timed by a pair of single helical AGMA 12 quality gears with hardened and ground teeth; minimum AGMA service factor of 1.70.
2. Gears shall be mounted on the shafts with a tapered interference fit, and secured by a locknut.

J. Seals

1. Seal shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine.
2. Four rotary piston ring shaft seals, an oil slinger and an O-ring seal shall be provided at the point where the shaft passes through the sideplates.
3. Further provision shall be made to vent the impeller side of the oil seal to atmosphere to eliminate any possible carry-over of lubricant into the air stream.

K. Lubrication

1. The timing gears and the bearings shall be splash lubricated. Grease lubrication shall be not acceptable.

L. Oil Sight Glass

1. An oil sight glass shall be provided on the exterior of the noise enclosure so the operator can easily view the oil level.
2. Sight glasses inside the enclosure or that cannot be easily viewed by the operator shall not be acceptable.

M. Painting

1. Painting shall be per supplier’s standard meeting the following criteria:
    a. Except for machined sealing and machined mounting surfaces, the package shall be painted dark blue.
    b. Aluminum, stainless steel, and brass shall not be painted.
    c. The supplied motor shall not be over sprayed and will be supplied with the

motor manufacturer's standard protection and paint color.

d. Painted Cast Iron and Carbon Steel shall be Alkyd Resin Primer and Final coat with a total dry film thickness of 70 □m. Surface p

e. Sound enclosure shall be powder-coated polyester base total dry film thickness 80 □m.

f. Galvanized components shall only be painted with appropriate surface preparation

2.02 BLOWER ACCESSORIES

A. Inlet Filter / Silencer

1. Each package shall be supplied with one combination inlet filter and silencer.
2. The inlet filter silencer shall be mounted directly to the inlet flange of the blower.
3. The filter media efficiency must meet the requirements of ASHRAE 52.2 MERV7 50-70% @ 3-10 microns corresponding to EN779 G4.
4. The silencer portion shall be located upstream of the inlet filter.
5. The filter element shall be designed to trap dirt on the inside so that upon changing, dirt does not fall into the machinery.
6. Filter and silencer performance losses shall be included in the blower performance calculation.

B. Base Frame / Discharge Silencer

1. Each package shall be supplied with one combination base frame / discharge silencer.
2. The silencer shall be a chamber type design for maximum sound attenuation and shall not use fibrous or absorption materials of any kind.
3. The silencer shall be fabricated of a single shell of pressure vessel quality steel with continuous welds.
4. The silencer shall be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum blower operating pressure.
5. The silencer shall have a machined inlet connection where the discharge flange of the blower stage bolts directly to, with no intermediary pieces.
6. Discharge silencer performance losses shall be included by the blower vendor in the blower performance calculation.
7. The base frame shall be constructed from welded carbon steel or cast iron that shall be designed to maintain alignment of the blower internal components and the drive during operation.
8. The base frame shall be designed to resist distortion while being installed on vibration isolating mounts.

9. The blower manufacturer shall supply a stainless steel grounding lug fully welded to the base.

C. Flexible Connectors

1. Each package shall be connected to the plant piping via flexible connectors located downstream of the discharge silencer.
2. Flexible connectors shall prevent the transmission of noise and vibrations from the blower package into the piping.
3. Flexible discharge connectors shall be Proco Style 240, Type EE, EPDM, with a standard ANSI flange discharge connection, rated for 300 °F at 20 psig.

D. Electric Motor

1. Each package shall be supplied with a WEG manufactured TEFC, premium efficiency motor that shall operate on 460 Volts, 3 Phase, 60 Hertz current, 1800 RPM.
2. Motors shall be horizontal, foot mounted, rigid base, Torque NEMA B, Temperature rise Class B, TEFC IP55, water tight and dust tight enclosure.
3. Class F, inverter rated insulation, 3:1 constant torque VFD-duty.
4. All frame sizes shall be NEMA standard, suitable for overhung belt drive and with the conduit box location on top of the motor. IEC frame motors shall not be allowed.
5. The motor shall be mounted on a pivoting base to provide automatic tensioning of the belts.
6. The motor nominal rating after any corrections for ambient conditions shall be 10% above the maximum operating bHp.
7. The motor shall have a 1.15 service factor.
8. Motor windings shall be supplied with a normally closed thermostat, one per phase, wired in series to form a fail-safe motor protection circuit for the external fault circuit of the motor controller.
9. Motor shall be supplied with an Aegis SGR bearing protection ring on either the drive end or non-drive end of the motor to discharge capacitive induced shaft voltage.
10. Blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor.

E. V-Belt Drive

1. Each package shall be supplied with a V-belt drive that shall be of the high capacity type, oil and heat resistant.
2. Drive shall be designed for a minimum service factor of 1.4 times operating power (bHp), or 1.1 times the motor nameplate Hp, whichever is larger to allow a minimum of 1.4-service factor based on the maximum blower bHp.

3. Belt tensioning shall be automatic without the use of any devices or interaction on the part of the operator. Neither slide rails nor load-adjusting springs shall be used.
4. Sheaves shall be dynamically balanced regardless of the operating speed.

F. Belt Guard

1. The belt drive shall be guarded in compliance with OSHA regulations.
2. Portions of the guard shall be easily removable allowing for belt inspection and replacement.
3. Guard material shall be perforated carbon steel.

G. Vibration Isolators

1. Each package shall be supplied with vibration isolating feet with a minimum efficiency of 80%.
2. Blower manufacture shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required, nor shall any additional measures be required to reduce vibrations from the blower package being transmitted to the base or the piping.

H. Pressure Safety Valve

1. Each package shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve.
2. The safety valve shall be set to protect the blower from exceeding its maximum pressure rating, and shall be sized to pass 100% of the design flow.
3. The safety valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED.
4. The valve shall be manufactured by Aerzen.

I. Check Valve

1. Each package shall be supplied with one check valve that shall be installed on the discharge line.
2. The check valve shall be of the full-bore low pressure-drop, flapper type design with a steel body, and steel flap embedded in EPDM with full-contact seal.
3. The valve shall be removable without disturbing the piping.
4. Pressure losses produced by the check valve shall be included in the blower performance calculation.
5. The valve shall be manufactured by Aerzen.

J. Instrumentation

1. Each package shall be supplied with the following instrumentation mounted on a panel to be field installed next to the blower package:

a. Inlet Vacuum Gauge

i. Dwyer model 2040 with 4” dial and scale from 0 to –40 inches of water column.

ii. Gauge to function as a filter maintenance indicator.

b. Discharge Pressure Gauge

i. Aerzen model 32-0053-02 with 4” dial and scale from 0 to 20 psig.

ii. The pressure gauge shall have a stainless steel case and be glycerin-filled for pulsation dampening.

iii. A pulsation snubber shall be provided.

c. Discharge Temperature Gauge / Switch

i. Jumo type 8523-20-10 with 4” dial and scale from 32°F to 572°F

ii. NEMA 4 enclosure, 5A @ 250volt, SA 28 SPDT microswitch

iii. UL & CSA approved.

2. Blower shall be provided at a minimum with differential pressure switch, discharge temperature switch, and motor over temperature thermistors, pre-wired to manufacturer supplied controller mounted on or within the blower enclosure package. All contacts shall be normally closed and open on an alarm condition. Switches shall be rated for 5A at 120VAC minimum. All switches shall be individually wired to the junction box so that each individual alarm can be monitored separately by the SCADA system.

3. Each blower motor shall be wired to an individual VFD, supplied under Specification Section 26 29 23 which in turn, is wired to the Blower Building PLC (supplied by the Owner) which will monitor and protect the blower by disabling the Division 26 provided VFD in the event of abnormal operating conditions.

4. Blower drive motor shall have normally closed thermostats embedded in the windings with leads wired to the terminal box. See Division 26 for additional requirements.

5. Exterior inlet filter differential pressure switch shall be plumbed to measure the pressure difference between the inlet of the filter and the outlet of the filter. Switch shall alarm if the inlet filter differential exceeds 50 mb. The switch shall be wired to the terminal box.

6. The enclosure shall have SPST contacts that close on high temperature, rated 5 amps at 120 VAC minimum, wired to the terminal box.

7. Provide delay relay for cooling fan to allow fan to run for set time after blower motor power is de-energized, wired to the terminal box.

K. Each blower shall receive its initial oil filling at the factory. Oil to be fully synthetic Mobil SHC 629. For continuous discharge temperatures greater than 248°F, Mobil SHC

630.

2.03 ACCESSORIES

A. Provide all necessary fittings within manufacturer's enclosure. Any fittings and or valves necessary outside manufacturer's enclosure shall be shipped loose for installation by Installation Contractor.

B. Provide a split disc type check valve with cast iron or carbon steel body, silicone seal, and stainless steel spring. Check valve shall be wafer style.

C. Provide flanged filled expansion joints, Mercer Rubber Company 450, or equal, suitable for 300°F service and connection to the discharge silencer.

D. Provide butterfly valves with cast iron body; cast iron ASTM A126B with polyamide coating.

2.04 SURFACE PREPARATION AND PAINTING

A. All equipment shall be factory coated in accordance with manufacturers standard procedures.

2.05 ANCHOR BOLTS

A. Contractor shall provide anchor bolts of ample size and strength required to securely anchor each item of equipment in accordance with equipment manufacturer's requirements. Bolts, washers and hex nuts shall be AISI Type 304 stainless steel unless noted otherwise. Anchor bolts shall be adhesive-type stainless steel.

B. Anchor bolts shall be set by the Contractor using templates provided by the equipment manufacturer. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall install the blowers in accordance with the Manufacturer's written instructions.

B. The Contractor shall make all electrical and process connections to the blower package prior to the arrival of the manufacturer's representative.

C. The Contractor shall complete and return the Manufacturer's installation check list prior to having a Manufacturer's representative come onsite.

D. Representatives of the blower manufacturer shall verify and adjust blower and motor alignment.

E. Systems to be installed complete with all necessary connections, valves, pipes, and fittings.

F. Contractor responsible for adequate amount of pipe, fittings, valves, and appurtenances required to provide a complete and functional system.

G. Contractor shall complete all electrical power and control connections as specified in Division 26.

3.02 STARTING AND ADJUSTING

A. Manufacturer's Service

1. Each packaged blower shall be run for a minimum of fifteen minutes by Manufacturer prior to shipping.

2. Provide services of an Experienced, Competent and Authorized Representative of Manufacturer for a minimum of eight (8) hours. Additional Manufacturer services for starting and adjusting shall be the responsibility of the Contractor.

3. Reference Sections 01 40 00, 01 75 00 and 46 05 01 for additional requirements.

3.03 COMMISSIONING

A. Provide commissioning plan and meet additional requirements of Section 01 91 00. Contractor shall be responsible for providing any additional services of manufacturer's representative for functional and performance and operation testing if necessary for commissioning.

B. Performance and Operational Testing period shall demonstrate that the WAS holding basin aeration system as a whole will have the capacity to maintain dissolved oxygen concentration at, or above, the specified criteria.

3.04 FIELD TESTING

A. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide one (1) trip for a total of two (2) 8 hour days to verify the installation, conduct an acceptance test under actual operating conditions and train plant personnel in the proper operation and maintenance of the blower package.

1. The Manufacturer shall perform a physical check of the blower installation, perform safety checks, power up the equipment and perform functional testing.

2. The functional test shall consist of 4 hours of operation of each blower with vibration, temperature, and pressure readings as well as motor amp readings taken and recorded at 60-minute intervals.

3. The Manufacturer shall provide operations and maintenance training to the plant personnel. The training shall consist of 1 hour of classroom training using the Operation and Maintenance Manual for reference and 2 hours of hands on training at the blower package.

B. If required, Contractor shall make any changes, at his own expense, to the installation that may be necessary to assure satisfactory operation. Contractor shall be held liable for changes needed in the installation.

C. Manufacturer shall provide a written field test / start up report after completion of testing.

END OF SECTION 43 11 33

SECTION 43 23 13
MAIN LIFT STATION
HORIZONTAL SELF-PRIME CENTRIFUGAL PUMPING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this Section includes furnishing and installing three (3) equally-sized self-priming centrifugal pumps in the ***Main Lift Station*** that are capable of handling the peak hourly flow (6.062 MGD) with one pump out of service. Further performance requirements are outlined in 1.03.C below.

1.02 RELATED DOCUMENTS

A. Related sections include but are not limited to:

1. Section 01 30 00 – Submittals
2. Section 01 40 00 – Quality Control.
3. Section 01 60 00 – Common Product Requirements
4. Section 01 70 00 – Starting and Adjusting.
5. Section 01 78 23 – Operation and Maintenance Data.
6. Section 09 90 02 – High Performance Painting and Coating.
7. Division 26 – Electrical.
8. Section 40 27 20 – Process Valves
9. Section 40 27 00 – Process Piping - General
10. Section 40 27 10 – Process Piping Specialties.

B. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections apply to this Section.

1.03 PERFORMANCE CRITERIA

A. The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

B. The pump manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.

C. Pumps must be designed to handle raw, screened, domestic sanitary sewage. Pumps shall have 10” suction connection, and 10” discharge connection. Each pump shall be selected to perform under the following operating conditions:

1. Single Pump Capacity (gpm) 2,370

2. Single Pump Total Dynamic Head (ft) 71.9
3. Combined Two Pump Capacity (gpm) 4,210
4. Combined Two Pump TDH (ft) 88
5. Total Dynamic Suction Lift (ft) 11.5
6. Maximum Re-priming Lift (ft) 13.0
7. Single Pump Minimum TDH (ft) 64.5
8. Single Pump Maximum TDH (ft) 71.6
9. Maximum Static Suction Lift (ft) 11.25
10. Total Discharge Static Head (ft) 65.0

D. Pump Performance Certifications

1. Solids Handling Capability

a. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

E. Re-prime Performance

1. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

2. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic re-priming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be necessary.

3. Pump must be capable of re-priming ***13.0*** vertical ft. at the specified speed and impeller diameter. Re-prime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must re-prime and deliver full capacity within five minutes after the pump is energized in the re-prime condition. Re-prime performance must be confirmed with the following test set-up:

a. A check valve to be installed downstream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.

b. A length of air release pipe shall be installed between pump discharge and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.

c. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe

configuration for re-prime test shall incorporate a 2 feet minimum horizontal run, a 90° elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.

d. Impeller clearances shall be set as recommended in the pump service manual.

e. Repeatability of performance shall be demonstrated by testing five consecutive re-prime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.

f. Liquid to be used for re-prime test shall be water.

g. Upon request from the engineer, certified re-prime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

F. Certified Pump Performance Test

1. Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B at the specified head, capacity, rated speed and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity and speed.

1.04 SUBMITTALS

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit all the required copies of submittal data for review and approval.

2. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for slide rail components. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

3. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

B. Operation & Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual

covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

a. Functional description of each major component, complete with operating instructions.

b. Instructions for operating pumps and pump controls in all modes of operation.

c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, valves and piping.

3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.05 QUALITY ASSURANCE

A. The manufacturer of the pump station shall have a quality management system in place and shall be ISO 9001 certified.

B. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

C. All pump openings and passages shall be of adequate size to pass 3" diameter spheres (minimum) and any trash or stringy material which can pass through an average house collection system.

D. The manufacturer’s technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating

personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.06 MANUFACTURER'S WARRANTY

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. Fiberglass components of the station enclosure shall be warranted for 10 years to resist UV damage, corrosion from moisture or corrosive soils, or physical failures occurring in normal service, without the need for special protective coatings, when installed according to the manufacturer's recommendations.

2. The pumping units installed in this station are warranted for a period of five (5) years or 10,000 hours of operation from the time of shipment from the factory on a pro-rated basis. The conditions of this warranty are predicated on factory approved installation and start-up of equipment in permanent municipal waste water installation. This warranty covers failures due to defects in material and workmanship. The warranty does not cover normal wear and tear on equipment. The pump station manufacturer will pay a percentage of the list price for replacement parts in labor as follows provided the pump with cable attached is returned pre-paid in accordance with the instructions:

Pump Warranty Obligation

Months after Shipment	0-18	19-38	40-60
Hours of Operation	0-2,999	3,000-6,499	6,500-10,000
Mfctr. Share of the Costs	100%	50%	25%

3. All remaining equipment apparatus and parts furnished shall be warranted for a period of five (5) years, excepting those items that are normally consumed in service such as light bulbs, oil, grease, packing, gaskets, O-rings, etc. The pump manufacturer shall be solely responsible for the warranty of the pumps and all related components.

B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.

C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

D. The warranty shall become effective upon the acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

E. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single

supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

B. In order to unify responsibility for proper operation, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source) and that source shall be the pump manufacturer. The pumps must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

C. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.

D. The term "pump manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

E. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

F. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping, electrical and power-generating systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

G. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

H. The three (3) suction lift pumps shall be model T10-A-B with 14¾" impeller as

manufactured by Gorman-Rupp or approved equal. This specification is not intended to eliminate other products of equal quality and performance.

2.02 PUMP DESIGN

A. Pumps for the ***Main Lift Station*** shall be overhung, horizontal, flexibly-coupled, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. The pumps shall be properly selected with the necessary features to provide the performance characteristics outlined in section 1.03.C above. Pumps shall be the Gorman-Rupp model T10-A or approved equal.

B. The pump manufacturer shall be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

C. Materials and Construction Features

1. Pump casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

   a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

   b. Fill port cover plate, 3½" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, a clamp bar screw must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

   c. Casing drain plug shall be at least 1¼" NPT to insure complete and rapid draining.

   d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under part 1.03.C of this section.

2. Suction Head shall be Class 30 cast iron. Its design must incorporate following maintenance features:

   a. The suction head will be secured to the pump casing by using hex head cap screws and lock washers. Access to the impeller and mechanical seal shall be accomplished by removing the suction head.

   b. Removal of any blockages in the impeller shall be accomplished by removing the suction head, or through a cleanout cover on the suction head. In consideration of safety, two clamp bar screws must provide slow release of pressure on two clamp bars securing the cleanout cover. A Teflon gasket shall prevent adhesion of the cleanout cover to the suction head casing.

   c. Removal of the suction check valve shall be accomplished through the removable cleanout cover on the suction head.

   d. In consideration for safety, a pressure relief valve shall be supplied in the suction head. The relief valve shall open at 75-200 PSI.

   e. A replaceable ductile iron wear plate shall be secured up against the pump

casing by the suction head. Measurement of the clearance between this wearplate and impeller shall be accomplished through the cleanout cover plate.

3. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

    a. Seal plate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

        i. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

        ii. The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

        iii. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

    b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lock screw and conical washer.

    c. Impeller shaft shall be AISI 17-4 pH stainless steel.

    d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.

    e. Shaft seal shall be cartridge oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.

    f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt

threaded holes shall be sized to accept same cap screws as used for retaining rotating assembly.

4. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means.

    a. Clearances shall be maintained by using external shims between the casing ring of the rotation assembly and the pump casing itself. Shims will be of various sizes to allow precise adjustment of this clearance. The clearance can be measured by removing the cleanout cover on the suction head.

    b. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

5. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the cleanout cover on the suction head without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to re-prime after each pumping cycle. Pumps requiring a suction check valve to assist re-prime will not be acceptable.

6. Removal of the rotating assembly will be accomplished through the front or the back of the pump casing.

7. Continuous Vane Impeller with Self-Cleaning Wear plate

    a. The nature of the conveyed medium poses significant challenges to the continuous operation of the pump. Of particular concern is the clogging of the impeller by debris in the pumped medium including but not limited to long rags, fibers, and like debris which are able to wrap around the impeller vanes, stick to the center of the vanes or hub, or lodge within the spaces between the impeller and the housing.

    b. The pump impeller shall be a continuous vane extending from one edge of the impeller through the central portion of the impeller to the other edge. The impeller height shall increase continuously from the outer radius of to the central region of the impeller.

    c. The matching wear plate shall have one or more notches and/or recesses provided along a common diameter of the wear plate to disturb and dislodge any solids which might otherwise remain on the impeller in dynamic operation. Clusters of notches and/or recesses may also be provided.

D. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

2. No special tools shall be required for replacement of any components within the

pump.

2.03 MOTOR DESIGN

A. Each pump shall be equipped with an electric motor designed, manufactured, and tested in accordance with the latest revised edition of NEMA MG-1. Each pump shall be equipped with a variable frequency drive (VFD) to allow the motor controller to automatically ramp the lead and lag pump speed(s) up and down in correlation to the rate at which the lift station wet well level is rising or falling. Pump motors shall be compatible with VFD operation.

B. The motor shall be a squirrel-cage induction type, single-speed, horizontally mounted motor conforming to the following:

1. **75** Horsepower
2. Explosion Proof: Class 1, Division 1, Group B
    a. Explosion Proof Definition: An apparatus enclosed in a case which is capable of withstanding an explosion of a specified gas or vapor which may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and which operates at such an external temperature that a surrounding flammable atmosphere will not be ignited.
    b. Class 1, Division 1: A location in which ignitable concentrations of flammable gasses or vapors may exist under normal operating conditions; or a location in which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or a location in which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors, and might also cause simultaneous failure of electrical equipment.
    c. Group B: Hydrogen & manufactured gases containing hydrogen.
3. Insulation: Class F or better
    a. Maximum Operation Temperature Allowed: 155°C
    b. Allowable Temperature Rise 1.15 Service Factor Motor: 115°C
4. Synchronous Speed: 1800 RPM
5. Enclosure: TEFC or ODP
6. Service Factor: 1.15
7. Duty Cycle: Continuous
8. Ambient Temperature Rating: 40° C
9. Bearing Lubrication: Manufacturer’s Standard
10. Bearing Life: 50,000 Hours Rating Life as Defined by AFBMA Standards
11. High Efficiency Design with Nominal Load Efficiency of 90% Minimum.
12. Motor windings shall have embedded, normally closed thermal switch that will open upon excessive temperature.
13. Operating current shall be 480V, 3-Phase

C. Acceptable Manufacturers

1. Baldor

2. WEG
3. US Motor

2.04 ELECTRICAL CONTROL COMPONENTS

A. The pump station control panel will be tested as an integral unit by the pump system manufacturer.

B. Panel Enclosure

1. The electrical control equipment shall be mounted within a NEMA 1 stainless steel, dead front type control enclosure. The enclosure door shall be hinged and sealed with a neoprene gasket. It shall include a removable plated steel back panel on which control components shall be mounted. Back panel shall be secured to the ***interior wall of the Main Lift Station Building*** with uni-strut. Operator controls shall be mounted on the panel door. The control panel shall be equipped with vapor emission type corrosion inhibitors.

2. All components shall be of the highest industrial quality, securely fastened to a removable sub-plate with screws and lockwashers. The sub-plate shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component. All operating controls and instruments shall be securely mounted and shall be clearly labeled to indicate function.

3. A main terminal block and ground bar shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electrical Code (NEC).

C. Phase Monitor

1. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. A time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

D. Transient Voltage Surge Suppressor

1. The control panel shall be equipped with a transient voltage surge suppressor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps, and a Joule rating of 1500.

E. Motor Branch Components

1. A properly sized heavy duty, 3-pole circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating selected specifically for the pump motor electrical load at 480 volts.

2. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. A padlocking operating mechanism shall be installed on each motor

circuit breaker. Operator handles for the mechanisms shall be located on the door, with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position.

3. Variable Frequency Drives for the Main Lift Station pumps shall have a minimum of the following features:

    a. Embedded control technology that supports the manipulation of discrete outputs and drive control functions, while using discrete inputs and drive status information onboard the drive;

    b. Predictive diagnostics that track information affecting the life of the cooling fans and relay outputs;

    c. Built-in Ethernet port and communication module allowing direct transfer of control information between the VFD and the Main Lift Station PLC. This communication will allow the PLC to ramp the VFD's up or down in response to the rate at which the wet well liquid level is rising or falling;

    d. Built-in I/O, that can be expanded with option cards;

    e. Safe torque off, safe speed monitor and integrated safety-Safety Torque Off, providing a choice of safety levels

    The Main Lift Station VFD's shall be Allen-Bradley PowerFlex 750-Series AC Drives or pre-approved equal.

F. Other Control Components

1. The pump control panel shall be equipped to terminate pump operation due to high motor winding temperature or moisture in the motor housing and shall utilize the contacts in the pump motor. If either event should occur, the motor starter will drop out, and a mechanical indicator, visible on the door, shall indicate the pump motor has been shutdown. The pump motor shall automatically reset when the condition has been corrected. However, the mechanical indicator shall require manual reset. Dry contacts, wired to terminal blocks, shall be furnished for each pump for thermal/moisture shutdown.

2. The control circuit shall be protected by a normal duty thermal- magnetic air circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all control circuits.

3. Pump mode selector switches shall be connected to permit manual start and manual stop for each pump individually, and to select automatic operation of each pump under control of the liquid level control system. Manual operation shall override the liquid level control system. Selector switches shall be heavy duty, oil-tight design, with contacts rated NEMA A300 minimum.

4. Pump alternator relay contacts shall operate after pump shutdown. Relay contacts shall be rated 10 amperes minimum at 120 volts non- inductive.

5. Control panel shall be equipped with one oil-tight pilot light for each pump motor. Light shall be wired in parallel with the related pump motor starter to indicate that the motor is on or should be running.

6. Six digit elapsed time digital indicators (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours".

7. A switch shall be provided to permit the station operator to select automatic alternation of the pumps, to select pump number one to be the lead pump for each pumping cycle or to select pump number two to be the lead pump for each pumping cycle. Selector switch shall be oil-tight design, with contacts rated NEMA A300 minimum.

8. A duplex ground fault indicating utility receptacle providing 115 VAC, 60 Hertz, single phase current, shall be mounted on the door panel of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

G. Pump Start Delay

1. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

H. Wiring

1. The control panel, as furnished by the manufacturer, shall be completely wired. The contractor shall field connect the power feeder lines to the main terminal block, final connections to the remote alarm devices, and the connections between the pump and the pump motor control. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).

2. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color coded as follows:

a. Line and load circuits, AC or DC power	Black
b. AC control circuit less than line voltage	Red
c. DC control circuit	Blue
d. Interlock control circuit, from external source	Yellow
e. Equipment grounding conductor	Green
f. Current carrying ground	White
g. Hot with circuit breaker open	Orange

3. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be of 16 gauge minimum, type MTW or THW, 600 volts. Power wiring shall be 14 gauge minimum.

4. The ampacity of motor branch conductors and other power conductors shall not exceed the temperature rating of the connecting terminals. Wires shall be clearly numbered at each end in accordance with the electrical diagrams. All wires on the sub-plate shall be bundled and tied.

5. Wires connected to components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be provided to allow the door to swing to its full open position without undue stress or abrasion on the

wire or insulation. Bundles shall be held in place on each side of the hinge by mechanical fastening devices.

I. Conduit requirements are as follows

1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
4. Conduit shall be sized according to the National Electric Code.

J. Grounding

1. The pump control manufacturer shall provide a common ground bar mounted on the enclosure back plate. The mounting surface of the ground bar shall have any paint removed before making final connections.
2. The contractor shall make the field connections to the main ground lug and each pump motor in accordance with the National Electric Code.

K. Identification

1. A permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:
   a. Equipment serial number
   b. Supply voltage, phase and frequency
   c. Current rating of the minimum main conductor
   d. Electrical wiring diagram number
   e. Motor horsepower and full load current
   f. Motor overload heater element
   g. Motor circuit breaker trip current rating
   h. Name and location of equipment manufacturer
2. Control components shall be permanently marked using the same identification shown on the electrical diagram. Identification label shall be mounted adjacent to the device.
3. Switches, indicators, and instruments shall be plainly marked to indicate function, position, etc. Marking shall be mounted adjacent to and above the device.

L. Pump Start Delay

1. The control circuit for operation of the lag pump(s) shall be equipped with a time delay to prevent simultaneous motor starts.

2.05 LIQUID LEVEL CONTROL SYSTEM

A. The manufacturer of the liquid level control system shall have a quality management system in place and shall be ISO 9001 certified.

B. The level control system shall start, adjust the speed of, and stop the pump motors in response to changes in wet well level, as set forth herein.

C. Level Sensing Transducer(s):

1. The level control system shall include intrinsically safe, primary and backup **submersible level-sensing transducers**.

2. The level sensing transducer(s) shall be a non-fouling design with non-clogging PTFE coated elastomeric diaphragm, specifically designed for adverse environments encountered in wastewater applications.

3. Full scale (FS) range shall be 6' to 115' of H_2O – vented gage reference. Proof pressure shall be minimum 1.5 X FS and burst pressure shall be 2 X FS;

4. Static accuracy shall be ±0.25% FSO using the BFSL method;

5. Resolution shall be +0.0001% FS;

6. All wetted materials shall be 316 stainless steel or titanium; FKM; PTFE; polyurethane or ETFE - the unit shall have a protection rating of IP 68, NEMA 6P;

7. Thermal error shall be ±-.10% FSO/°C and the compensated temperature range shall be 0°C to 50°C;

8. Input current shall be 20 mA maximum;

9. Output shall be 4-20 mA, 0-5 VDC, 0-2.5 VDC;

10. Capability to re-zero after installation for optimum accuracy and the span shall not be affected;

11. Insulation resistance shall be 100 mega ohm at 50 VDC;

12. The transducer(s) shall be CE compliant (EN 61326-1:2013 and 61326-2-3:2013; UL, CUL and FM compliant – Class I, II, III, Div. 1, Groups A, B, C, D, E, F & G;

13. Cable pull strength shall be a minimum of 200 lb;

14. Cable shall have 4 conductors, each 22 AWG with a molded polyurethane cable seal;

15. Transducer(s) and cable assembly shall be the KPSI 705 as manufactured by TE Connectivity Sensors.

D. The level control system shall utilize a Programmable Logic Controller as per Specification Section 40 94 43 – Programmable Logic Process Controllers.

E. The level control system shall utilize a Human-Machine Interface (HMI) to provide: operational input into the Main Lift Station PLC; visualization of pump operational and performance status; reporting of events and logging measured values and alarms. The HMI shall be equipped with a minimum 12" touch screen

F. The level control system shall be provided with field-adjustable set points for speed reference commands. Setpoint adjustments will be made using the operator keypad on the controller HMI. The maximum field adjustable setpoint range is 0.0 ft W.C. to 8.4 ft. W.C.

G. The level control system shall utilize the alternator relay to select first one pump, then the second pump, then the third pump to run as lead pump for a pumping cycle. Alternation shall occur at the end of each pumping cycle.

H. Upon operator selection of "Automatic", the lead pump shall start when the wet well level rises to the "lead pump start level". *The pump shall start at a prescribed speed and ramp up and down in response to the speed at which the liquid level in the wetwell rises or falls. Sensing and responding to the rate of rise and fall of liquid level in the wet well shall be intrinsic to the control system operating protocol*. A rising wetwell level will induce the control system to increase the pump speed through control of the VFD typical operating range. A falling wetwell level will induce the control system to decrease the pump speed through control of the VFD typical operating range. The lowest VFD range shall be determined by the pump manufacturer such that it will not result in damage to the pump through lack of cooling. When the wetwell level reaches the "lead pump stop", the controller shall stop the lead pump. These actions shall constitute one pumping cycle. Should the wetwell level continue to rise at the lead pump maximum VFD frequency, the controller shall start the lag pump when the "lag pump on" level is reached. At this point, the operating pumps shall ramp up until the rpm's match, after which, all pumps shall ramp up and down together in response to the speed at which the liquid level rises or falls. Once the wetwell level reaches the "lead pump stop" level, the controller shall stop all operating pumps and the typical lead pump control scenario shall be re-instituted.

I. On loss of power, pumps and VFD's shall restart upon restoration of either auxiliary or line power.

J. The level control system shall activate the "high water alarm" in the event that water level continues to rise to a pre-determined setpoint after the "lead" and "lag" pumps have been activated. High water alarm shall provide a signal to the plant SCADA system that requires a manual reset at the Main Lift Station control panel.

K. The level control system shall alert the operator of a low liquid level in the event the wet well level reaches the preset low water alarm set point where the alarm contact will energize an alarm relay. The controller will flash a low water alarm banner on the HMI screen to indicate such. Low water alarm will also cause interruption of electrical power to all pump motors. Power will be automatically be restored to the motors, without manual reset, when the wet well level rises to the "lead pump on" and the typical lead pump control scenario shall be re-instituted.

L. The control system shall permit silencing of the alarm functions during corrective actions. After silencing the alarm, manual reset of the alarm relay provides automatic reset of the alarm silence circuit.

M. The level control system shall utilize a primary level-sensing transducer with redundant transducer backup for: "lead pump start"; "lag pump start"; "lead pump stop" and "high water level alarm".

2.06 CONTROL PANEL OUTPUTS

A. The ***Main Lift Station*** control panel shall have the following outputs to the Main Lift Station PLC:

1. Pump #1 running

2. Pump #2 running
3. Pump #3 running
4. Pump #1 VFD fault
5. Pump #2 VFD fault
6. Pump #3 VFD fault
7. Pump #1 motor high temp
8. Pump #2 motor high temp
9. Pump #3 motor high temp
10. High water level
11. Low water cut-out
12. High water – Activated/running on backup transducer
13. Pump control panel phase failure
14. Pump panel control power confirmation
15. Generator running
16. Power fail

Note that the Main Lift Station PLC will also have inputs from the Screening Building – covered elsewhere in these specifications.

B. Control panel output voltages shall be as determined by Division 16 and as shown on the project drawings.

2.07 INSTALLATION, STARTUP AND TRAINING

A. The pump and motor manufacturer will furnish services of a factory-based engineer for one (1) eight (8) hour day to check the pump and motor installation, make any field adjustments necessary to insure proper mechanical operation, and instruct plant operations personnel on equipment supplied.

B. The pump and motor manufacturers shall submit written report for record certifying that equipment has been satisfactorily installed and lubricated. The report shall also certify that training has been provided for operation and maintenance of the blower equipment.

C. Factory Testing – The pump and motor supplier shall supply certified performance test data based on a factory shop test. A certified test report, signed by a professional engineer, shall be submitted for record.

D. Seismic Bracing – Each pump and motor shall be supplied with all support systems necessary to meet seismic requirements in accordance with ASCE 7-10, Chapter 13, utilizing the following seismic design parameters : SDS = 0.604g, SD1 = 0.389g, Ip = 1.00." At a minimum, the pump and motor units shall be supplied with an anchorage system suitable for mounting to the existing steel equipment base as indicated in the drawings. Contractor to coordinate anchorage system with pump and motor manufacturer, prior to placing equipment base.

2.08 CONTROL PANEL OUTPUTS

A. The ***Main Lift Station*** control panel shall have the following outputs to the Main Lift Station PLC:

1. Wetwell level (transducer)
2. Transducer failure – backup transducer in service
3. Low water alarm
4. Lag pump off
5. Lead pump off
6. Lead pump on
7. Lag pump on
8. High water alarm
9. Pump Speed (per pump)
10. Pump overheat (per pump)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, contractor shall inspect complete pump and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all pump serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. Install, level, align, and lubricate pump(s) as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

E. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

3.03 FIELD QUALITY CONTROL

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, drives, and control

systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable, it is safe and in optimum working condition, and conforms to the specified operating characteristics.

2. After construction debris and foreign material has been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

END OF SECTION 43 23 13

SECTION 43 23 31
VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. These specifications are intended to cover the furnishing of two complete motor-driven vertical turbine pumps for the City of Whitefish. The pumps will be used to supply a non-potable plant water system supplying process water for utilization at the wastewater treatment facilities and irrigation. The water to be pumped will be treated and disinfected wastewater coming directly downstream from an ultraviolet disinfection system. VFD motor controls and a storage tank will be used with the pumps. However, pressure control will also be used to initiate pump operation. Pumps shall be Peerless Model 7B Vertical Turbine pumps or approved equal.

B. Installation will be made by the general contractor. Pumps shall be mounted on reinforced concrete pads. Pumps shall be vertical turbine type operating under the service conditions specified. No consideration will be given to equipment which has not demonstrated its reliability and efficiency through results obtained from operation of similar units of approximately the same capacity and type under similar circumstances. The general design shall be such that all components may be easily disassembled and that replacement parts are readily available. The contractor/manufacturer shall review pumping conditions and verify that the provided pumping system will meet design conditions.

C. All combinations of manufactured equipment which are approved under this specification shall be entirely compatible and the CONTRACTOR and the listed manufacturer shall be responsible for the compatible and successful operation of the various components of the units conforming to the specified requirements. All necessary mountings, couplings, and appurtenances shall be included with each unit. All materials employed in the pump equipment shall be suitable for the intended application and shall be high grade commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

D. Should the equipment selected by the CONTRACTOR require revisions to the structures, piping, electrical, or other work shown on the drawings, the CONTRACTOR shall include the cost of such revisions in his bid for the equipment, and no extra payment shall be made for such revisions. All such revisions shall be submitted for OWNER approval, and shall be subject to the approval of the ENGINEER.

1.02 OPERATING CONDITIONS

A. Size of sump (usable volume) 1640 gallons

B. Depth of sump 5.875 ft

C. Minimum wetwell level 1.6 ft

D. Total pumping head (4 plus 5) 150 ft

E. Capacity of pump 160 gpm

The total pumping head does not include losses in the pump, which must be allowed for by the bidder. The efficiency of the pumping unit shall be as high as correct design and good engineering will permit. All things being equal, consideration will be given to overall pumping costs.

1.03 MOTOR DRIVER

A. The motor shall be NEMA standard design B, Vertical Hollow Shaft high thrust, WP-1 enclosure, 1770 RPM, squirrel cage induction cross the line type starting used with VFD, powered by an electrical service rated at 480 volts, 60 hertz, 3 phase. Each motor shall be capable of driving the pump under all head conditions without exceeding the rated capacity of the motor. Motor shall have class B insulation, 1.15 service factor rated 40 degrees C ambient, 80 degrees C rise at service factor load. Motor shall be supplied with a non-reverse ratchet. Motor shall conform to IEEE and NEMA, standards. Motor design shall be premium efficiency style and appropriate for use with VFD controls.

B. The motor thrust bearing shall be designed to carry the hydraulic thrust plus the weight of the shaft and the impellers. The thrust bearing life expectancy shall have a five year average rating based on 24 hours per day usage. The motor shall be capable of carrying momentary up thrust equal to approximately 30% of the total down thrust. Bearings shall be oil or grease lubricated as per manufacture's standard design.

C. Each motor shall be provided with a corrosion-resistant nameplate giving the name of the manufacturer, horsepower, voltage, frequency, speed, efficiency and current for unit at full load.

1.04 DISCHARGE HEAD ASSEMBLY

A. Discharge head shall be of cast iron, surface discharge with 125/150# ANSI dimension discharge flange and shall support the motor, column, shafting, and pump bowl assembly. The discharge head shall be mounted on a fabricated steel sole plate (landing plate for deep well installations) which shall be anchored to a concrete pad over the sump or well. The bottom surface of the head shall be machined smooth. A tapped drain line connection shall be provided for the removal of the excess water to a drain, plus taps for pressure gages shall be provided.

B. A cast iron stuffing box shall be provided with a bronze removable stuffing box bushing, 316 stainless steel split gland, T-bolts with stainless steel clips and brass nuts. Stuffing box shall utilize a minimum of five synthetic (Garlock 8913 or equal) packing rings, compressed around the pump shaft and lubricated by the pumped water.

C. A two piece top shaft shall be threaded and coupled just above the stuffing box (on column setting 50 feet or less).

D. Lifting lugs shall be integral with the discharge head, and be capable of supporting the entire weight of the pump assembly unless a landing plate is furnished which supports the column and bowl assembly weight.

1.05 COLUMN ASSEMBLY

A. Column pipe shall be furnished in interchangeable sections not over 10 feet in length and shall be connected with threaded sleeve type couplings or flanges for larger diameters. The actual column lengths shall be determined by the pump manufacturer, calculated so that the bearing spacing intervals shall not allow operation within +/-20% of the first critical speed. The friction loss in the column shall not exceed 5 feet per 100 feet of column, based on the rated capacity of the pump. The weight and size of the column shall be no less than required in AWWA Spec E101-1. The line shafting shall be AISI 416 stainless steel of ample size, a minimum of 1.00" diameter, to operate the pump without distortion or vibration.

B. Carbon steel shafting with glued on, sprayed, or set screw mounted sleeves shall not be acceptable in Open Line Shaft, OLS service. In abrasive service or in deep wells, Enclosed Line Shaft (ELS) design shall be used when lubricated by oil or if clean flushing water is available.

C. OLS lines shafts shall be furnished in interchangeable sections not more than 10 feet in length and shall be coupled with AISI 410 stainless steel couplings. The column assembly shall have bronze drop in bearing retainers retained by the butted pipe ends or column flanges. For larger column sizes, weld-in fabricated steel bearing retainers will be utilized. Bearing retainers of cast iron shall not be acceptable. Each bearing retainer shall contain an easily removable, water-lubricated, cutlass rubber bearing designed for vertical turbine pump service.

1.06 PUMP BOWL ASSEMBLY

A. The pump bowls shall be of close grained cast iron, having a minimum tensile strength of 30,000 pounds per square inch, free from blow holes, sand holes, and all other faults. Bowls shall be accurately machined and fitted to close dimensions. Bowls are to be coated inside with a smooth vitreous enamel to reduce friction losses; corrosion and sand wear in the water passages and thus give better efficiency. Each intermediate bowl shall be constructed by using both a bronze bearing and a neoprene bearing to support the impeller shaft, thus giving the longest possible life, based on the widest range of pump conditions. All bowl fasteners shall be of stainless steel.

B. Bowls shall be fitted with a resilient neoprene ring, reinforced with an imbedded steel core, installed in the bowl directly below the impeller skirt. This lateral bowl wear ring is to reduce the wear of the impeller skirt, and maintain the as new capacity and efficiency by periodic adjustment of the lateral clearance from top shaft nut at the top of the motor.

C. The impellers shall be of the enclosed type, only made of ASTM B148 C952 aluminum bronze, and accurately machined, finished, and balanced. Semi open impeller designs are strictly prohibited. Impellers shall be securely fastened to the impeller shaft with steel taper lock bushing or split rings and keys for larger bowls. The impeller shaft shall be of stainless steel of not less than 12% chrome. The impeller shaft shall be supported by a combination of water lubricated, fluted rubber and bronze bearings.

D. The suction bell/manifold shall incorporate an integrally cast bearing housing with an SAE 660 bronze bearing and cast iron manifold plug. The suction bell bearings shall be permanently packed with grease (unless in abrasive service then a clean water flush is required).

E. Sand collars of bronze shall be provided for protecting both the suction bell/manifold bearings and the top bowl bearings from abrasives in the water being pumped which could settle when the pump is idle.

1.07 STRAINER

A. The suction bell/manifold shall be fitted with a clip-on basket type strainer or vortex suppressor of 316 stainless steel. The openings in the strainer shall be of proper size to exclude anything large enough to clog the impeller. The open area of the strainer shall not be less than four times the impeller eye area. All mounting hardware for clipping the strainer to the suction shall be 300 series stainless steel.

1.08 COATINGS

1. The pumping unit shall be provided with a high quality epoxy factory applied coating suitable for protecting the pumping unit from corrosion and general wear and tear. The coating shall be warranted for at least five years.

1.09 FACTORY ASSEMBLY

A. Close coupled vertical pump(s) shall be factory assembled if the overall length does not exceed 20 feet from top of discharge head to bottom of suction casing. The motor(s) and motor shaft of the two-piece top shaft shall be shipped un-mounted for field installation by contractor. Longer pumps shall be shipped for assembly in the field.

1.10 PUMP REQUIREMENTS - GENERAL

A. Pressure Gauges. Pressure gauges shall be installed on all pump discharge lines via a brass nipple with ball valve installed in the respective pumps' discharge piping. The pressure gauges shall be oil-filled *2.0"* diameter minimum and accurate to one-half percent of full-scale.

B. Air Release Valve. An air release valve sized as shown on the Contract drawings shall be installed on the discharge head for the purpose of venting accumulated air. The valve shall be Valmatic Well Service Air Release Valve VM-l OOST-S or approved equal.

1.11 START-UP PROCEDURE

A. The pump and motor shall be installed in strict compliance with the pump manufacturer's instructions. The correct motor rotation shall be confirmed prior to installing the top shaft and the impeller lateral adjustment shall be in accordance with the pump manufacturer's instructions. Pumping capacity at design conditions shall be verified.

1.12 TESTING

A. The bowl assembly shall be performance tested in the pump manufacturer’s test lab prior to shipment. Testing will include checking the equipment at sufficient conditions of head and capacity as to firmly establish the actual performance curve of each pump using the Affinity Laws. The limitations and guidelines of ANSI/HI 14.6 Grade 2B shall govern the testing procedures and the correlation of all test data. All test instruments and gauges shall be regularly calibrated within the guidelines of the Hydraulic Institute by the pump manufacturer. Testing of pumps shall be performed with a calibrated dynamometer or with calibrated test motors provided by the pump manufacturer. The curves generated as a result of this testing shall include the pump capacity, total dynamic head, calculated efficiency, brake horsepower, and the equipment operating speed. Certified copies of all test results shall be provided with the order.

END OF SECTION 43 23 31

SECTION 43 41 43
DOUBLE WALL POLYETHYLENE STORAGE TANKS

PART 1 - GENERAL

1.01 REQUIREMENTS

A. The CONTRACTOR shall provide a double wall high density cross-linked polyethylene tank and accessories per section 2.05, complete and in place, in accordance with the Contract Documents. The tank will be located in the grit handling building and will be used for storage of liquid alum. The tank will be filled with an auxiliary pumper truck.

1.02 REFERENCES, CODES AND STANDARDS

A. American Society of Testing Materials (ASTM).

1. D638 Tensile Properties of Plastics
2. D883 Standard Definitions of Terms Relating to Plastics
3. D1505 Density of Plastics by the Density-Gradient Technique
4. D1525 Test Method for Vicat Softening Temperature of Plastics
5. D1693 ESCR Specification Thickness 0.125" F50-10% Igepal
6. F412 Standard Terminology Relating to Plastic Piping Systems

B. ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings

C. Building Code: International Building Code, IBC 2009

D. ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure)

E. NSF/ANSI Standard 61, AWWA – Drinking Water System Components

F. ASTM D-1998, Standard Specification for Polyethylene Upright Storage Tanks

1.03 SUBMITTALS

A. Shop Drawings: Shop drawings shall be approved by the engineer or contractor prior to the manufacturing of the SAFE-Tank® double wall tank(s). Submit the following as a single complete initial submittal. Sufficient data shall be included to show that the product conforms to Specification requirements. Provide the following additional information:

1. SAFE-Tank® double wall tank and Fitting Material
    a. Resin Manufacturer Data Sheet
    b. Fitting Material
    c. Gasket style and material
    d. Bolt material
2. Dimensioned Tank Drawings

a. Location and orientation of openings, fittings, accessories, restraints and supports.

b. Details of manways, flexible connections, and vents.

3. Calculations shall be stamped and signed by a registered, third party engineer in the state of the installation.

a. Wall thickness. Hoop stress shall be calculated using 600 psi @ 100 degrees F.

b. Tank restraint system. Show seismic and wind criteria.

B. Manufacturer’s warranty

C. Manufacturer's unloading procedure (see Poly Processing Company Installation Manual)

D. Manufacturer's installation instructions (see Poly Processing Company Installation Manual)

E. Supporting information on Quality Management System.

F. Manufacturer’s Qualifications: Submit to engineer a list of 5 installations in the same service as proof of manufacturer's qualifications.

G. Electrical heat tracing and foam insulation data sheets as required.

H. Factory Test Report

1. Material, specific gravity rating at 600 psi @ 100 degrees F. design hoop stress.

2. Wall thickness verification.

3. Fitting placement verification.

4. Visual inspection

5. Impact test

6. Gel test

7. Hydrostatic test

1.04 QUALITY ASSURANCE

A. The Contractor shall supply SAFE-Tank® double wall tanks of the high density cross-linked polyethylene or approved equal. Tanks furnished under this Section shall be supplied by a company who has been regularly engaged in the design and manufacture of chemical storage tanks for over 10 years.

B. Tanks shall be manufactured from virgin materials.

1.05 WARRANTY

A. A limited 5 year full replacement warranty shall be provided for the specific service application. A copy of the warranty will be provided with the submitted shop drawings for the tank.

PART 2 - PRODUCTS

2.01 GENERAL

A. Tank shall be rotationally-molded, high density cross-linked polyethylene, double wall, flat bottom tanks. The assembly consists of one cylindrical, closed top inner primary tank and one cylindrical, open top containment outer tank. Each tank is a rotationally molded one-piece seamless constructed tank. The tanks provided are to be designed for above-ground, vertical installation and are designed to store approved chemicals at atmospheric pressures. The assembly shall be designed to prevent rainwater and debris from entering the containment tank. Tanks shall be adequately vented as prescribed in Poly Processing Company's Technical Bulletin, Venting-Design for ACFM (air cubic feet per minute) considering the piping sizes used on the drawing. Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories. Tanks shall be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

2.02 MANUFACTURER

A. Tank shall be manufactured by Poly Processing Company or approved equal.

2.03 POLYETHYLENE STORAGE TANKS

A. Service: Chemical storage tanks shall be suited for the following operating conditions:

B. High Density Cross-linked Polyethylene resin used in the tank manufacture shall be Poly CL™ or equal and shall contain ultraviolet stabilizer as recommended by resin manufacturer. Where black tanks are indicated, the resin shall have a carbon black compounded into it. The tank material shall be rotationally molded and be a resin that is commercially available at the time of tank manufacture.

C. For sodium hypochlorite and sulfuric acid storage, resin shall include additional medium density polyethylene (OR-1000) with four times the antioxidant properties of a standard polyethylene bonded to the interior surface during the manufacturing process.

D. Wall thickness for a given hoop stress is to be calculated in accordance with ASTM D 1998. Tanks shall be designed using a hoop stress no greater than 600 psi. In NO case shall the tank thickness be less than design requirements per ASTM D 1998.

1. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

$$T = P \times OD/2SD \quad \text{or} \quad 0.433 \times SG \times H \times OD/2SD$$

Where:

T	=	wall thickness, in
P	=	pressure, psi
SG	=	specific gravity, gm/cc
H	=	fluid head, ft
OD	=	outside diameter, ft
SD	=	hydrostatic design stress, 600 psi

a. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187" thick.

2. On closed top tanks the top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall. In most cases, flat areas shall be provided for attachment of large fittings on the dome of the tank.

3. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be:

Tank Diameter, ft	Min Knuckle Radius, in
less than or equal to 6	1
greater than 6	1-1/2

4. Tanks with 3000 gal capacity or larger shall have at least 3 lifting lugs. Lugs shall be designed for lifting the tank when empty.

   a. Unless otherwise indicated by Contract drawings, for indoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with an emergency pressure relief device or SAFE-Surge™ Manway with pressure relief at 6" water column to prevent over-pressurization. The SAFE-Surge manway shall be chemically compatible with the chemical being stored. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.

   b. Unless otherwise indicated by Contract drawings, for outdoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with Poly Processing Company's F.S.2650® combined manway and vent to prevent over pressurization of tank. Manway must be capable of relieving a volume flow rate of up to 2650 ACFM. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.

   c. Unless otherwise indicated, tanks less than 2000 gallons in non-pneumatic applications shall have a manway cover 17-in or smaller of Polyethylene material with a coarse thread. Gaskets shall be closed cell, cross-linked polyethylene foam, viton or EPDM materials.

NOTE: Tanks must be vented to allow for performance at atmospheric pressure, in accordance with the following matrix:

Venting Requirements For Polyethylene Tanks

Mechanical Pump Fill	**Pneumatic Fill**								
IF ≤ 1000 gallons	**IF** - Vent length ≤ 3 feet			**IF -** Vent length > 3' and ≤ 30'			**IF** - Scrubber Application		
Vent size should equal size of largest fill or discharge fitting	**AND - Vent** screen mesh size ≥ 1/4" or no screen used			**AND -** 3 or less 90° elbows with no other restrictions or reduction in pipe size			**Vent pipe size throughout scrubber system CANNOT be reduced!** Centerline of dispersion pipe not to be submersed > 6 inches		
IF > 1000 gallons	**Emergency Pressure Relief Cover Required**			**Emergency Pressure Relief Cover Required**			Perforated dispersion pipe must be same diameter or larger, as vent. Sum of perforations ≥ cross sectional area of pipe		
Vent size should exceed the largest fill or discharge fitting by 1 inch	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size
	2"	2"	4"	2"	2"	6"	2"	2"	6"
	3"	2"	6"	3"	2"	6"	3"	2"	8"
	3"	3"	6"	3"	3"	8"	3"	3"	10"

(2) 2 inch vents **DO NOT EQUAL** 4 inch venting capacity rev. Nov 2006

For detailed venting guidelines, please visit our Technical Resources at www.polyprocessing.com

E. Tank colors shall be natural (un-pigmented), black (compounded), or as specified by the ENGINEER with written agreement by the tank manufacturer.

2.04 TANK ACCESSORIES

A. Ladder:

1. A standard FRP access ladders shall be provided with the polyethylene chemical storage tanks at locations as shown. Safety cages shall be added to ladders only if required, per OSHA.

2. Ladders must be secured to the tank and secured to the concrete to allow for tank expansion/ contraction due to temperature and loading changes. Use proper chemical resistant materials when anchoring to tank dome or sidewall. See Poly Processing Company's Tank Installation Manual.

3. All ladders shall be designed to meet applicable OSHA standards. Reference:

OSHA 2206; 1910.27; fixed ladders.

B. Restraint System:

1. Metal components to be stainless steel, edge softeners and tension ring with stainless steel, cables and clamps.

2. Tank restraint system shall be supplied and the design of same certified by a Structural Engineer registered in the State of tank installation. Design shall conform to the most recent edition of the IBC code for seismic and wind load. Anchor bolts as required by the calculations shall be supplied by the tank manufacturer.

C. Leak Detection System

1. Provide a PolyLevel optical visual/audio leak detection system complete with leak sensor and alarm. Sensor shall be LevelPro LDS-YN series installed between tank walls near bottom as per manufacturer's instructions.

2. Alarm shall be installed in a Nema 4X enclosure and connected to 120 VAC receptacle.

3. Provide sufficient cable to install enclosure on wall adjacent to chemical storage tank. Install as per manufacturer's instructions.

2.05 TANKS

A. Tank Schedule per the following specifications

1. 4385 gallon tank, excluding dome approximately 10.0' in height and 10'2.5" in diameter.

B. Fittings

1. Tank fittings shall be according to the fitting schedule in 2.05B above. Threaded fittings shall use American Standard Pipe Threads. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.

2. Bolted flange fittings shall be constructed of one 150 lb. flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts to have chemical resistant polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. Stud bolt heads are to be color coded for visual ease of identifying the bolt material by onsite operators. Green- 316 Stainless Steel, Black- Titanium, Red- Alloy C-276, Blue- Monel. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.

3. For sodium hypochlorite and sulfuric acid storage, Bolted One-Piece Sure Seal (B.O.S.S.), double flange fittings constructed of virgin polyethylene shall be supplied. Bolts will be welded to a common backing ring and encapsulated with polyethylene preventing fluid contact with the metal material. Flange will have one full face gasket to provide a sealing surface against inside tank wall. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.

4. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be PVC or material compatible with the chemical stored.

5. U-Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). U-vents shall be sized by the tank manufacturer and be furnished complete with insect screen if required (Insect screen lessens the vent capacity by 1/3) in accordance with the venting schedule listed above.

6. On dual wall tank(s) greater than 1000 gallons, bottom fitting(s) must be designed to maintain 110% secondary containment integrity. Bottom containment fitting must include PTFE expansion joint designed to accommodate movement of primary tank in design accordance with ASTM-D 1998 tolerances. All secondary containment fittings and parts shall be resistant to chemical fume corrosion. Fitting shall include the option to connect a secondary containment pipe over primary pipe. Transition fittings shall be installed by the manufacturer.

7. All fittings on the 1/3 lower sidewall of tanks with capacities > 1000 gallons shall have 100% virgin PTFE Flexijoint® expansion joint. Expansion joint to have 3 convolutions, stainless steel limit cables, FRP composite flanges and meet the following minimum performance specifications. Galvanized parts will not be accepted.

   Expansion joints to meet the following minimum performance requirements:

   Axial Compression ≥ 0.67”
   Axial Extension ≥ 0.67”
   Lateral Deflection ≥ 0.51”
   Angular Deflection ≥ 14º

Torsional Rotation ≥ 4º

2.06 LEVEL INDICATION

A. Float Indication: The level indicator shall be a reverse float assembly utilizing a float system installed inside of the tank that relays water level information to a sight line outside of the tank. Both internal and external piping shall be adequately support. A calibration tape shall be provided with the sight line. The line shall have a drain for removal of moisture. The level of the transfer piping from internal to external components shall be located above the high liquid overflow.

2.07 FACTORY TESTING

A. Material Testing

1. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.

2. Degree of Crosslinking. Use Method C of ASTM D 1998- Section11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

B. Tank Testing

1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.

2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.

3. Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment. The tank will then be tested hydrostatically for 24 hours after installation, prior to commissioning.

4. Level sensor and leak detection system shall be checked for accuracy and function.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. The tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving. AVOID sharp objects on trailers.

B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.

C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit. If damage has occurred, Poly Processing Company shall be notified immediately.

3.02 INSTALLATION

A. Install the tank and accessories in strict accordance with Poly Processing Company's Tank Installation Manual and shop drawings. Tank installation to be reviewed using tank manual installation check list as supplied by manufacturer.

B. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program. Four hard copies and one electronic copy of operation and maintenance manuals shall be provided.

END OF SECTION 43 41 43

SECTION 43 42 23
BLADDER TYPE HYDRO-PNEUMATIC TANKS

PART 1 - GENERAL

1.01 APPLICATION

The hydro-pneumatic tank will be installed on the non-potable water system which will pump treated and disinfected wastewater to a distribution system which serves various needs throughout the treatment plant. Two turbine pumps will pump water from a wet well following the ultraviolet disinfection process to the distribution system, generally operating in a 50 to 60 psi pressure range. Variable speed control will be utilized on the pumps to regulate system pressure in conjunction with the hydro-pneumatic pressure tank.

1.02 DESIGN PRESSURE AND TEMPERATURE

A. Maximum design pressure: 125 PSI (862 kPa)

B. General operation pressure: 60 PSI

C. Maximum design temperature: 240°F (115°C)

PART 2 - PRODUCT

2.01 TYPICAL DESIGN SPECIFICATION

A. Furnish and install as shown on plans John Wood Model No. JOPR-22-017 528 gallon ASME pre-charged vertical steel hydro-pneumatic tank with a replaceable heavy-duty butyl rubber bladder or approved equal.

B. The tank shall have a bottom mounted 2.0" FNPT galvanized system connection and a charging valve connection (Schrader valve) with full guard to facilitate on-site charging of the tank to meet system requirements.

C. The tank shall be fitted with a lifting lug and angle type legs designed for vertical installation.

D. The tank must be designed and constructed in accordance with the ASME Boiler and Pressure Vessel Code Section VIII, Division 1, with a stamped MAWP of 125 PSI (862 kPa) and a maximum design temperature of 240°F (115°C).

E. Design and installation shall comply with ASCE 7-10 seismic design standards using the following site specific parameters:

$S_S = 0.627$
$S_1 = 0.179$
$S_{DS} = 0.604$
$S_{D1} = 0.389$
Seismic Design Category D
Risk Category III

2.02 SPECIFICATIONS

A. Designed and built in accordance with the ASME BPV Code Section VIII, Division 1

B. Installation: vertical

C. Shell: Carbon Steel with exterior gray primer finish

D. System connection: FNPT bottom mounted Stainless Steel coupling with stainless steel elbow

E. Replaceable bladder: high quality butyl rubber, NSF/ANSI Standard 61 bladders are available upon request

F. Full acceptance bladder

G. Maximum acceptance volume is approximately 90% of the tank capacity

H. Air charge valve: 1⁄4" Schrader charging valve, top mounted with protective guard

I. Standard factory precharge: 12 PSI

J. An automatic air vent (JHAV-63-075 or similar) must be installed in the piping to the tank to vent off accumulated air. The valve shall be installed as per tank manufacturer's instruction and capable of being isolated with two ball valves.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. The tank shall be package and shipped in accordance with manufacturers instructions.

B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.

C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit.

3.02 INSTALLATION

A. Install the tanks in strict accordance with manufacturer's Installation Manual and shop drawings. Tank installation to be reviewed using tank manual installation check list as supplied by manufacturer.

B. The tank must be painted as per Division 9 requirements.

C. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings, materials of construction, and recommended maintenance program. Four hard copies and one electronic copy of operation and maintenance manuals shall be provided.

END OF SECTION 42 43 23

DIVISION 46

WATER & WASTEWATER EQUIPMENT

SECTION 46 00 01
AQUANEREDA® AGS SYSTEM

PART 1 - GENERAL

1.01 SYSTEM SOURCE & QUALITY ASSURANCE

A. These specifications and accompanying drawings are based upon the use of the AquaNereda® Aerobic Granular Sludge (AGS) Technology manufactured by Aqua-Aerobic Systems, Inc. (Supplier), 6306 North Alpine Road, Loves Park, IL, 61111, phone no. 815/654- 2501, fax no. 815/654-2508.

B. The Contractor shall assign full responsibility for the functional operation of all AGS System components to a Single Source Supplier. This Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing contractor's equipment installation and connections, calibrate, and place into operation the AGS System along with all other equipment and accessories as specified herein.

1.02 QUALITY ASSURANCE

A. Electrically Actuated Valve

1. Actuated valves shall be tested to Aqua-Aerobic Systems test protocol prior to shipment. Testing shall consist of the following:

a. Project and nameplate data verification per assembly documentation

b. Limit switch and torque switch setup and cycle test

c. Hydrostatic test (two pressurization cycles) for all plug and butterfly valves

1.03 SYSTEM OPERATION AND MAINTENANCE MANUALS

A. Complete system Operation and Maintenance manuals shall be available in hardcopy and electronic form. The electronic form shall be provided in .pdf format and be fully bookmarked. Manuals shall address:

1. General project information
2. Installation and start-up
3. Process design and operational control description
4. Mechanical, electrical and field instrumentation component descriptions
5. Maintenance and troubleshooting
6. Mechanical and electrical drawings

1.04 MOTOR COMPLIANCE

A. Motors shall be in compliance with the Energy Independence and Security Act of 2007 (EISA 2007).

1. All three phase motors and components shall be 460 volt, 60 hertz.

2. All single phase components shall be 115 volt, 60 hertz.

1.05 INSTALLATION

A. The installation of the equipment furnished by the manufacturer shall be the responsibility of the installing contractor in accordance with all requirements of the contract documents.

1.06 SPECIFICATION PRECEDENCE

A. The specifications for equipment and controls under this section supersede specifications for equipment and controls specified elsewhere in the contract documents and drawings. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided with standard recommended manufacturers paint, unless otherwise specified within this section.

B. The AGS area electrical classification shall be Nonclassified. Motors within the basin shall be rated for a temperature code T2A (280 Deg.C).

1.07 SERVICE

A. The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of five (5) trip(s) and twenty (20) eight-hour days at the jobsite to inspect the installing contractor’s equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

B. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor’s expense.

1.08 PERFORMANCE GUARANTEE

A. The single source supplier of the AGS System equipment shall provide a written Process Performance Guarantee to guarantee the AGS System will meet the effluent criteria specified under this section. The Process Performance Guarantee shall be submitted as part of the engineer’s submittal data.

1.09 WARRANTY

A. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of two (2) years from the date the goods are put into service, or thirty (30) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or part which has been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.

1.10 – NEREDA® TECHNOLOGY NON DISCLOSURE AND END USER AGREEMENTS

A. AquaNereda® is a proprietary technology; in order to protect this technology some

additional Safeguards such as non-disclosure agreements (NDAs) are typical.

B. Prior to disclosure of confidential information that is the proprietary know-how of Aqua-Aerobic Systems, Inc. and Royal HaskoningDHV, recipients, including Contractors, must execute a “Nereda® Non Disclosure Agreement” as supplied by Aqua-Aerobic Systems, Inc. and HaskoningDHV Nederland B.V. Executed NDAs will be required at project execution (and at assignment of contract, if applicable).

1.11 AGS FUNCTIONAL REQUIREMENT

A. The manufacturer of the AGS system shall be completely responsible for the proper design of their system, including but not limited to; diffused aeration equipment, transfer pump(s), process piping, and controls. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the plans and specifications.

B. The jobsite conditions are summarized as follows:

Average Dry Weather Flow	1.594	MGD
Average Wet Weather Flow	2.07	MGD
Max Daily Flow	5.60	MGD
Peak Hour Flow	6.062	MGD

Design Loadings		Influent		Effluent
BOD	4459.4	lbs/day	133	lbs/day
TSS	3540.5	lbs/day	133	lbs/day
TKN	550.4	lbs/day		--
NH3-N		--	66.5	lbs/day
Total Nitrogen		--	133	lbs/day
Phosphorus	79.77	lbs/day	10.74	lbs/day

Monthly Average WW Temperature		
Minimum	45.5	°F
Maximum	59	°F
Ambient Temperature		
Minimum	-20	°F
Maximum	100	°F
Jobsite Elevation	3,028	Ft MSL
Alpha	0.60	
Beta	0.95	

MLSS	8,000	mg/l
Oxygen Requirements		
AOR	8,221	lbs O2/day

1.12 AGS STRUCTURE

A. The AGS system shall be field erected as shown on the contract drawings and summarized below:

Basin Quantity:	3	
Inside Dimensions		
Basin Width	40	feet
Basin Length	60	feet
Process Water Depth: Top Of Wall:	23.0 25.0	feet SWD feet

1.13 INFLUENT PLUG VALVE

A. Furnish electrically operated flanged plug valve(s) for each basin to control the influent flow.

Valve quantity	1	Per basin
Valve Size	20	inch
Valve Model	Milliken 601	
Actuator	Auma	
Actuator Power	Three	Phase
Actuator Type	Open/Close	Service

B. Valves shall be a 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, coated non-lubricated ductile or cast iron plug with 80 % port opening, assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provisions for valve access shall be provided by the installing contractor.

1.14 INFLUENT DISTRIBUTION SYSTEM

A. Furnish (1) influent distribution system for each basin, as shown on the drawings. System shall be of PVC and HDPE construction. Supports and anchors of 304 stainless steel construction shall be supplied.

1.15 FIXED FINE BUBBLE DIFFUSER SYSTEM

A. Aeration system shall be designed to transfer the following minimum amount of oxygen per day at standard conditions in clean water, at the specified submergence, air rate, and pressure.

Airflow per basin	1,459	SCFM
Pressure @ Top of Drop Pipe	11.74	PSIG
Diffuser Submergence	22.5	feet

Diffuser quantity	561	disks per basin
Diameters		
Riser Pipe	8	inches
Riser Pipe Isolation valve	8	inches
Isolation Valve Manufacturer	Bray	
Materials of construction		
Isolation Valve disk	Aluminum Bronze	
Isolation Valve Seat	FKM	
Tank Connection	304 SS anchors	

1.16 MATERIALS AND FABRICATION

A. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276. Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal. Clean all welded stainless steel surfaces and welds after fabrication to remove weld splatter and finish clean all interior and exterior welds by full immersion pickling and rinse with water to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

1.17 DROP PIPES

A. Provide a minimum 12 ga. stainless steel drop pipe from the air main connection to a point 3 feet above the manifold. Provide a stainless steel flange with a 150-pound drilling at the top connection. Provide a stainless steel gasketed coupling for connection to the manifold.

B. Each riser pipe shall include a manually operated isolation butterfly valve for connection to the main air supply piping by the installing contractor. Valve gaskets and hardware are to be provided by the installing contractor.

C. Isolation valve shall be a wafer or lug style butterfly valve with cast or ductile iron body, and one piece stainless steel shaft.

1.18 MANIFOLDS

A. Provide a manifold for connection to the air distribution headers. Fabricate maximum 30 feet long manifolds with threaded union or flanged joints to connect manifold sections and to connect to the air distribution headers to prevent rotation and blow apart. Fabricate manifolds of Schedule 40 conforming to ASTM D1784, D1785 and D2466. Design piping, pipe joints and supports to resist expansion/contraction thrust forces of the air distribution headers over a temperature range of 125°F. PVC components to be produced from PVC compound with a minimum tensile strength of 7000 psi. Design manifolds to withstand 125° F mean wall temperature. PVC components shall have minimum 1.5 percent titanium dioxide to minimize ultraviolet light degradation. Factory solvent weld all PVC joints and diffuser holders.

1.19 AIR DISTRIBUTION HEADERS AND DIFFUSER HOLDERS

A. Fabricate maximum 24 feet long air distribution headers with diffuser holders factory solvent welded to the crown of the pipe for positive air seal and strength. Fabricate minimum 4 inch diameter air distribution headers conforming to ASTM D3915 and D3034. Connect air distribution header sections with threaded union or flange joints to prevent blow apart and rotation. Design joints with mating halves factory solvent welded to the ends of the air distribution header. Design threaded union joints with spigot and socket ends joined with a threaded ring and sealed with an O-ring gasket. Design union joints with threads of a minimum of 0.013 square inches to provide adequate strength of the socket and retainer ring. Design flange joints with an angle face ring, follower flange with 150 lb drilling and stainless steel hardware. Diffuser holders shall have a continuous contact area of 13 square inches minimum to insure structural integrity. Air distribution headers and diffuser holders to resist a dead load of 200 lbs applied vertically to the outer edge of the diffuser holder. Provide end caps at the end of each air distribution header.

1.20 PIPE SUPPORTS

A. Provide each section of manifold and air distribution header with a minimum of two supports. Support spacing to be limited to a maximum of 8 feet. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125°F and to minimize stress build up in the piping system. Design supports shall be adjustable without removing the air distribution header from the support. Design supports shall include hold down guide straps, support structure and two anchor bolts. Design guide straps with a 2 inch minimum width to eliminate point load on manifold and minimize binding. Design support for a total of 4 inch vertical adjustment for leveling of manifold within ¼ inch of a common plane.

1.21 AIR DISTRIBUTOR AND MANIFOLD SUPPORTS

A. Provide guide and fixed type supports to allow expansion/contraction. Design supports to include hold down straps, support structure, locating plate and single anchor bolt. To prevent improper installation, the locating plate shall be able to be installed in either of two directions relative to the support. Design support for a total of 3 inch vertical adjustment for leveling air distribution headers within ¼ inch of a common plane. Guide

straps shall have 1 1/2-inch wide top and bottom contoured bearing surface with chamfered edges to minimize binding and resistance to movement of air distributor under full buoyant uplift load. Design strap with 1/8 inch clearance around distributor so strap is self-limiting and cannot be over tightened.

1.22 DIFFUSER ASSEMBLIES

A. Furnish diffuser assemblies including diffuser, holder, retaining ring and air flow control orifice. Incorporate an integral check valve into the membrane diffuser.

B. Test diffuser using primary sampling criteria outlined in Military Standard 105E. Manufacture circular membrane diffuser with integral O-ring of EPDM synthetic rubber compound with precision die formed slits. Add carbon black to the material for resistance to ultraviolet light. Design diffuser as one piece injection molded part with a minimum thickness of 0.080 inches for 9 inch diameter unit. Extractable oil content shall not exceed 10%. Limit the maximum tensile strength of the diffuser to 10 psi when operating at 2.4 SCFM/sq. ft. of material.

C. Visual Uniformity: Observe diffusers for uniform air distribution across the active surface of the diffuser at 1.0 SCFM/diffuser and 2 inches submergence. Active surface shall be defined as the perforated horizontal projected area of the diffuser. Factory test diffusers for a dynamic wet pressure (DWP) of 12 inches ±20% water column @ 1.0 SCFM/diffuser and 2 inches submergence.

1.23 DIFFUSER HOLDERS

A. Design holder with air flow control orifice, integral diffuser support plate and removable retainer ring. Holder shall provide support for the diffuser and seal the diffuser in the holder to prevent air leakage around the O-ring. Design retainer ring threads with minimum cross section of 1/8 inch and allow for one complete turn to engage threads.

1.24 ANCHOR BOLTS

A. Design a mechanical or adhesive anchor bolt system for embedment in 4000 psi concrete with a pullout safety factor of 4. Condensate evacuation system shall be provided to substantially drain the submerged aeration piping system for each aeration grid.

1.25 BLOWERS

A. Furnish three phase rotary lobe compressors as described below with premium efficient, T.E.F.C. U.S. Electric, Class F insulation, Teco, Siemens, or equal motor. The blowers shall be manifolded for individual and/or combined operation.

Blower Quantity	3	
Motor Size	100	HP
Manufacturer	Aerzen	
Model Number		
Airflow rate	1,045	SCFM per blower
Maximum discharge gauge pressure	11.74	PSIG

Inlet Configuration	Combination filter/silencer	
Enclosure	Galvanized steel acoustic hood with oil drip pan	
Discharge Isolation Valve		
Diameter	6	inches
Seat material	FKM	

B. Each motor shall include a single phase normally closed motor winding thermostat.

C. Each blower assembly shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

D. Equipment shall include a blower, electric motor, belts and sheaves, inlet package, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

1.26 LOCAL CONTROL PANEL

A. Each package shall include an Aerzen AERtronic Digital Controller panel with the following features:

1. Intuitive TFT color touch screen display
2. Display, monitoring, alarm and shutdown of inlet pressure, discharge pressure, discharge temperature, enclosure cooling fan thermal overload, main drive motor thermal overload, oil temperature and oil pressure (if applicable)
3. Display run hours
4. Log errors and first out indication
5. Track and log maintenance
6. E-Stop button mounted on front of blower enclosure
7. Operation of enclosure cooling fan motor starter and oil demister

B. Control Enclosure:

1. Factory installed, integral to sound enclosure

C. Control Supply Power:

1. 460 VAC, 10 amp feed with 24 VDC transformer

D. Monitoring Sensors (minimum):

1. Inlet Pressure Transducer
2. Discharge Pressure Transducer

3. PT 1,000 Discharge Temperature RTD
4. PT 1,000 Oil Temperature RTD

E. The installing contractor shall provide all air piping from the diffuser termination(s) at the basin(s) to the blowers as shown on the contract drawings. Supply of electrical wiring and junction box/disconnects shall be the responsibility of the installing contractor.

1.27 BLOWER ENCLOSURE

A. A sound enclosure shall be provided for each blower package to help reduce the resultant noise level. The sound enclosure shall encompass the entire blower package for maximum noise attenuation. The enclosure shall be constructed of durable powder coated carbon steel with a sound absorbing internal surface. The walls and ceilings shall be shop assembled with all corners and joints properly insulated to prevent noise leakage and maintain the attenuation levels of the room. The blower package and sound enclosure shall ship as a unitized one piece assembly. Maintenance access doors shall be provided to facilitate servicing of the blower package. A baffled inlet shall be provided to allow supply and cooling air to enter the enclosure during the operation of the blower. An exhaust fan sized for proper enclosure ventilation will be supplied.

1.28 AIR CONTROL VALVES

A. Furnish operated butterfly valve(s) to control the air flow as outlined herein.

Valve (quantity)	3	Shared for all AGS basins
Valve Size	8	Inch
Valve Model	Bray	
Connection type	Lug Style	
Materials of Construction		
Valve seat	FKM	
Disk	Aluminum Bronze	
Valve Actuator	Auma	
Actuator Power	Three	Phase

Actuator Type	Modulating	Service
Compartment Heater	Yes	

B. Furnish electrically operated butterfly valve(s) as specified above to direct the airflow. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provisions for valve access shall be provided by the installing contractor.

1.29 AIR FLOWMETER

A. Furnish (1) Air Flowmeter for each basin. Each flowmeter shall be an E&H model t-mass B 150 or equal. Each transmitter shall have a NEMA 4X enclosure containing a display and the microprocessor based electronics. Each sensor shall be a thermal dispersion type. The sensor shall utilize a 3/4" compression fitting and will be fabricated of stainless steel. The location of the sensor in the process flow must have twenty (20) pipe diameters of undisturbed length upstream and five (5) pipe diameters of undisturbed length downstream. A local 24 VDC power source for the transmitter, and a twisted shielded pair for the 4-20 mA output signal from the transmitter to the main control panel shall be provided by the installing contractor.

1.30 SOLIDS WASTE SYSTEM

A. Furnish (1) solids waste system for each basin as shown in the drawings. Manifold shall be of 304 stainless steel construction.

1.31 SOLIDS WASTE VALVES

A. Furnish electrically operated flanged plug valve(s) for each basin to control the flow from the reactors to the sludge buffers.

Valve quantity	5	Shared for all AGS basins
Valve Size	16	inch
Valve Model	Milliken 601	
Actuator	Auma	
Actuator Power	Single	Phase
Actuator Type	Open/Close	Service

B. Valves shall be a 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, coated non-lubricated ductile or cast iron plug with 80 % port opening, assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provisions for valve access shall be provided by the installing contractor.

1.32 WATER LEVEL CORRECTION VALVES

A. Furnish operated flanged plug(s) to control the flow from the reactors to the water level correction tank as outlined herein.

Valve (quantity)	3	Shared for all AGS basins
Valve Size	16	inch
Valve Model	Milliken 601	
Connection type	Flanged	

Materials of Construction		
Valve seat	EPDM	
Disk	Aluminum Bronze	
Valve Actuator	Auma	
Actuator Power	Single	Phase
Actuator Type	Open/Close	Service
Compartment Heater	Yes	

B. Furnish electrically operated butterfly valve(s) as specified above to direct the waste sludge. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position.

C. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installing contractor.

D. Provisions for valve access shall be provided by the installing contractor.

1.33 EFFLUENT WEIR ASSEMBLY

A. Furnish (1) effluent weir system for each basin. System shall be of 304 stainless steel construction.

1.34 SPARE PARTS

A. The following spare parts shall be supplied by the equipment manufacturer:

Component	Quantity
Compactlogix Processor Power Supply Input card, each type	1 1 1
Output card, each type	1
Blower Inlet Filters	1 per blower
Blower V-belts	1 per blower

1.35 PRESSURE TRANSDUCER

A. Furnish submersible pressure transducer unit(s) constructed of stainless steel as specified herein. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid.

B. Transducer output shall be a 4-20 mA signal. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire.

Quantity	1	Per basin

Model	KPSI Model 700	
Mounting materials of construction		
Support pipe	304	SS
Supports	304	SS
Anchors	304	SS
Tank Connection	304 SS adhesive anchors	

C. Transducers shall be suspended on a removable mounting pipe assembly. Pipe, supports and anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect.

D. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

1.36 LEVEL SENSORS

A. Furnish one (1) level sensor assembly consisting of an Anchor Scientific model GSI 40NONC float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket for each basin. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall. Field wiring and junction box/disconnect shall be provided by the installing contractor.

B. Field attachment of the level sensor assembly to the tank shall be the responsibility of the installing contractor.

1.37 REACTOR INSTRUMENTATION

A. Furnish one (1) Dissolved Oxygen probe per basin. The probe shall be a continuous-reading probe utilizing luminescent sensor technology, and shall provide electrolyte-free operation without requiring sample conditioning.

B. Furnish one (1) TSS probe per basin. The probe shall use dual infrared light beam technique design utilizing an LED light source in the sensor to transmit an infrared/scattered dual beam into the basin at an angle of 45 degrees to the sensor face. Probe shall feature a photoreceptor in the sensor face at 90 degrees to the transmitted beam and a backscatter photoreceptor at 140 degrees to the transmitted beam. Sensor shall include a self-cleaning device.

C. Furnish one (1) pH sensor per basin. The probe shall use two measuring electrodes to compare the process value to a stable internal reference. The sensor shall have a built-in preamplifier, and include an integral temperature sensor. The pH sensor shall automatically compensate measured values for changes in temperature.

D. Furnish one (1) ORP sensor per basin. The probe shall use two measuring electrodes to compare the process value to a stable internal reference. The sensor shall have a built-in preamplifier, and include an integral temperature sensor.

E. Furnish one (1) 2 mm path length nitrate probe per basin. The probe shall be a continuous-reading probe utilizing UV absorption technology, and shall provide reagent-free operation. Sensor shall include a self-cleaning device.

F. Furnish one (1) Ammonium Analyzer per basin. The analyzer shall include an ASA UV-resistant, lockable housing, rated to IP55. It shall feature automatic cleaning and calibration, and adjustable extensive self-diagnostics. A Filter Probe sc with 5 Meter Heated Hose shall be included with the analyzer.

G. Furnish one (1) Ortho-Phosphate Analyzer per basin. The analyzer shall include an ASA UV-resistant, lockable housing, rated to IP55. It shall feature automatic cleaning and calibration, and adjustable extensive self-diagnostics. A Filter Probe sc with 5 Meter Heated Hose shall be included with the analyzer.

H. Furnish one (1) Multi-Parameter Universal Controller Probe Module per basin. The probe module shall receive the input from each instrument sensor of a given basin, and provide for a "daisy-chain" connection between the probe modules and the display module. A Modbus network card in the probe module provides data communication with the PLC. The probe module shall be provided in IP65 enclosure with corrosion resistant finish. Probe module shall include internal 125 VAC power supply and EEPROM memory back-up.

I. Furnish one (1) Multi-Parameter Universal Controller Display Module. The single display module shall be portable to allow use with any probe module, and shall have a color graphical touch-screen display. The display module shall be provided in IP65 enclosure with corrosion resistant finish.

J. All in-basin instrumentation shall be provided with all mounting hardware and accessories as shown on the drawings, for installation by the installing contractor. Installing Contractor shall be responsible for the Modbus connection from the controller probe module to the Modbus card in the PLC enclosure, as shown on the drawings.

1.38 CONTROL & MONITORING SYSTEM

A. A monitoring system shall be provided by the wastewater equipment manufacturer as described herein and as shown on the contract drawings.

B. The monitoring system includes remote access capabilities using a broadband internet communication. The remote access facilitates support from the monitoring system supplier (to address concerns or future upgrades) and provides the option to allow remote access by the operations personnel to help assess a situation when away from the site.

C. The monitoring system shall be designed, programmed and functionally tested by the monitoring system manufacturer prior to shipment. All software packages shall be provided with licenses that can be transferred to the end user.

D. The monitoring system shall be provided loose for installation, interconnection, and field wiring by the installing contractor.

1.39 MONITORED EQUIPMENT

A. The monitoring system may provide monitoring and control of remote functions and processes for the following wastewater applications.

1. AquaNereda System

1.40 MONITORING SYSTEM HARDWARE

A. The monitoring system provided shall meet or exceed the following hardware specifications. At the time of manufacture, components specified below shall be subject to "or equal" or "upgrade" status to provide for the most current model available.

B. Personal Computer (PC)

Dell Precision Tower 5820, with 5-Year ProSupport

Processor:	Intel® Xeon® W-2123, 3.6GHz
Memory:	16GB, 2666MHz RDIMM ECC
Monitor:	Dell UltraSharp™ 24 inch Widescreen
Video:	1GB
Boot Hard Drive:	500GB SATA, 16MB DataBurst Cache™
Second Hard Drive:	Identical to boot hard drive
Operating Mode:	RAID 1
Removable Media:	16X DVD+/-RW, with read/write support software
Keyboard:	USB Quiet Keyboard
Mouse:	USB Optical mouse with scroll
NIC:	10/100/1000 Ethernet

C. Uninterruptable Power Supply (Ups)

APC battery backup UPS, 1000VA minimum

D. PC Operating System And Productivity Software

Operating system:	Microsoft® Windows 10 Professional
Productivity software:	Microsoft® Office Home and Business 2016
Anti-virus / Anti-spam / Firewall:	10 year subscription
Screen capture/edit software:	TechSmith® SnagIt®

E. Graphical Software

Rockwell Software FactoryTalk View SE Station

Rockwell Software FactoryTalk View SE Development

F. Programming Software For Plc

Rockwell Software RSLogix 5000 (IEC-61131-3 compliant)

G. Programming Software For Hmi

Rockwell Software FactoryTalk View Studio ME

H. The PLC(s) shall communicate to a dedicated PC network interface card (NIC) which shall provide the monitoring system connectivity to the plant control network.

I. Ethernet shall be a local area network that provides communication between various devices at 10/100 MBaud. The protocol utilized for message transport between devices shall be TCP/IP. The processor connector shall conform to ISO/IEC 8802-3 STD 802.3 and utilize 10/100Base-T media. Connections shall be made directly from the processor to an industrial Ethernet switch. The monitoring system computer NIC shall also be of the type 10/100Base-T and shall connect directly to an Ethernet switch. Twisted-pair 10/100Base-T cables with RJ-45 connectors shall be used to make connections between switches and devices. Twisted-pair cabling between all switches and devices shall be a maximum of 323 feet in length; and kept to a minimum whenever possible. If a distance greater than 323 feet or runs through high noise environments are required, the monitoring system supplier must be contacted.

J. Conduit and routings for the communication cable(s) shall be provided by the installing contractor. Communication cable(s) shall not be installed within conduit which contains AC control or power cable(s).

K. Additional hardware (repeaters or switches) to accommodate longer Ethernet cable runs shall be supplied by others.

1.41 SLUDGE BUFFER BASIN STRUCTURE

A. The Sludge Buffer basin shall be field erected as shown on the contract drawings and summarized below:

Basin Quantity:	2	
Inside Dimensions		
Basin Width	10.3	feet
Basin Length	18.0	feet
Maximum Operating Level:	15.4	feet SWD

1.42 TRANSFER PUMP

A. Furnish external pump(s) for each basin as specified herein.

Pump Quantity	2	Per basin
Pump Manufacturer	Gorman Rupp	
Pump Function	Transfer	
Motor Size	5	HP
Pump Flow rate and Required total dynamic head (TDH)	130 GPM at 59 ft. TDH and 195 GPM at 45 ft. TDH	

Diameters		
Inlet connection	2	inches
Discharge connection	2	inches

B. Supply of all inlet and discharge piping, manual valves, supports, gaskets, and hardware beyond the flanged connection specified above shall be the responsibility of the installing contractor.

C. Pump(s) shall be installed with adhesive anchors by the installing contractor.

1.43 SLUDGE & SUPERNATANT PLUG VALVES

A. Furnish electrically operated flanged plug valve(s) for each basin to control the sludge and supernatant flow.

Valve quantity	1	Per basin
Valve Size	3	inch
Valve Model	Milliken 601	
Actuator	Auma	
Actuator Power	Single	Phase
Actuator Type	Open/Close	Service

Valve quantity	2	Per basin
Valve Size	4	inch
Valve Model	Milliken 601	
Actuator	Auma	
Actuator Power	Single	Phase
Actuator Type	Open/Close	Service

B. Valves shall be a 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, coated non-lubricated ductile or cast iron plug with 80 % port opening, assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provisions for valve access shall be provided by the installing contractor.

1.44 SLUDGE REMOVAL ASSEMBLY

A. Furnish (1) sludge removal assembly for each basin as shown in the drawings. Manifold shall be of PVC and HDPE construction. Supports and anchors of 304 stainless steel construction shall be supplied.

1.45 SOLIDS SENSOR

A. Furnish one (1) TSS probe per basin. The probe shall use dual infrared light beam technique design utilizing an LED light source in the sensor to transmit an infrared/scattered dual beam into the basin at an angle of 45 degrees to the sensor face. Probe shall feature a photoreceptor in the sensor face at 90 degrees to the transmitted beam and a backscatter photoreceptor at 140 degrees to the transmitted beam. Sensor shall include a self-cleaning device. The probe shall be inline pipe mounted and supplied with a transmitter that will be connected to the PLC via a 4-20 mA connection.

1.46 PRESSURE TRANSDUCER

A. Furnish submersible pressure transducer unit(s) constructed of stainless steel as specified herein. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid.

B. Transducer output shall be a 4-20 mA signal. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire.

Quantity	1	Per basin
Model	KPSI Model 700	
Mounting materials of construction		
Support pipe	304	SS
Supports	304	SS
Anchors	304	SS
Tank Connection	304 SS adhesive anchors	

C. Transducers shall be suspended on a removable mounting pipe assembly. Pipe, supports and anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect.

D. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

1.47 LEVEL SENSORS

A. Furnish one (1) level sensor assembly consisting of an Anchor Scientific model GSI 40NONC float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket for each basin. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall. Field wiring and junction box/disconnect shall be provided by the installing contractor.

B. Field attachment of the level sensor assembly to the tank shall be the responsibility of the installing contractor.

1.48 SLUDGE BUFFER INFLUENT PIPING

A. Inlet piping for the sludge buffer tanks to be provided by the contractor as shown in the contract drawings. Piping shall be of 304 stainless steel construction and must allow for free air discharge.

1.49 WATER LEVEL CORRECTION BASIN STRUCTURE

A. The Water level Correction basin shall be field erected shown on the contract drawings and summarized below:

Basin Quantity:	1	
Inside Dimensions		
Basin Width	9.0	feet
Basin Length	10.0	feet
Maximum Operating Level:	15.7	feet SWD

1.50 TRANSFER PUMP

A. Furnish external pump(s) for each basin as specified herein.

Pump Quantity	2	Per basin
Pump Manufacturer	Flygt	
Pump Function	Transfer	
Motor Size	5	HP
Pump Flow rate and Required total dynamic head (TDH)	150 GPM at 46 ft. TDH and 300 GPM at 37 ft. TDH	
Diameters		
Inlet connection	4	inches
Discharge connection	4	inches

B. Supply of all inlet and discharge piping, manual valves, supports, gaskets, and hardware beyond the flanged connection specified above shall be the responsibility of the installing contractor.

C. Pump(s) shall be installed with adhesive anchors by the installing contractor.

1.51 PRESSURE TRANSDUCER

A. Furnish submersible pressure transducer unit(s) constructed of stainless steel as specified herein. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid.

B. Transducer output shall be a 4-20 mA signal. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire.

Quantity	1	Per basin

Model	KPSI Model 700	
Mounting materials of construction		
Support pipe	304	SS
Supports	304	SS
Anchors	304	SS
Tank Connection	304 SS adhesive anchors	

C. Transducers shall be suspended on a removable mounting pipe assembly. Pipe, supports and anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect.

D. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

1.52 LEVEL SENSORS

A. Furnish one (1) level sensor assembly consisting of an Anchor Scientific model GSI 40NONC float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket for each basin. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall. Field wiring and junction box/disconnect shall be provided by the installing contractor.

B. Field attachment of the level sensor assembly to the tank shall be the responsibility of the installing contractor.

1.53 CONTROL PANEL

A. The control system shall be designed to optimize the AquaNereda® process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.

B. The control system shall be a timer based system with level overrides and shall provide control, sequence, monitoring, and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows.

C. A complete control system shall be provided as described in the following and as shown on the contract drawings. The control system shall include 115 volt control circuit breaker, microprocessor control, and operator interface display.

D. The incoming service of the control system shall be 115 volt, 60 hertz, single-phase. Controls for the equipment listed below shall be provided within the AGS control panel. Elapsed time indication shall be provided through (the operator interface of the AGS control panel for equipment indicated by an asterisk(*).

1.54 AGS EQUIPMENT DESCRIPTION

A. (3) 100HP Blowers*

B. (3) 20” Influent Valve(s)

C. (5) 16” Solids Waste Valves

D. (3) 16” Water Level Correction Valves

E. (3) 8” Air Control Valves

F. (3) Air Flow Meters

G. (3) D.O. signal(s)

H. (3) ORP signal(s)

I. (3) pH signal(s)

J. (3) TSS signal(s)

K. (3) Nitrate signal(s)

L. (3) Ammonium signal(s)

M. (3) Phosphorus signal(s)

N. (3) Pressure Transducer(s)

O. (3) Level Sensors

P. Common Alarm

1.55 SLUDGE BUFFER EQUIPMENT DESCRIPTION

A. (4) 5HP Transfer Pump(s)*

B. 3” Sludge Valve(s)

C. 4” Sludge Valve(s)

D. (2) Pressure Transducer(s)

E. (2) Level Sensors

1.56 WATER LEVEL CORRECTION EQUIPMENT DESCRIPTION

A. (2) 5HP Transfer Pump(s)*

B. Pressure Transducer(s)

C. Level Sensors

1.57 CONTROL PANEL WIRING AND ASSEMBLY

A. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.

B. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire

(MTW) minimum, with PVC insulation.

C. Wire colors are as follows:

208 VAC or higher	Black
120 VAC control power	Red
Neutral	White
Ground	Green
AC Power from remote source	Yellow
Neutral from remote source	White with Yellow Stripe
24 VDC (+)	Blue
24 VDC (-)	White with Blue Stripe
VDC (+) from remote source	Orange
VDC (-) from remote source	White with Orange Stripe
Intrinsically Safe	Light Blue

D. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

E. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

F. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

1.58 CONTROL PANEL QUALITY ASSURANCE

A. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

1. Point to point testing of all wiring prior to application of power Intended supply voltage shall be applied to the enclosure
2. All components shall be tested for proper operation and calibration
3. The PLC and operator interface program shall be loaded and functionally checked
4. All components shall be checked to confirm proper mounting specifications have been followed Enclosure shall be inspected for defects and repaired if necessary
5. All labeling of wires and devices are correct, properly installed and clean

B. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.

C. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e. finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

1.59 CONTROL ENCLOSURE

A. The automatic controls shall be provided in a UL listed, NEMA Type 4X 304 stainless steel (12 gauge) floor mount enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316SS padlocking POWERGLIDE® handle shall be provided.

B. Enclosures shall be unpainted, with a smooth #4 brushed finish. Enclosure shall include a painted white mild steel (12 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

C. The control enclosure shall be mounted remotely.

1.60 CORROSION INHIBITOR

A. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

B. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

1.61 MAIN DISCONNECT CIRCUIT BREAKER

A. A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/FAL, HDL, JDL, LAL, MGL, PGL or approved equal.

1.62 CIRCUIT BREAKER

A. All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

1.63 FUSE

A. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for

discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

1.64 HIGH FREQUENCY NOISE FILTER

A. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120/240VAC operating at 47 to 63 Hz. The unit shall reduce normal mode transients to plus or minus 2 volts, provide surge capacity of 45,000 amps and protect in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be an Islatrol IC+ or approved equal.

1.65 GROUND FAULT DUPLEX RECEPTACLE

A. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

1.66 24 VOLT DC POWER SUPPLY

A. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single- phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

1.67 CONTROL RELAY

A. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

1.68 TERMINAL BLOCK

A. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

1.69 PROGRAMMABLE LOGIC CONTROLLER

A. Automatic operation of the AquaNereda shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall

consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in USB and two (2) Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks.

B. Processor design characteristics shall include: 2.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating temperature range between 32 °F and 140°F. The PLC processor shall be an Allen-Bradley CompactLogix 1769-L33ER or approved equal.

C. Modular equipment shall be provided to complete the PLC system. These Allen-Bradley components include: 1769- PA4 – Power Supply, 1769-IA16 – Discrete input (16 point) modules, 1769-OW16 – Discrete output (16 point) modules and 1769-IF8 – Analog input (8 point) modules, 1769-OF4 – Analog output (4 point) modules.

1.70 PLC POWER SUPPLY

A. Input voltage range of 85-265 / 170-265 VAC, 47-63 Hz, maximum inrush current of 30 amps, backplane output current of 4 amps @ 5V or 2 amps @ 24V, internal fuse protection, ambient operating temperature of 32°F to 140°F, Class I, Division 2 hazardous location certified, UL Listed.

1.71 DISCRETE INPUT MODULE

A. Operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5VDC = 115mA , off-state current 2.5mA maximum, maximum inrush current 250mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

1.72 DISCRETE OUTPUT MODULE

A. Operating voltage of 5 to 265 VAC at 47 to 63 Hz / 5 to 125 VDC, backplane current draw at 5 VDC = 205mA , at 24VDC = 180mA, off-state current leakage is 1.0mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

1.73 ANALOG INPUT MODULE

A. Backplane current draw at 5 VDC = 120mA, at 24VDC = 70mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

1.74 ANALOG OUTPUT MODULE

A. Backplane current draw at 5 VDC = 120mA, at 24VDC = 170mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

1.75 ETHERNET SWITCH

A. An Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation and provide for store and forward switching mode. The switch shall have eight (8) 10/100Base-T ports with RJ-45 sockets and shall support auto-

crossing, auto-negotiation and auto-polarity. Maximum distance between devices shall be 100m.

B. The unit shall be DIN rail mounted and require 24VDC/100mA power. Diagnostic LEDs for power, link status, data, and data rate shall be provided. The Ethernet switch shall be UL listed and manufactured by Hirschmann, or approved equal.

1.76 REMOTE ACCESS ETHERNET MODEM

A. A UL listed, remote access Ethernet modem shall be supplied to provide connection capability between the Ethernet PLC network to a standard analog phone line. The device shall be complete with 4 RJ-45 10/100 full/half duplex network ports with on RJ-12 modem port capable of line rates (V90) of 56K thru 28K bps. The unit shall meet compliance with FCC Part 68,

B. Part 15-Class b, UL/CSA Certified, CTR 21, CE. Mounting shall be on 35 mm-din rail with an operating input of 8 to 48V DC. The remote access Ethernet modem shall be a Rockwell Automation Model 9300-RADES.

1.77 HUMAN MACHINE INTERFACE

A. The operator interface shall be a NEMA Type 12, 13, 4X rated, 15” diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 1024 x 768 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 15”.

1.78 MOTOR CONTROL CENTER (MCC)

A. Furnish one (1) MCC Motor Control Center consisting of the following items shall be provided by the AGS System equipment supplier as specified herein. Installation and field wiring shall be the responsibility of the installing contractor.

B. Industrial Package System Voltage: 480Y/277V 3PH 4W 60Hz

C. Control Power - 120Vac

D. General Purpose NEMA Type 12

E. Motor starters, adjustable speed drives and feeders shall be included as required for proper operation of the AGS System.

END OF SECTION 46 00 01

SECTION 46 05 01
WASTEWATER EQUIPMENT – GENERAL PROVISIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Wastewater Equipment General Provisions.

B. Related Sections Include:

1. Section 00 21 13 – Instructions to Bidders
2. Section 00 72 00 – Standard General Conditions
3. Section 01 33 00 – Submittal Procedures
4. Section 01 40 00 – Quality Control
5. Section 01 60 00 – Product Requirements
6. Section 01 75 00 – Starting and Adjusting
7. Section 01 77 00 – Closeout Procedures
8. Section 01 78 23 – Operations and Maintenance Data

1.02 REFERENCES

A. The following references, in their latest revision, form part of this specification. To the extent specified, the requirements of this specification prevail in case of conflict.

B. Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps – Test Code.

C. American Society for Testing and Materials (ASTM)

D. American Gear Manufacturers Association (AGMA)

E. American Institute of Steel Construction (AISC)

F. American Welding Society (AWS)

G. Steel Structures Painting Council (SSPC)

H. American Society of Civil Engineers (ASCE)

I. DEQ-2: Montana Department of Environmental Quality – Circular DEQ-2: Design Standards for Public Sewage Systems

J. NFPA 820: Comply with most current edition of National Fire Protection Association Standard for Fire Protection in Wastewater Treatment and Collection Facilities for electrical equipment installed within boarders indicated on “Preliminary Site Plan.”

K. National Electric Code (NEC-501)

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit in accordance with Section 01 33 00, detailed specifications, drawings and data covering all materials, parts, devices, equipment, and other accessories forming part of equipment for each complete operational system.

B. Operations and Maintenance Data: Submit in accordance with Section 01 78 23 on all parts, devices, equipment, and other accessories forming the complete operational system.

C. Shop drawings shall be specific to this project with inappropriate information clearly removed. Each shop drawing shall clearly indicate the specific piece of equipment being referenced. Each shop drawing shall clearly indicate the specific system being referenced.

D. Preliminary characteristics performance curves for all process pumps shall be submitted with associated shop drawings. Performance curves shall include operating head, brake horsepower and efficiency, plotted against pump capacity, as a minimum.

E. Certified performance curves for all specific process pumps shall be approved by Engineer prior to shipping pumps. Certified curves shall include specific pump serial numbers.

F. Manufacturer's preliminary operation and maintenance manuals for specific pieces of equipment shall be submitted with shop drawings. Shop drawings will not be reviewed until preliminary operation and maintenance manuals are submitted for review.

G. After equipment installation, and before acceptance of equipment, submit final instruction manual containing complete information with respect to assembly, operation, maintenance, repair, and adjustment of all equipment. Manuals shall be submitted to Engineer for transmittal to Owner.

1.04 PROJECT RECORD DRAWINGS

A. Changes from original project drawings and specifications shall be compiled by Contractor and submitted to Engineer. Changes shall be clearly indicated through drawings and the written word.

1.05 QUALITY ASSURANCE

A. The Contract Documents represent the minimum acceptable standards for the equipment in Division 40, 43, & 46. Standard manufacturer products shall be redesigned and modified from standard mode, if necessary, or provided with special features, accessories, materials, or finishes as may be necessary to conform to the requirements of the specifications and the drawings.

B. All furnished equipment and systems shall conform completely to the requirements of specific drawings and specifications.

C. Steel design and fabrication shall conform to the standard practices of the American Institute of Steel Construction (AISC).

D. Equipment and systems shall be suitable for mounting on level concrete surfaces with all

live and dead loads transmitted within the limits of the concrete specified.

E. Each piece of equipment furnished shall have a standard nameplate securely attached in an easily viewed location showing the name of the manufacturer and the serial number of the specific unit. The nameplate shall also provide the rated capacity of the unit at specified conditions. Motor nameplates shall show the horsepower, speed and electric current characteristics of each specific motor. The nameplate of distributors is not acceptable.

F. Drawings and specifications are complimentary and what is called for in either one shall be binding as if called for in both.

G. For locations indicated on plan drawings, contractor shall follow the requirements called out in NFPA 820 regarding NEC-501.

1.06 QUALIFICATIONS

A. Unless otherwise specified in individual specification sections, the following minimum requirements shall apply to all products specified in Divisions 40, 43, & 46:

1. No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of equipment designed for use in wastewater treatment.

2. The manufacturer must have installed and had in satisfactory use for a period of not less than five (5) years a minimum of five (5) installations having similar size and type of equipment as compared to the units specified.

3. Experience information shall be furnished with shop drawings. The term “installations” shall mean individual projects/contracts. Multiple equipment units for a project will be considered as one (1) installation toward meeting the experience requirements. Installations shall be only in the United States (fifty states). Information shall include, but not limited to, the following:

a. Name and location of installation.

b. Name of person in direct responsible charge for the equipment.

c. Address and phone number of person in direct responsible charge.

d. Month and year the equipment was placed in operation.

e. Brief description of equipment.

B. Equipment manufacturers not listed in the individual specification sections of Division 40, 43, & 46, and wishing to be considered, must follow the following procedure at the respective period: Section 00 21 13 – Instructions to Bidders during Bid Period; Section 00 72 00 – Standard General Conditions for Construction Contracts (7.04 & 7.05), after Bid Period and Award, and During Construction.

1.07 PROJECT CONDITIONS

A. Contractor shall be responsible for verifying any dimensions of existing or proposed structures, piping, or equipment required for the proper fabrication and installation of all new equipment and the necessary connections.

B. Discrepancies found before or after the work has started, shall be immediately brought to the attention of the Engineer. Engineer reserves the right to require minor changes in the work of the Contractor to eliminate such discrepancies.

C. Prior to roughing in any facilities, or installing any equipment, Contractor shall consult all drawings (general, structural, process, mechanical, electrical, and etc.) and shall inform himself of structural members, ceilings, pipes, ducts, materials, finishes, and etc., which may affect the installation.

D. Contractor shall examine all substrata, openings and conditions under which materials and equipment are to be installed. Contractor shall not proceed with work until unsatisfactory conditions are corrected.

E. Drawings indicate the size and general arrangement of all equipment and piping. The final exact location and dimensions will be determined by the actual equipment furnished.

F. Contractor shall determine and be responsible for the proper location and character of all sleeves, chases, inserts, hangers, anchor bolts, openings, and etc. in the construction for mechanical and process equipment and piping installation. Contractor shall be responsible to have anchorage items delivered to the project site in ample time to prevent a delay in associated work.

1.08 DELIVERY, STORAGE AND HANDLING

A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and storage in accordance Section 01 66 00.

B. Protect equipment from exposure to elements and keep all items thoroughly dry at all times.

C. Primed or Painted Surfaces: Protect against impact, abrasion, discoloration, and other damage. Factory finished coatings damaged during shipment unloading and initial storage will be the responsibility of the Seller. Factory finished coatings damaged during long term storage, assembly, and installation will be the responsibility of the Installation Contractor. Responsible party will be expected to repair damaged coatings per manufacturer’s recommendations at not additional cost to owner.

D. Protect electrical equipment, controls, and insulation against moisture or water damage.

E. Store pumps, motors, and electrical equipment in weather tight areas and maintain temperature of 50 degrees F minimum.

F. Rotating equipment in storage shall be rotated by hand weekly to protect the life of new bearings.

1.09 MAINTENANCE AND SERVICE

A. If not indicated in individual specification sections, Manufacturer's authorized representative shall provide a minimum of four (4) hours for on site field calibration, startup, and training services for each specific piece of equipment.

B. A factory serviceman and service vehicle equipped with tools to make all necessary repairs, as well as component parts required to maintain satisfactory operation of the equipment outlined in these Specifications, shall be available if needed, without undue delay.

C. Manufacturer’s authorized representative shall provide a start-up report, to be included in the submittal of the final Operations and Maintenance Manuals, documenting site visit, start-up, and installation and or operational recommendations made during startup.

1.10 REGULATORY REQUIREMENTS

A. All Products that may come into contact with water intended for use in a Public Water System shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.11 WARRANTY

A. Unless otherwise noted a written manufacturer's warranty shall be provided for the equipment specified. The warranty shall be for a minimum period of one (1) year from Final Acceptance. Such warranty shall cover all defects or failures of materials or workmanship that occur as the result of normal operation and service. Special warranty (guarantee) on individual pieces of equipment may also be called out in individual specification sections and shall take precedence.

B. Guarantee all equipment against:

1. Faulty or inadequate design.
2. Defective construction or materials.
3. Improper assembly.
4. Leakage, breakage, or other failure.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials shall be new, undamaged and conform to the latest standards listed.

2.02 MOTORS

A. Motors are specified in individual specifications sections.

B. Motors shall be selected to meet Seller’s process treatment requirements, as supported by process design calculations.

2.03 GEAR REDUCERS

A. Unless specified otherwise, all gear reducers shall be horizontal straight-line concentric type with heat treated alloy steel precision cut helical gearing. AGMA rating plates shall be attached to the gear housing. All gearing shall comply with the requirements of the AGMA. All gearing will be provided with a 1.5 service factor for continuous operation.

B. Unless specified otherwise, all shafts shall be of high carbon steel forgings turned and grounded to size. All gearing shall be lubricated by revolving through an oil reservoir. Lubrication shall be adequate to provide both lubrication and cooling. Shafts shall be mounted on anti-friction bearings. All shafts shall be provided with oil seals. Housings shall protect against dust and moisture intrusion. Housings shall be provided with an easy means of filling, draining, and checking oil levels.

C. Unless specified otherwise, drive motors shall be separate from the gear reducer. Motor shaft shall be connected to the gear reducer with a shear pin or torque overload coupling to protect against overload.

2.04 GUARDS

A. All rotating shafts, couplings, and belts shall be covered by an OSHA approved, and substantial, removable sheet metal or expanded metal guard or screen.

2.05 SHEAR PINS

A. Unless specified otherwise, shear pins shall be fabricated of 2017T4 aluminum, cold-headed rod, conforming to the standards set forth in ASTM B316-90.

B. Furnish pins that are 0.0002 inch oversized, and of constant diameter. Pins shall not be necked down in any way. Hubs or bushings shall be furnished to ensure that larger pins cannot be installed.

C. Pins shall have a Brinell hardness of at least 300 when tested with a 500 kg load and 10mm ball.

D. One end of the pin shall be chamfered and the other end provided with a radius to form a crown.

2.06 FLEXIBLE SHAFT COUPLINGS

A. Unless specified otherwise, flexible shaft couplings for connection of motor and equipment drive shafts shall be of the non-metallic flexible member type. Flexible element shall be of reinforced rubber tire type held in place by twin flanges. No lubrication shall be required. Coupling shall eliminate metal to metal contact between driver and driven shafts in the coupling. Coupling shall act to cushion shock loads.

B. Coupling design shall allow for replacement of flexible element without moving either driver or driven equipment.

C. Couplings shall accommodate angular misalignment up to 4 degrees, parallel misalignment of up to 1/8 inch, and end float of up to 5/16 of an inch, either singularly or in any combination.

2.07 ENCLOSURES

A. Unless specified otherwise, control devices appurtenant to major equipment shall be provided with dust and moisture tight enclosures.

B. Unless specified otherwise, electrical conduit connections shall be of the threaded type.

2.08 ANCHOR BOLTS AND FASTENERS

A. Equipment manufacturer shall furnish all anchor bolts of proper size and strength to securely anchor each piece of equipment. Anchor bolts and fasteners shall be set by template and protected from misalignment by Contractor. Equipment shall be leveled, shimmed, bolted down, and grouted in place with a non-shrinking type grout. Unless specified otherwise on the drawings or in individual specification sections, anchor bolts, and fasteners shall be 304 stainless steel. Anchor bolts shall be of the embedded, headed, type. Expansion type, and adhesive type, anchors will not be acceptable.

2.09 FACTORY SURFACE PREPARATION AND PAINTING

A. Thoroughly clean, fill and smooth surfaces, as necessary, to provide a smooth and uniform base for applying coatings.

B. Permanently protect surfaces which will not be accessible after assembly or installation of equipment.

C. Protect all steel and iron surfaces by applying proper factory coatings and finishes.

D. Provide a protective coating to surfaces that are to be painted after installation. Protective coatings are to be compatible with coating systems specified in Section 09 90 00.

E. Provide an oil resistant factory finish on electric motors, speed reducers, starters, and other self-contained or enclosed components which is compatible with the coating systems specified in Division 9.

F. Apply a rust prohibiting compound on all machined, polished, and ferrous surfaces which are not to be painted.

PART 3 - EXECUTION

3.01 FACTORY TESTS

A. All process equipment will be subjected to factory testing as specified in individual specification sections, and in accordance with the overall testing requirements specified in Division 1.

B. Process equipment which does not pass testing requirements shall be replaced with equipment which does meet the specified requirements.

C. Factory testing of all pumping equipment shall be in accordance with Hydraulic Institute Standards.

D. Certified factory performance test curves for each pump shall be furnished to Engineer, and approved by Engineer, before shipment of the pump to the construction site. Certified test curves shall cover the full operating range, from shut off, to maximum capacity.

3.02 INSPECTION

A. Contractor shall inspect all equipment as it is delivered to ascertain if the equipment has arrived at the project site in a damaged condition, and to determine if any parts are missing.

B. Contractor is responsible to repair or replace damaged items in accordance with manufacturer's instructions, and Engineer's approval.

3.03 FIELD PREPARATION AND PAINTING

A. Immediately following receipt of equipment at the construction site, Contractor shall touch up paint damaged in shipping with paint supplied by the equipment manufacturer. Touch up paint shall be compatible with coating systems specified in Division 9.

B. Unless specified otherwise, finish field preparation and painting shall be in accordance with specification Division 9.

C. Prior to assembly, all stainless steel bolts, nuts, and fastener threads shall be coated with a non-seizing compound.

3.04 INSTALLATION

A. Furnish and install all equipment as shown on the drawings in accordance with manufacturer's recommendations, to provide for a complete and operational system.

B. Contractor shall make appropriate allowance in his bid for the fact that the Owner must continue to operate the wastewater treatment facility to meet NPDES effluent standards. Contractor's activities at the site must be coordinated to meet this requirement.

C. Connections to existing plant piping and processes, modifications to existing plant piping and processes, and relocation of existing piping and processes required for proper installation of new equipment shall be performed on a continual basis, and coordinated with Owner and Engineer, to minimize shut down time of wastewater treatment facilities.

D. Coordinate with other trades to minimize interferences in the installation of work, and to minimize delays.

E. Contractor shall provide all necessary scaffolding for installation of this work in conformance with the standards of any local, state, and federal codes applying to scaffolding.

F. Oil and grease required for initial operations, and acceptable to the equipment manufacturer, shall be provided by the Contractor.

3.05 FIELD TESTING

A. Field testing shall be performed in accordance with individual specification sections, and in accordance with the requirements of Division 1.

B. Excessive equipment vibration shall be cause for rejection of the equipment.

C. Motors shall be field checked for compliance with current limitations indicated in Division 26.

3.06 START-UP AND ADJUSTMENT

A. The equipment manufacturer shall inspect the completed installation and make all necessary adjustments and corrections prior to equipment start-up.

1. Check equipment clearances.
2. Remove debris from in and around equipment.
3. Check for proper lubrication.
4. Check for ease of rotation of rotating equipment. Check direction of rotation.
5. Check for proper valve positions.
6. Check for alignment of all parts.
7. Check that all nuts and fasteners are adequately torqued.

B. Following start-up authorization by Engineer, the equipment manufacturer shall supervise the actual starting of the equipment. The equipment manufacturer shall make all final adjustments of the operating equipment, and shall provide written certification that the equipment is properly installed, adjusted, and operating properly.

1. Check safety equipment.
2. Check lubrication systems, and lubricant usage.
3. Check temperatures of bearings and seals.
4. Check motor loads.
5. Check that the system is operating under all design conditions.
6. Check for excessive vibration.
7. Check for excessive noise.
8. Optimize system operation.
9. Provide initial operation instruction to Owner.

C. See Section 01 75 00 for additional requirements.

3.07 WRITTEN REPORT (CERTIFICATION)

A. Contractor shall provide manufacturer's written certification to Engineer for approval, and transmittal to Owner. Manufacturer shall certify that the equipment:

1. Is properly installed.
2. Is properly lubricated.
3. Is properly and accurately aligned.
4. Has been operated at all design load conditions, and is operating satisfactorily.
5. Is free from stress caused by connecting pipes and other attachments.

B. Final acceptance of equipment will not be provided until written certification is provided and approved by Engineer.

3.08 OPERATOR TRAINING

A. The manufacturer shall provide the minimum hours of operator training on the proper use and maintenance of the equipment, as specified in individual specification sections.

B. Time of operator training shall be coordinated and agreeable to Owner and Engineer.

C. Operator training hours may not be consecutive.

D. Operator training will usually take place after plant start-up.

3.09 SPARE PARTS

A. All spare parts shall be new and identical to the original equipment. Spare parts shall be packaged in individual boxes suitable for long term storage. Spare parts required shall be as listed in the individual specifications sections.

B. Contractor shall provide the Owner with all spare parts called for in individual specification sections. Spare parts shall be provided to the Owner at the wastewater treatment plant site.

END OF SECTION 46 05 01

SECTION 46 06 70
SLUDGE HANDLING & DISPOSAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including general and Supplementary Conditions and Division 1 Sections, apply to this Section.

1.02 SUMMARY

A. The work in this section consists of furnishing all labor, equipment, materials and performing all operations related to removing and disposing sewage sludge from Treatment Cell #3. Information pertaining to the quality and quantity of sludge in Cell #3 is included in Appendix D of these project documents. Quality and quantity data is based on measurements taken in July 2019. The estimated volume of wet (in place) sludge within Cell #3 is 1,800 yd^3 (based on an average of 0.94' of depth measured 7-11-19) with approximately 9.08% total solids. Considerable reduction in sludge volume can be expected if the material is dried to a higher solids content.

B. The Owner and Contractor will work cooperatively to either:

1. Seek authorization from MDEQ to land apply accumulated sludges in accordance with applicable MDEQ and EPA rules. The Owner will be responsible for completing/submitting the MDEQ's General Biosolids Agricultural Application form and the Contractor will be responsible for securing a disposal site and complying with the land application conditions of that form - or;

2. Seek authorization from Flathead County to dispose of accumulated sludges in the local landfill. Applicable federal/state rules regarding non-hazardous & non-liquid wastes will apply.

1.03 SUBMITTAL

A. Sludge Disposal Plan: The Contractor shall submit a detailed plan, fully outlining the proposed system of sludge dewatering and disposal, to the Engineer. No sludge disposal work shall begin until such plan is approved by the Engineer. The plan shall include detailed proposals for the following items:

1. Isolating and draining Cell #3;

2. Dewatering and removing the residual sludge

3. Transporting sludge from Cell #3 to the disposal site;

4. Equipment to be used for sludge de-watering, transfer and handling;

5. Application of the sludge to the disposal site and compliance with applicable regulations;

6. **Land application of sewage sludge must strictly follow 40 CFR Part 503 Standards for use or disposal of sewage sludge**.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. The sludge removal plan shall include a complete listing showing the type and quantity of equipment to be used. The Contractor may use any type of earth moving, compacting, tilling, and pumping equipment, provided the equipment is in satisfactory condition and of such capacity as to fulfill the requirements of this section. The Contractor is solely responsible for the condition of his equipment. Only equipment in good working condition is acceptable. The Engineer assumes no responsibility for the safety of Contractor's equipment. The Engineer reserves the right to periodically inspect all equipment provided by the Contractor and to reject pieces found to be in unsatisfactory condition or doing unsatisfactory work. Leak-proof trucks will be required for overland hauling of all sludge, if applicable.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall perform all excavation, pumping, hauling, and disposal or land application of accumulated sludge in the existing treatment facility as specified and shown in the contract drawings. Contractor shall be responsible for inspection of Cell #3, determination of methods for transferring and disposing of sludge, regulatory compliance and, if applicable, haul routes to a suitable land application site or landfill in order to provide the proper equipment and personnel required to complete the specified work in an efficient and timely manner. All special equipment required for the sludge removal element of the project will be furnished by the Contractor at no additional cost to the Owner.

B. The results of analyses performed by Energy Laboratories Inc. in July 2019 to determine fecal coliform bacteria, total metals, nitrogen constituents, and percent solids of the sludge are presented in Appendix D of the project documents. The analyses indicate the sludge qualifies as a non-hazardous waste and is well below the “Clean Sludge” metals concentrations outlined in 40 CFR Part 503.13(b)(3). This sludge could be landfilled if it passes as non-liquid or could be land applied for agricultural uptake in accordance with 40 CFR part 503.

C. Bidder shall make their own interpretations of the data contained in said drawings, and the Contractor shall not be relieved of liability under the contract for any loss sustained as a result of any variance between conditions indicated by or deduced from said data and the actual conditions encountered during the progress of work. The accuracy of the sludge quality data is not guaranteed by the Owner or the Engineer.

D. Bidders are hereby advised that the sludge may be corrosive and that it may

contain disease producing micro-organisms. The Contractor shall therefore plan his work operations accordingly.

3.02 HANDLING AND HAULING OF SLUDGE

A. General. Sludge residing in the drying beds or removed from the lagoons shall undergo disposal in accordance with the requirements of the site Owner and all applicable regulatory agencies. If the Contractor proposes offsite disposal, refusal of potential sludge application site Owners to accept sludge shall not be the basis for claims by the Contractor and shall not relieve the Contractor of his responsibility to complete the lagoon clean-out work. No sludge shall be brought to Contractor-proposed sites until the Owner, the Engineer, and the appropriate regulatory agencies have reviewed and accepted the site and disposal method. The Contractor shall be responsible for obtaining all required approvals from regulatory agencies prior to sludge application at Contractor-proposed sites. The application of sludge to Contractor-proposed sites shall not result in additional costs to the Owner.

B. Contractor is hereby advised that sludge transfer, hauling, handling and disposal shall be fully coordinated with disposal site owners/operators.

C. No sludge shall be spilled onto roadways or adjacent properties during transport. In the event that sludge spillage occurs, the Contractor shall promptly clean up the spilled sludge. Any fines assessed for sludge spillage shall be paid by the Contractor.

D. Finished grade of lagoons following removal of sludge shall be as shown in the contract drawings.

E. All aspects of the sludge disposal operation shall be conducted in full accordance with the requirements of local, state, and federal regulatory agencies.

3.03 REGULATORY REQUIREMENTS

A. The Contractor shall be responsible meeting all requirements in 40 CFR Part 503 Standards for the Use or Disposal of Sewage Sludge. These requirements include the following:

1. For a “one-time” land application event, sewage sludge shall be applied at no more than the agronomic nitrogen uptake rate specific to the type of vegetation that is planted on the land application site.

2. Pollutant levels for the nine (9) regulated metals shall not be exceeded. Note, the sampling results acquired in July 2019 indicate compliance with the heavy metals requirements of 40 CFR §503;

3. If land applied, sewage sludge shall be incorporated into the soil in accordance with the Vector Attraction Reduction requirements of 40 CFR §503.

END OF SECTION 46 06 70

SECTION 46 23 23
GRIT REMOVAL EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes general requirements, products, and methods of execution relating to a Grit Removal System approved for use on this project. Each **PISTA® VIO™** Grit Chamber shall be complete with the following equipment: gear motor, gear head, air bell, drive tube, axial flow propeller, internal baffling, grit removal pump and auxiliary equipment as specified herein. All wetted parts shall be constructed of 304 stainless steel.

1.02 QUALITY ASSURANCE

A. The **PISTA® VIO™** ***(Model 7)*** Grit Chamber shall be manufactured by Smith & Loveless®, Inc., Lenexa, Kansas, or approved equal.

1.03 DESIGN CONDITIONS

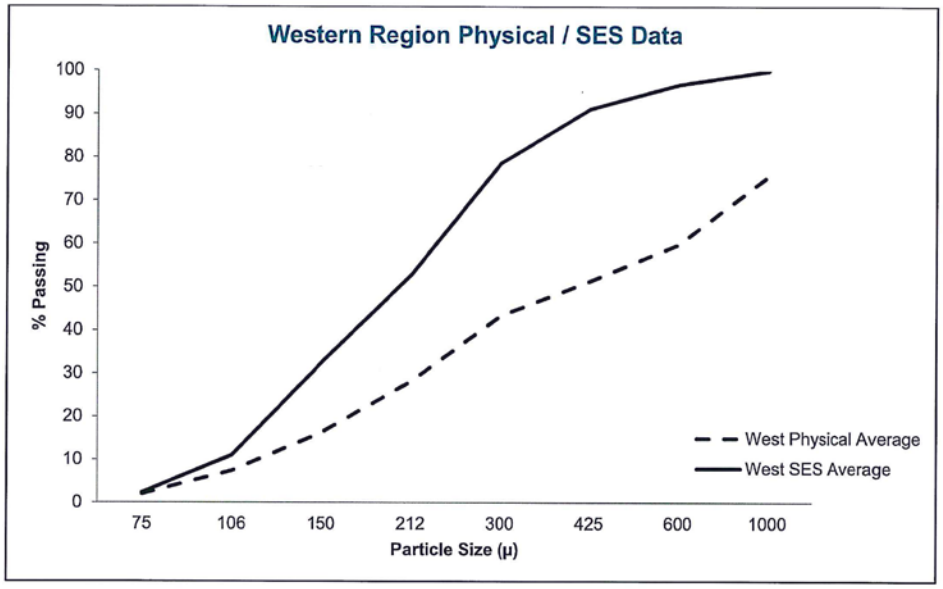
A. The grit removal equipment will be used for the new Whitefish wastewater treatment plant with the following design conditions:

Average Dry Weather Flow	1.594	MGD
Average Wet Weather Flow	2.070	MGD
Peak Day Flow	5.600	MGD
Peak Hour Flow	6.062	MGD
Recycle Flow Rate	320	GPM
Average Day BOD_5 load	4459.4	lb/day
Average Day TSS load	3540.5	lb/day

The entire flow from the City's users will be screened with a 6 ml perforated screen then pumped to the grit removal facilities. The new grit removal equipment will be located outdoors in a covered basin whereas the grit pump will in a building with a flood suction line arrangement. The grit basin drive motor must function in all weather conditions.

Specific characteristics of the grit found in the City of Whitefish raw wastewater have not been evaluated. However the following information describes grit characteristics of typical grit found in wastewater generated in the western US, which should be similar to that found in Whitefish.

Western US Regional Gradation



Micron	% Passing 75	106	150	212	300	425	600	1000	
West Physical Average	2.0	7.4	16.3	28.2	43.3	51.3	59.9	75.6	*Physical*
West SES Average	2.3	11.0	32.5	52.7	78.6	91.1	96.8	99.9	*SES*

The above table shows the % of grit passing through various sieve sizes based on physical size (unshaded) and Sand Equivalent Size (SES) (shaded). SES provides the settling velocity distribution of the grit particles.

PART 2 - **PRODUCTS**

2.01 PRODUCT INFORMATION

A. The **PISTA**® **VIO™** Grit Chamber shall operate on the vortex principle, and shall be capable of removing grit from raw waste or process water and depositing the grit in a storage hopper.

B. No moving parts subject to wear or stoppage shall be below the water surface. An integral grit transporting means shall be provided to transport the grit from the storage hopper to the disposal means.

C. To minimize the possibility of clogging, all internal openings in the piping to the grit pumping device as well as the grit pumping device shall be large enough to pass a 3" sphere. No bends or elbows will be allowed in the piping on the suction side of the grit pump.

D. All drives, lubrication and bearings shall be readily accessible from walkways above the operating water level.

E. To minimize the possibility of organic capture, the floor of the grit separation chamber shall be flat and there shall be no greater than a 3" opening for grit to pass through to the storage hopper. Sloping floors in the upper chamber will not be allowed due to reduced grit removal efficiency and extra construction costs.

F. The **PISTA® VIO™** Grit Chamber shall be manufactured by Smith & Loveless®, Inc., Lenexa, Kansas.

2.02 CONDITIONS OF OPERATION

A. The grit removal device shall be capable of removing the following at the rated hydraulic peak flow rate, with no decrease in efficiency allowed at flows less than the design rate.

1. 95% of the grit down to 140-mesh (106 microns) in particle size

B. Grit removal efficiency is defined as the weight of the grit entering the chamber at the inlet ramp minus the weight of the grit exiting the chamber at the outlet, divided by the weight of the grit entering the chamber at the inlet ramp. [(Grit In – Grit Out)/Grit In.]

C. Before the bid, any alternate grit removal system manufacturer shall submit to the consulting engineer, performance test data for at least 5 installations, showing through previous certified tests the stated grit removal efficiency of 95% down to 140-mesh (106 microns) in particle size. The stated performance must be proven in full scale field testing utilizing certified grit removal efficiency test procedures as performed by qualified, Factory payroll personnel who have at least one (1) year experience performing the test. (See Execution of testing procedure)

2.03 INTEGRAL BAFFLES

A. Equipped with integral 304 stainless steel flow control baffling for both the inlet and outlet of the main chamber.

B. Equipped with an integral 304 stainless steel underdrive chute within the sloped inlet channel to assist with conducting grit into the chamber.

C. A fabricated 304 stainless steel nozzle shall be installed at the bottom of the influent ramp to direct the grit across the bottom of the separation chamber as well as enhance the chamber vortex flow pattern.

D. The inlet nozzle shall be designed to direct the inlet flow into the chamber beneath a horizontal perimeter baffle in a manner ensuring the proper vortex flow and to prevent short-circuiting and rollover.

E. The outlet tunnel on the discharge shall retain the grit near the floor of the chamber and also direct the separated flow out of the unit, acting as a horizontal weir to provide a low velocity discharge area, preventing rollover of grit from the bottom portion of the chamber.

F. The broad outlet shelf will direct the flow to the narrowed outlet opening which controls the water level in the main chamber and in the velocity in the inlet channel.

G. No additional downstream flow control device shall be required to keep the velocity between 3.5 fps at peak flow and 1.6 fps at minimum flow with a 10:1 turn down.

H. The baffles shall be constructed of 304 stainless steel.

I. The installing contractor shall attach the baffling to the concrete structure using 1/2" (13 mm) anchor bolts, as shown on the drawings.

J. The Grit Chamber shall handle all flows equal to, or less than, a hydraulic peak flow of 7.0 MGD.

K. The influent flume, transporting the liquid waste to the grit chamber, shall be of the size and shape shown on the contract drawings to assure that grit does not settle in the inlet flume and to provide for proper operation of the grit chamber.

L. The effluent flume exiting the unit shall be a free-flowing flume for maintaining proper velocity within the chamber.

2.04 MECHANICAL DRIVE

A. Grit Removal Unit shall have an axial flow propeller connected by a drive tube through gearing to a 3-phase, 60 cycle, 460 volt, totally enclosed explosion proof helical gear motor. The minimum rated horsepower of the motor shall be 1.0 HP.

B. The drive tube shall be driven by a large, totally enclosed combination spur gear and turntable bearing. The maximum output speed of the drive shall be 21 RPM.

C. Pinions and gears shall be high quality steel, machined and hardened for high strength and long wear. Propeller blades shall be tapered, with generously rounded leading edge, to reduce energy consumption and prevent foreign material from fouling the propeller.

D. A pinion mounted on the output shaft of the helical gear motor shall drive a large spur tooth bull gear enclosed in a heavy cast-iron case.

E. The spur gear pinion shall be cut from heat-treated steel. The bull gear shall rotate with a minimum 21" diameter turntable bearing for durability and stability.

F. The pinion and bull gear shall have a service factor of 5.0 or greater at standard operating speeds.

G. All bearings of the drive unit, including the motor, shall have a minimum B-10 bearing life of 100,000 hours, except for the 21" diameter turntable bearing supporting the propeller assembly which shall have a minimum B-10 life of 20 years.

H. The bull gear housing shall be specifically designed for this service.

I. It shall have an opening for the 10-3/4" diameter torque tube driving the propeller.

J. The gearbox shall be sealed and the bottom opening shall have an air bell around the torque tube to prevent water from entering the gearbox in case of flooding. The top of the gearbox shall have a bolted flanged connection for the grit discharge pipe.

K. Clarifier drives, which are modified to meet the higher propeller speed, specifically will

not be acceptable.

L. The drive motor shall have normal starting torque and low starting current. The motor shall not be overloaded beyond the nameplate rating under any normal conditions encountered.

2.05 GRIT FLUIDIZER

A. Grit Collection System shall be equipped with **PISTA® GRIT FLUIDIZER™** vanes. The **PISTA® GRIT FLUIDIZER™** vanes shall be located within 6" of the elevation of the pump suction inlet.

B. The **PISTA® GRIT FLUIDIZER™** vanes shall be bolted to the propeller drive tube in a helical fashion so as to gently pump the grit upward and keep the grit fluidized at the grit pump suction inlet.

C. The **PISTA® GRIT FLUIDIZER™** vanes shall be fabricated of the same material as the drive tube. The **PISTA® GRIT FLUIDIZER™** vanes shall be bolted to the drive tube to facilitate easy removal of the drive tube.

D. The **PISTA® GRIT FLUIDIZER™** shall be a helical pump that provides two (2) functions:

1. The **PISTA® GRIT FLUIDIZER™** vanes shall continuously pump the grit upward at the center of the **PISTA®** Grit Collection Chamber. This gentle pumping action shall prevent the grit from packing down around the pump suction pipe. The fluidizing action shall prevent grit that has a sticky or greasy consistency from packing together to the point where the pull of water created by the pump might not break it loose. The **PISTA® GRIT FLUIDIZER™** vanes shall keep the grit fluidized at the suction inlet so packing cannot occur.

2. The upward pumping action of the **PISTA® GRIT FLUIDIZER™** vanes shall enhance the performance of the propeller in keeping organics in suspension. This shall cause the heavier grit to fall downward through the gently circulating water, and enable the organics to be more readily swept away by the currents induced by the **PISTA®** propeller.

2.06 TURBO GRIT PUMP

A. The pump shall be a 4" vertical, close-coupled type with curved 5-vane flow inducer completely out of the flow path between the pump inlet and discharge connection, so that the grit pumped is not required to pass through the impeller.

B. All internal clearances shall provide for the passage of a 3" spherical solid to preclude clogging of the pump and suction line.

C. The pump shall be vertical, for easy removal of the motor and impeller, to facilitate maintenance of the suction line by providing a straight path to any potential blockage.

D. The pump shall be of Ni-Hard construction, with Ni-Hard impeller, and especially designed for the use of mechanical seals.

E. In order to minimize seal wear caused by lineal movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 1-7/8". The dimension from the lower bearing to the top of the impeller hub shall not exceed 6".

F. The bottom bearing of the motor shall be locked in place and designed to handle all thrust loads and the necessary radial load. The upper bearing shall be free to move up and down and, thus, carry only radial load. This movement allows for thermal expansion of the shaft.

G. The shaft shall be solid stainless steel through the mechanical seal to eliminate corrosion and abrasive rust particles. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified 1-7/8" minimum diameter. Carbon steel shafts are not acceptable.

H. The impeller shall produce a turbine-like flow pattern within the casing, generating flow. To prevent grit from entering the seal area, all impellers less than full diameter shall have an untrimmed back shroud so that a minimum clearance from shroud to casing is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

I. The pump shall be specifically designed for vacuum priming service and have been proven in this service for a period of at least ten (10) years. The pump shall have an adapter providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication and grit shall be excluded from this area by a full size, untrimmed, impeller shroud. Pumps, which do not use hollow priming adapters for positive lubrication of the seal, will not be acceptable.

J. The pump shall be arranged so that the complete rotating element can easily be removed from the casing without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal.

K. The seal shall be of carbon and ceramic materials with the mating surface lapped to a flatness tolerance of one light band. The rotating ceramic shall be held in mating position with the stationary carbon by a stainless steel spring. The **PISTA® TURBO GRIT PUMP™** shall be capable of delivering 250 GPM against a total dynamic head of 15-18'.

L. The maximum allowable speed shall be 1170 RPM. The minimum rated horsepower of the **PISTA® TURBO GRIT PUMP™** motor shall be 5 HP.

M. The pump motor shall be vertical, solid shaft, TEFC explosion-proof NEMA P-base, squirrel-cage induction-type, suitable for 3-phase, 60 cycle, 460 volt electric current. It shall have Class F insulation, but the motor shall have Class B temperature limits. The motor shall have normal starting torque and low starting current, as specified for NEMA Design B characteristics. It shall have a 1.15 service factor.

N. The motor-pump shaft shall be centered, in relation to the motor base, within 0.005". The shaft run-out shall be limited to 0.003".

O. A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

P. The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.

MINIMUM REQUIREMENTS

Shaft through seal:	1-7/8" Diameter
Lower bearing to impeller distance:	6" Maximum
Shaft run-out:	0.003" Maximum
Shaft end play:	Limited to bearing shake
Shaft to motor base:	0.005" Maximum
Impeller to shaft fit:	Tapered
Impeller: Type: Material: Shroud:	Recessed 5-Vane **PISTA®** **TURBO™** Ni-Hard - High nickel iron Untrimmed - Full diameter
Seal housing:	Bronze
Fronthead to casing:	One piece
Backhead & motor adapter:	One piece
Upper bearing:	Axially free
Lower bearing:	Locked in place
Motor insulation:	Class F
Motor temperature rise:	Class B
Motor service factor:	1.15

Pumps will only be considered if all of the above requirements are met as a minimum. These requirements are specified for long service life and ease of operator maintenance. Deviations from the grit pump specifications will be cause for rejection.

2.07 ELECTRICAL CONTROLS FOR AUTOMATIC GRIT REMOVAL

A. The grit system control equipment shall be mounted in a NEMA Type 4 - 304 stainless steel enclosure with hinged, lockable doors. All components within the control panel shall be UL listed or recognized, and the complete grit system control panel itself shall be labeled as a UL 508A General Use Industrial Control Panel.

B. To facilitate wire tracing and servicing, the control wiring shall be run in enclosed wireways, with removable covers, rather than tied up in bundles.

C. Control relays up to 6-amp capacity shall be the modular, plug-in type, with integral LED indicating lights to show activation. Larger control relays shall be enclosed to be "finger safe".

D. A duplex GFI protected convenience outlet shall be provided in the panel for operation

of 120-volt AC devices.

E. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short-circuit protection of all auxiliary circuits, and thermal magnetic circuit breakers with lockout capability shall be provided for each drive and pump motor, matched to the motor inrush current.

F. Magnetic across-the-line starters with 24-volt coils and solid-state overload protection for each phase shall be provided for each motor to give positive protection against phase unbalance, thermal overload, phase loss and ground fault. To provide the fastest trip speed and for ground fault protection, only solid-state overload protection will be used, and motor starters using heater coils will not be acceptable. Each single-phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. Circuit breakers shall be used in lieu of fuses, to eliminate the need for stocking spare fuses. All switches shall be labeled and a coded wiring diagram shall be provided.

G. Individual NEMA 4 oil-tight Hand-Off-Automatic selector switches shall be provided for the pump and dewatering device drives and the flush water solenoid control.

H. An On-Off selector switch shall be provided to operate the propeller drive motor starter.

I. To control the operation of the grit removal and dewatering system, and monitor the control, environmental and alarm functions, a specially preprogrammed, dedicated microprocessor-based control system shall be provided. The controller shall interface with the panel display unit, motor starters, flush water, accessories and alarm functions through digital and analog input and output ports as required. The digital controls shall operate on 24 volts or less, to eliminate shock hazard.

J. The 24-volt DC power supply shall be overload protected to be “crowbar safe” and will return to operation when a short is removed. Program integrity shall be maintained by battery-backed RAM. A surge suppressor with power filter shall be provided for the control circuits.

K. A NEMA 4 stainless steel rated display unit shall be mounted through the front of the panel to provide operator input to and visual output from the microprocessor controller. An aluminum hood to shade the HMI display from direct sunlight shall be mounted on the face of the control panel. The metal shade shall cover the entire display, shield the top and sides of the display, and shall be hinged to fold over the display and stow against the front of the panel.

1. This interface shall be a 10.4” graphic interface with color active-matrix TFT Liquid Crystal Display with backlighting have a “sleep” feature to prolong screen life. Menu screens shall be available for display and management of grit system control functions listed below:

“Run – Off” indication for drives and pump Grit removal cycle time settings and indication of remaining run time Set time intervals for pump run time, prime fail

alarm, dewatering device run time, View current status Alarm list/status and diagnostics
A “prime failure” alarm shall be initiated if pump does not prime within a programmable pre-set time. Interlocks shall be provided to prevent the **PISTA® TURBO GRIT PUMP™** from operating if the pump is not primed. A common alarm contact shall be provided to indicate any of the following faults: Vacuum Prime Fail, Conveyor fail to start, Overload Trip (Paddle Drive, Grit Pump or Dewatering device). A manual push button alarm reset shall be provided.
Provisions shall be made to allow interfacing the grit system PLC with a Customer supplied SCADA system, using an Ethernet IP connection.
To control the operation of the **PISTA® TURBO GRIT PUMP™**, a manual Hand-Off-Automatic selector switch shall be provided. In the Automatic position, control shall be from the PLC program, with a manual push button to override the timed program and initiate a pumping cycle. A manual push button shall also be provided to reset the grit removal cycle. The program shall be capable of initiating grit pumping cycles at adjustable intervals throughout the day. The pumping cycle and dewatering device cycle lengths shall also be programmable.
A pneumatically controlled discharge pinch valve shall be furnished for installation in the vertical discharge piping run, and the controls shall be located in the control panel. The controls shall utilize plant air and and solenoid valve to operate the pinch valve. The operation of the discharge pinch valve shall be tied into the PLC controller and the **SONIC START®** level sensor, so as to be fully automatic.
All necessary capacitors, relays, diodes, etc., shall be provided as shown on the schematic diagram. In order to ensure continuity of operation, the Manufacturer of the **PISTA® GRIT CHAMBER™** shall provide these controls, and the full-opening pneumatically controlled pinch valve for installation on the grit discharge line as shown on the drawings.

2.08 MANUFACTURER INFORMATION

A. CORROSION PROTECTION

1. All structural carbon steel surfaces shall be Factory-blasted with steel grit to remove rust, mill scale, weld slag, etc. All weld spatter and surface roughness shall be removed by grinding. Surface preparation and coatings shall comply with Section 09 90 02 specifications. Immediately following cleaning, a single 3-mil dry film thickness of red oxide primer shall be Factory-applied prior to shipment.

2. Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces, not otherwise protected, shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components, such as the grit pump, gear motor, etc., shall be furnished with the original

Manufacturer's coating.

3. Final touch-up and finish coating of the primed surfaces shall be the responsibility of the purchasing contractor, and shall be accomplished in the field. The purchasing contractor shall be responsible for ensuring that the finish coating is compatible with the above specified primer.

B. MANUFACTURING QUALITY

1. The specified Manufacturer markets, designs, fabricates and manufactures the grit chamber equipment at its own U. S. facility. The Manufacturer shall have on staff registered engineers, both in process and design. This would be for providing current capabilities in these areas as well as future capabilities after the equipment is installed and operating, for the best long term interest of the Owner. Alternate manufacturers will be required to show that they meet these criteria also.

C. INSTALLATION AND OPERATING INSTRUCTIONS

1. Installation and operation shall be in accordance with instructions provided by the Manufacturer.

D. START-UP

1. The Manufacturer shall provide the services of a Factory-trained representative for a minimum period of 2 days on-site to assist with the initial startup, and to instruct the Owner's operating personnel in the operation and maintenance of the equipment.

E. WARRANTY

1. The Manufacturer of the equipment shall warrant for one (1) year from date of startup, not to exceed eighteen (18) months from date of shipment, that all equipment he provides will be free from defects in material and workmanship.

2. In the event a component fails to perform as specified, or is proven defective in service during the warranty period, the Manufacturer shall repair or replace, at his discretion, such defective part. The cost of labor and all other expenses resulting from replacement or replacement of parts is not included. The repair or replacement of those items normally consumed in service such as seals, grease, light bulbs, etc., shall be considered as part of routine maintenance and upkeep.

3. It is not intended that the Manufacturer assume responsibility for contingent liabilities or consequential damages of any nature resulting from defects in design, material, workmanship or delays in delivery, replacement or otherwise.

PART 3 - EXECUTION OF TESTING PROCEDURE

3.01 TESTING PROCEDURE

A. Samples of grit shall be taken simultaneously from a minimum of 6 different locations in both the influent and effluent stream of the unit, at different points across the width of the bottom of the flume.

B. These samples shall be collected through 1"x 1" square grit sample probes located in the influent and effluent channels and routed to large containers to be utilized as settling basins.

C. During each test run, the 1" sample probes shall be monitored to ensure that there is no pluggage and that full flow is obtained.

D. The sample run times must be sufficient to capture a minimum of 500 grams (approx. 1 cup) combined influent post-burn, at all six (6) locations along the bottom of the channel. If less than 500 grams combined, influent post-burn samples were collected, the test will be void. Samplers that are not moved or multiport samplers will not be accepted.

E. The chamber shall be suitably baffled to minimize grit carryover and control velocity through the unit for maximum organic separation. Grit chambers incorporating the gravity principle will not be acceptable due to the turbulence in the flow, which prevents gravity settling from being effective and due to the extra area needed for settling fine grit. Aerated grit chambers, including those incorporating conventional settling criteria, are also specifically unacceptable.

F. To ensure the efficient transport of the grit and simultaneous lifting and discharge of the organic material, the bottom of the upper chamber covering the storage hopper shall be constructed of structural grade 304 stainless steel plate, free from rotation and shall be flat.

G. The grit moving across the bottom of the grit chamber shall be hydraulically scoured as the propeller blades, moving within 6" of the grit, pass over the moving grit and cause hydraulic currents to lift up the organics. The grit scouring intensity shall be adjustable. Propellers running with a center line greater than 8” from the bottom of the chamber will not be acceptable. The grit shall pass from the removal chamber through an opening in the transition plate and drop into a grit storage hopper.

END OF SECTION 46 23 23

SECTION 43 23 63
HUBER – GRIT WASHER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Contractor shall furnish, install and place into satisfactory operating condition one (1) grit washer for removing, washing and conveying grit particles before discharging the material into a dumpster as shown on the drawings and described in the following specification section. Grit will be delivered to the grit washer from a mechanical vortex style grit removal system. The washer will be located within a building. The grit washer will be utilized for the new City of Whitefish wastewater treatment plant with the following design conditions:

Average Dry Weather Flow	1.594	MGD
Average Wet Weather Flow	2.070	MGD
Peak Day Flow	5.600	MGD
Peak Hour Flow	6.062	MGD
Recycle Flow Rate	320	GPM
Average Day BOD_5 load	4459.4	lb/day
Average Day TSS load	3540.5	lb/day

B. The grit washer shall include the following:

1. Grit washer tank
2. Central inlet vortex chamber
3. Coanda tulip for directing inflowing grit slurry in radial direction to a circumferential overflow weir
4. Conical stratification tank with cover
5. Stirring device with gear motor
6. Fluidized grit bed at the bottom of the stratification tank for intensive grit washing and separation of particles dependent on their specific gravity difference
7. Grit conveying and dewatering screw
8. Controls and appurtenances
9. Grit Bagger system for holding grit in plastic tubes after discharge into hopper, utilizing *Longopac* bagger system by Paxxo including necessary adapters.

C. It is the intent of these specifications that all equipment called for under this section shall be supplied by a single supplier.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM) Publications:

1. Section A322: Carbon and Alloy Steel Bar Specifications.
2. Section A507-10: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled

B. Anti-Friction Bearing Manufacturers Association (AFBMA) Publications:

1. Standard 9-90 Load Ratings and Fatigue Life for Ball Bearings.
2. Standard 11-90 Load Ratings and Fatigue Life for Roller Bearings.

C. American Institute of Steel Construction (AISC) Publications

D. American Welding Society (AWS) Publications

E. American Structures Painting Council (ASPC) Publications

1.03 SUBMITTALS

The following information shall be submitted to the Engineer. In accordance with Section 01300, copies of all materials required to establish compliance with this Section. Submittals shall include the following:

A. Product Data: Include the following:

1. Descriptive literature, brochures, catalogs, cut-sheets and other detailed descriptive material of the equipment.
2. Motor characteristics and performance information.
3. Gear reducer data including service factor, efficiency, torque rating, and materials.
4. Parts list including a list of recommended spare parts.

B. Shop Drawings: Include the following:

1. Manufacturer’s installation drawings.
2. Wiring and schematic diagrams.

C. Operations and maintenance manual: See Section 01300.

D. Detailed installation instructions, with clear step-by-step points on the correct mechanical and electrical installation procedures.

E. Equipment weights and lifting points.

F. Recommendations for short and long term storage.

G. A copy of the manufacturer’s warranty

H. A copy of documents proving certification of the Manufacturer’s Quality Management System according to ISO 9001 and Environmental Protection Management System according to ISO 14001.

I. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

1.04 QUALITY ASSURANCE

A. To ensure quality, conformance, and reliability with regard to the manufacturing and production of the equipment, the manufacturer shall meet all requirements listed hereafter:

B. Manufacturer shall have a minimum of twenty (20) years experience producing equipment substantially similar to that required and shall be able to submit documentation of at least fifteen (15) independent installations using the same size or larger equipment as detailed in the below. Each installation must have been in satisfactory operation for at least five (5) years.

C. The Contract Documents represent the minimum acceptable standards for the grit washing equipment for this project. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. The entire unit shall be Manufacturer's standard product, but shall be modified, redesigned, furnished with special features or accessories, made of materials or provided with finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the specification.

D. The entire unit shall be manufactured from AISI 304L stainless steel shapes. All components made of stainless steel shall be passivated by full submergence in a pickling bath for perfect surface finishing. No stainless steel components may be fabricated or assembled in a factory where carbon steel products are also fabricated, in order to prevent contamination by rust.

E. Electric motors, gear reducers, and other self-contained or enclosed components shall have an acrylic enamel finish.

F. All stainless steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid (pickling bath) to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. No stainless steel components may be fabricated or assembled in a factory where carbon steel products are also fabricated, in order to prevent contamination by rust. Glass bead or sand blast or chemically treatment processes not based on nitric acid / hydrofluoric acid for stainless steel shall not be allowed.

G. Fabrication shall be done in compliance with all applicable ASTM standards or equivalent international standards.

H. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide for a cross section equal to or greater than the parent metal. Butt welds shall fully penetrate to the interior surface and gas shielding to interior and exterior of the joint shall be provided.

I. Bolts, nuts and washers shall be selected from AISI 316L stainless steel such that they are anti-seizing.

J. Manufacturer shall have established an ISO 9001 certified quality management system. Equipment suppliers not utilizing ISO 9001 facilities shall not be considered or approved for this project. Equipment supplier shall provide evidence of certification before being named as an acceptable manufacturer.

K. Manufacturer shall have established an ISO 14001 certified environmental protection management system designed to monitor and help minimize the harmful effects on the environment caused by its manufacturing processes. Equipment suppliers not utilizing ISO 14001 facilities shall not be considered or approved for this project. Equipment supplier shall provide evidence of certification before being named as an acceptable manufacturer.

L. All welding is performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.

M. Manufacturer shall provide grit washer, motors, gear reducers, control stations, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system. The manufacturer shall test-run the fully assembled machine in his factory before shipment.

N. Manufacturer shall provide services by a factory-trained Service Engineer, specifically trained on the type of equipment specified. The Service Engineer requirements include, but are not limited to the following:

1. The Service Engineer shall be present during initial energizing of equipment to determine directional testing as described in Section 4.03 (Installation).

2. The Service Engineer shall inspect and verify location of anchor bolts, placement, leveling, alignment and field erection of equipment, as well as control panel operation and electrical connections.

3. The Service Engineer shall provide classroom and/or field training on the Operation and Maintenance of the equipment to operator personnel. These instructions may include the use of slides, videos, literature, and/or oral presentations.

4. Manufacturer shall state field service rates for a Service Engineer to Owner and Contractor. In the event that the field service time required by this section should not be sufficient to properly place the equipment into operation, and the requirement for additional time is beyond the manufacturer's responsibility, additional time shall be purchased by Contractor to correct deficiencies in installation, equipment, or material without additional cost to Owner.

1.05 ENGINEER'S PRE-APPROVAL OF ALTERNATE EQUIPMENT

A. Design is based on the Huber grit washer RoSF4. If Contractor desires to supply equipment from another manufacturer, contractor shall be responsible for all necessary modifications to the piping, electrical, structural, and mechanical layouts to

accommodate the equipment proposed. The contractor shall be responsible for all additional charges by engineer for additional work resulting from the selection of other equipment.

B. Manufacturer of alternate equipment shall submit a pre-approval package to Engineer at least two (2) weeks prior to bid date or as specified elsewhere. Alternate manufacturer shall submit the following information and supporting documentation. This information package shall include a signed statement by an Officer of the Manufacturing Company that he has reviewed and that he confirms accuracy of the provided information.

1. A reference list of all installations of the same type or similar equipment including contact names and phone numbers. At least 15 of the installations shall be of the same size and shall have been in successful operation for at least 5 years.
2. A complete set of drawings, specifications, catalog cut-sheets, and detailed descriptive material. Drawings shall show all relevant details of the unit. This information shall identify all technical and performance requirements stipulated on the drawings and in the specification. If the proposed equipment does not meet these specifications, any deviation from the specification must be expressly noted. All deviations shall be listed on a single document.
3. Detailed installation drawings illustrating how the proposed grit washer will be installed. The drawings shall include plan, elevation, and sectional views of the installation. Drawings shall include details of anchor bolt locations.
4. Hydraulic performance curves showing the relationship of capture rate versus the full range of flow rates up to the peak flow as detailed in paragraph 2.02. Curves based upon other manufacturer's data will not be accepted.
5. Documentation showing capture rates for a grit particle size of 200 micron depending on the flow through the grit washer. Such diagrams must include calculated as well as measured capture rates.
6. Test reports by independent investigators for a minimum of five (5) installations must be provided proving that the organic content of the washed grit product at these tested installations has been below 5%.
7. Motor characteristics and performance information. Vendor data shall be furnished to confirm the torque and thrust rating of the drive.
8. Complete bill of materials for all equipment, showing dimensions and materials of construction of all components.
9. Certification by the manufacturer that all stainless steel equipment will be manufactured in a stainless steel only factory.
10. Certification that the entire equipment will be passivated by submersion in an acid bath as specified in chapter 2.03.C.

11. A copy of documents proving certification of the Manufacturer's Quality Management System according to ISO 9001 and Environmental Protection Management System according to ISO 14001.
12. Details of the control and instrumentation system including wiring diagrams.
13. Information on equipment field erection requirements including total weight of assembled components and weight of each sub-assembly.
14. List of recommended spare parts.
15. A maintenance schedule showing the required maintenance, frequency of maintenance, lubricants and other items required at each regular preventative maintenance period, including all buy-out items.
16. Failure to provide all required informationmay result in rejection of the pre-submittal. It shall be in Engineer's and Owner's discretion to accept or reject the pre-submitted alternate equipment.

PART 2 - PRODUCT

2.01 MANUFACTURERS:

A. RoSF4 Size 2 by HUBER Technology, Inc.

B. Or pre-approved alternate (see 1.05 above)

2.02 DESIGN AND PERFORMANCE DATA:

A. Number of units: 1 (one)

B. Design flow of grit slurry from grit trap per unit: 250 gpm

C. Maximum flow of grit slurry from grit trap per unit: 300 gpm

D. Grit processing capacity per unit: 1.5 ton/hr

E. Maximum water content in washed grit product at design flow: 10 %

F. Maximum volatile solids content in dried grit product at design flow: 5 %

G. Minimum capture rate of 200 micron quartz sand at design flow: 95 %

2.03 MATERIALS

A. Unless otherwise specified in these specifications, the entire equipment shall be manufactured from AISI 304L austenitic stainless steel shapes (rods, angles, and channels), pipes, and sheets. All mechanical parts shall be designed to handle the forces that may be exerted on the unit during fabrication, shipping, erection, and proper operation according to the O&M manual.

B. The entire equipment shall be manufactured in a stainless steel only factory to prevent contamination of the stainless steel with foreign contaminants.

C. The equipment, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. All stainless steel components and

structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. Submergence insures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and uniform corrosion protection.

2.04 COANDA GRIT WASHER:

A. Grit Washer Tank

1. Water containing grit from a grit chamber shall be introduced through a 6 inch inlet into the vortex chamber, creating a rotating flow pattern, and through the Coanda tulip into the grit washer tank. The grit slurry mixture shall be fed directly to the grit washing unit without the need for additional screening via a drum screen, designs requiring a screen to meet the performance requirements shall not be allowed. Designs incorporating a tangential side inlet entry shall not be acceptable.

2. The inlet connection of the grit washer unit shall be rotatable 360 degrees for site adjustment. Designs that incorporate a fixed inlet connection or that rotate less than 360 degrees shall not be allowed.

3. The water flow is directed by the Coanda from an axial flow to a radial flow towards the overflow weir that is provided at the circumference of the grit washer tank. This change of the flow direction leads to effective sedimentation of the grit towards the bottom of the grit washer tank.

4. The classified water shall pass over the overflow weir and discharge out of a single 8 inch clean water outlet.

5. Effective stratification of particles, depending on their specific density, but not depending on their particle size and weight, shall be achieved within the conical portion of the grit washer tank.

6. A 4 inch connection with an automatically operated one quarter-turn ball valve shall be provided for removal of organic material out of the conical section of the tank. The ball valve shall be directly flanged to the conical tank without any adapter or connection pieces to avoid clogging issues. The ball valve shall have a PVC body and ball to prevent binding when in contact with abrasive materials. Metallic ball valves which can bind in highly abrasive applications shall not be acceptable.

7. A 110VAC, single phase, electrically operated AUMA actuator shall be provided to provide automatic control of the ball valve. The AUMA actuator shall only be acceptable for the grit washer unit. The actuator shall be suitable for operation in a Class I, Division I, Group D hazardous location. The stirrer shall move organic matter toward this connection.

8. A 110VAC, single phase, pressure probe by VEGA shall be mounted in the bottom of the grit settling area to monitor the grit level within the tank and to control the operation of the grit stirrer and grit removal screw. The pressure probe shall be suitable for installation in a Class I, Division I, Group D hazardous location.

9. Designs incorporating Hydro-cyclones/concentrators or grit classifiers without washing feature will not be acceptable.

B. Fluidized Grit Bed

1. A fluidized grit bed shall be maintained in the bottom portion of the grit washer tank. Within this fluidized bed, the grit is intensively washed and organic material is effectively removed from mineral particles.

2. The grit washer shall be designed for a water supply of 22gpm with a minimum pressure of 29psi with a single 1-inch connection point for connecting to the treatment plants final effluent water supply.

3. Wash water shall be introduced into the bottom of the grit washer and dispersed through a perforated diaphragm to generate the fluidized bed in the bottom portion of the grit washer. This wash water shall also effectively flush the organic components out of the fluidized bed towards the overflow weir.

4. Wash water through the perforated plate diaphragm shall be distributed uniformly in order to reduce grit sedimentation on the bottom of the grit tank. The perforated plate neoprene diaphragm shall have a 2mm thickness.

5. The wash water manifold will be provided with a variable area flow meter with a transparent PVC casing to allow visual inspection of the internal float for manual flow rate confirmation. The variable area flow meter shall be factory installed and attached to the grit washer unit before shipment.

6. Wash water control shall be provided via a 1-inch 110V, 60Hz, Class I, Division I, Group D solenoid valve.

C. Grit Screw

1. Washed grit shall be removed through a central tube at the bottom of the grit washer. The stirrer shall move washed grit to the central tube. The grit to be removed shall drop into an inclined auger. This auger shall dewater and convey the grit above the level of the overflow weir. The washed and dewatered grit is discharged at the upper end of the auger.

2. Its inlet hopper shall be flange-connected to the grit discharge tube. The auger shall have a discharge height of 96” (2443 mm) above the floor. Its inlet hopper shall be provided with a 3” diameter (DN 80) drain connection that is provided with a ball valve. The drain connection shall also be provided with a 3/4” flush connection with ball valve.

3. The screw conveyor trough shall be made of minimum 10/64 inch (4 mm) thick stainless steel.
4. The screw shall be shafted and shall be made of stainless steel. A shaft-less screw is not acceptable. The lower end of the screw shaft shall be supported by a chilled cast-iron stub bearing with a maintenance-free ceramic sleeve. Wear strips are not acceptable.
5. The grit screw design shall have intelligent screw flights preventing clogging issues within the grit screw.
6. A screw drive shall be provided at the upper end of the auger. The motor shall be continuous duty rated and shall be selected to match the duty of the particular grit conveying screw. The drive unit shall be directly coupled to the grit conveying screw drive shaft

D. Grit Stirrer

1. The center stirrer shaft diameter shall be 60 mm and shall have a thickness of 5 mm. The stirrer arms shall be 30 mm in diameter and constructed of 304L stainless steel. The stirrer shall consist of a minimum of 2 arm sections. The stirrer design shall promote better discharge of organics, grit bed fluidization, and ability to discharge larger stones.

E. Motors

1. Grit Screw
    a. Maximum Motor Speed: 1760 rpm.
    b. Service Factor: 1.15
    c. Torque must be sufficient to start and operate grit washer without exceeding nameplate ratings for current and power.
    d. Rating: 230/460V, 3-phase, 60 Hz.
    e. Location Rating Class I, Division I, Group D
    f. Nominal power screw drive motor: 1.5 hp
2. Grit Stirrer
    a. Maximum Motor Speed: 1760 rpm.
    b. Service Factor: 1.15
    c. Torque must be sufficient to start and operate grit washer without exceeding nameplate ratings for current and power.
    d. Rating: 230/460V, 3-phase, 60 Hz.
    e. Location Rating: Class I, Division I, Group D
    f. Nominal power stirrer motor: .75 hp

F. Anchor Bolts

1. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Anchor bolts, hex nuts, and washers shall be stainless steel. Anchor bolts shall be wedge or epoxy type.
2. Anchor bolts shall be set by the contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout

G. Control System

1. All controls necessary for the fully automatic operation of the grit washer shall be provided, including a NEMA 4X main control panel, and a NEMA 7 local control station. The control system shall be compatible with the City of Whitefish plant SCADA system.
2. The electrical control system shall provide for automatic control of the grit washer via a signal from the feed pump control panel.
3. Main control panel shall be suitable for outdoor, wall-mounting. Enclosure shall be NEMA 4X Stainless Steel with continuous hinge and lockable door latch, and shall include the following:
    a. Door-interlocked and fused disconnect
    b. 600 VAC terminal block
    c. NEMA motor starter and Circuit Breaker Branch Circuit Protection for grit screw motor
    d. NEMA motor starter and Circuit Breaker Branch Circuit Protection for grit stirrer motor
    e. Control power transformer with 120 VAC transient voltage surge compressor (TVSC) and fused primary and secondary
    f. Programmable logic controller (PLC), Allen Bradley Micrologix 1400
    g. Operator Interface (OIU), Allen Bradley PanelView 800
    h. Pilot lights for:
        i. Control power on (white)
        ii. Grit Screw running (green)
        iii. Grit Stirrer (green)
        iv. Organic Valve open (green)
        v. Grit Screw fault (red)
        vi. Grit Stirrer fault (red)
        vii. Organic valve fault (red)

viii. E-stop push button (red)

ix. Grit Washer reset push button (black)

i. Door mounted elapsed time meters for the following:

i. Screw drive

ii. Stirrer drive

j. Remote dry contact input for the following:

i. Machine start

ii. One spare input

k. Remote dry contact outputs for the following:

i. Grit washer running

ii. Grit Washer fault

iii. Grit Washer E-stop

iv. One spare output

l. Flashing alarm light and alarm horn with silencer-reset button

i. Plastic Nameplates

4. A local operator station shall be provided, and shall be suitable for wall-mounting. Enclosure shall be NEMA 7 cast Aluminum, and shall include the following:

a. Hand-Off-Auto selector switches for the following

i. Grit Washer drive

ii. Stirrer drive

b. Grit Washer forward-off-reverse

i. Grit Washer drive

c. Spray wash pushbuttons (push-to-test)

i. Solenoid valve

d. E-stop pushbutton (red)

H. Spare Parts

1. The following Spare Parts shall be included and supplied by Manufacturer:
2. One (1) perforated diaphragm (membrane)
3. One (1) complete solenoid valve assembly
4. One set of all special tools, if required, shall be included and supplied by the Manufacturer.

5. One (1) year supply of bags for the grit bagging device on the discharge chute.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Contractor shall install complete equipment in accordance with Manufacturer's instructions and as indicated and specified.

3.02 FIELD TOUCH-UP PAINTING AND FIELD WELDS

A. After installation touch-up paint shall be applied to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

B. Contractor shall passivate all field welds with pickling acid.

3.03 START-UP AND OPERATOR TRAINING

A. Manufacturer’s Service Engineer for the equipment specified herein shall be present at the jobsite for one (1) trip and three (3) man-days, travel time excluded, for installation assistance, functional testing, certificate of the installation, and Operator training.

B. Service Engineer must have a minimum of five (5) years of experience on the type and size of equipment specified.

C. Installation Inspection: Manufacturer’s Service Engineer shall inspect location of anchor bolts; check setting, leveling, alignment, field erection.

D. Start-up: Manufacturer’s Service Engineer shall calibrate and start-up the equipment.

E. Operator Training: Manufacturer’s Service Engineer shall provide classroom and field operator training.

3.04 PERFORMANCE AND PERFORMANCE TESTING

A. Grit Washer Grit Quality Test:

1. Summary

a. Manufacturer shall field test installed Grit Washing Equipment to demonstrate compliance with performance requirements specified in section 2.02 above. The following physical conditions shall be demonstrated by classifier(s):

i. Performance test shall be performed for each grit washer installed.

ii. Accept pumped design flow, in the case of the grit washer unit this is 250gpm.

iii. Produce dry grit with less than 10% moisture content.

iv. Have no visible fecal matter (less than or equal to 5% organic content) and be absent of putrescent odor.

v. Operate reliably without breakdown or stoppage due to blockage at all design conditions. Grit washer(s) shall have completed 120 hr systems demonstration prior to start of performance test.

vi. Require minimal operation and maintenance.

vii. Performance data will not be evaluated on a combined average of all units tested. Each unit must meet the design requirements.

b. Owner shall furnish labor for each sample collection and the manufacturer shall pay cost of laboratory analysis as specified herein, unless otherwise negotiated with owner. Performance analysis will be carried out at laboratory approved by owner.

2. Compliance

a. If test results demonstrate that equipment does not conform to requirements of specifications concerning organics residual and percent moisture, manufacturer shall have the opportunity to make improvements at no cost to owner.

b. Manufacturer shall perform a second test. If the second test has not successfully passed the organic and moisture performance parameters as specified, the OWNER will modify the contract cost or reject the grit washing equipment as a whole based first on failure of organic content, if organics content is acceptable then on moisture content as follows:

c. Organics content

i. 5% or less- 100% payment

ii. Greater than 5% but less than 7.5% - 75% payment

iii. Greater than 7.5% but less than 10% - 50% payment

iv. Greater than 10%, equipment will be rejected and manufacturer shall reimburse owner of all costs for providing and installing grit washing equipment.

d. Moisture content

i. 10% or less – 100%

ii. Greater than 10%, but less than 20% - 75% payment

iii. Greater than 20%, but less than 30% - 50% payment

iv. Greater than 30%, equipment will be rejected and manufacturer shall reimburse owner of all costs for providing and installing grit washing equipment.

e. Owner and/or owners representative shall be present for test.

3. Performance Requirements

a. Prior to performance test, washer shall have completed 120hr systems demonstration test, and grit shall be produced from grit discharge minimum of one week prior. If grit has not yet discharged from unit(s) within one week of performance test, manufacturer shall supply and fill unit(s) with amount of sand recommended in order to create a base and start producing grit. Unit(s) shall operate for one week following addition of supplemental sand prior to start of performance test.

b. Manufacturer shall guarantee and demonstrate that the grit washer(s) supplied shall meet the following performance requirements:

i. Grit Washer(s) shall be capable of accepting minimum flow of 250gpm from grit storage hopper of grit removal system containing grit, and possibly other settleable solids including vegetable matter, cigarette butts, popsicle sticks, rags etc, without plugging problems and loss of performance stipulated herein.

ii. Grit discharged to dumpster for disposal shall be clean with solids containing no visible fecal matter, and shall be free of putrescible odors.

iii. Organic content of grit discharged from each unit shall be 5% or less. The combined average organic content of all units tested is not acceptable. All vegetable matter within the sample shall remain and be included as part of the test.

iv. Moisture content of grit discharged from each unit shall be 10% or less. The combined average moisture content of all units tested is not acceptable. All vegetable matter within the sample shall remain and be included as part of the test.

v. Washer shall operate reliably without breakdown or stoppage due to blockage at all design conditions and shall require minimal operation and maintenance.

4. Test Procedure

a. As a requirement of this specification the manufacturer shall demonstrate that the grit washer(s) conform with the performance and operating criteria specified herein and the following tests shall be conducted at site on each operating grit washer unit:

i. Contractor shall provide clamp on type flow meter and shall be attached to grit delivery pipe from the grit pump and after calibration, flow readings shall be taken for a minimum three pumping cycles, or over one half hour of continuous run time, to demonstrate the grit classifier is operating at the specified flow.

ii. The organic content and moisture tests shall take place over a two week period. Plant staff shall take three (3) random 2-cup samples taken any 3 days within a consecutive two week period for a total of 9 samples.

Samples shall be taken immediately upon discharge from each classifier, sealed in a vapor tight container and sent out for testing the same day.

iii. The test results and observations shall be submitted for approval and acceptance by OWNER.

END OF SECTION 43 23 63

SECTION 46 23 66
GRIT STORAGE CONTAINER

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes furnishing and installing a grit storage container and associated materials in the grit building as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

1.02 SYSTEM DESCRIPTION

A. The contractor shall furnish and install one grit storage container with the outlet drains plumbed together with steel piping and a ball valve.

B. The storage container shall be located as indicated on the project drawings. The storage container shall drain into a floor drain when the ball valve is in the open position as indicated on the project drawings.

1.03 SUBMITTALS

A. Product Data

1. Prior to fabrication, grit storage container manufacturer shall submit all the required copies of submittal data for review and approval.

2. Shop drawings shall provide layout of container with dimensions material properties. Drain plumbing with steel pipe and valving.

B. Operation & Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the grit storage container manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied.

2. Documentation shall be specific to the grit storage container supplied and collated in functional sections. Instructions shall include the following as a minimum:

a. Functional description of each major component, complete with operating instructions and maintenance requirements.

1.04 QUALITY ASSURANCE

A. The manufacturer of the grit storage container shall have a quality management system in place and shall be certified.

1.05 MANUFACTURER'S WARRANTY

A. The grit storage container manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship.

B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be

replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.

PART 2 - PRODUCTS

2.01 CONTAINER CONSTRUCTION

A. The unit shall be a Model FL-3-0-O-S Front Loader Container Filter as manufactured by Flo Trend Systems, Inc. of Houston, Texas (800-762-9893 or an approved alternate. Vendors wishing to respond to this bid request with an alternate to the specifications must notify the Buyer no less than ten (10) days prior to the bid request opening date. If the proposed submitted alternate is acceptable, the Buyer will advise the other potential respondents, thereby maintaining equality in the bid process. Failure to advise the Buyer of pending alternate could result in rejection of the alternate proposal at the bid opening date.

B. Dimensions shall not exceed 74 1/2″ L x 44 1/2″ W x 51″ H (without casters) and not weigh more than 900 lb. empty. Internal area shall yield a minimum of 2.5 cubic yards of waste storage.

C. Front Loader Container Filter shall be constructed of A-36 carbon steel plate with 10-gauge floor, walls and end plates. The unit shall be rectangular in shape. Framing and supports are made of 10 gauge and 3″ formed channels.

D. The unit shall have one 2″ threaded drainage port provided on the container body below the bottom position of the interior floor support plate. One 2” threaded drainage port shall be provided to drain the sides and back.

E. Drain ports shall be plumbed together with steel pipe as indicated on the contract drawings.

F. Blunderbuss gussets are made of 7 gauge and sleeve gussets are 12 gauge and the taco gussets, sleeves and bottom channels are made of 10-gauge A-36 carbon steel plate.

G. Internal filter support system will be comprised of ¼″ angles, cold formed channels and removable filter support panels with frames made from perforated plate with 3/8″ holes on 1/2″ centers or 1-1/2 No. 9 flat both sides A-36 carbon steel expanded metal and reinforced with flat bars.

H. All removable filter panels shall have a ¼″ x 1/2″ wide neoprene gasket installed between the panel and framework. Chalking or other sealant is not an acceptable gasket material.

I. Filter Media shall be four pieces made from Flo Trend Systems Poly 2004. Poly 2004 Filter Fabric Specifications: Fiber: Polyester, Color: Clear White, Count: 64 x 24 (per inch), Weave: 6 x 2 Herringbone Satin, Warp Diameter: 500 Microns, Weft Diameter: 800 Microns, Weight: 38.9 (oz. per sq. yd), Tensile Strength: 1560 (lbs/inch), Air Permeability: 400 CFM, Water Permeability: 282 (mm3/mm2/s), Thickness: .083”, Micron Opening: 0 x 325, Micron Retention: 260, Open Area: 19%. A commercial heat knife and hole-maker shall be used for cutting ends and locating holes. No substitutions or alternates will be accepted.

J. Filter media shall cover each panel face and anchor into place with stainless steel

fasteners consisting of studs, flat washers and acorn nuts. Rivets or drive screws are not acceptable fasteners.

K. A two-piece sectioned rear hinged plastic cover shall be installed to cover the top opening.

L. Unit to be inspected and water tested for leaks prior to shipping

2.02 MATERIAL SPECIFICATIONS

A. Hot-rolled structural steel shapes and plates shall be ASTM A36.

B. Hot-rolled carbon steel sheet and strip structural quality shall conform to ASTM-A570 grades D & E.

C. Hot-formed welded and seamless steel tubing shall conform to ASTM A500 grade B.

D. Welded and seamless steel pipe shall conform to ASTM A53 grade B.

E. Stainless steel fasteners shall conform to AISI grade 304/305.

F. Welding electrodes are E70S used in gas metal arc process conforming to the specifications for mild steel electrodes for gas metal ARL welding AWS A518.

2.03 PAINT

A. All exposed welds shall be cleaned of welding slag and rounded. All exposed sharp edges and corners shall be rounded.

B. All steel metal surfaces shall be sandblasted to near white metal and commercially coated with a two-part epoxy primer.

C. The internal and external final surface shall receive 5 mils dry Corothane II industrial/marine coating.

2.04 OPERATION AND MAINTENANCE MANUALS

A. The manufacturer shall be responsible for supplying written instructions, which shall allow the operator to operate and maintain the equipment supplied. Instructions shall assume that the operator is familiar with piping, valves, and filter maintenance, but that he has not previously operated and/or maintained the exact equipment supplied.

B. The instruction shall be prepared as a system manual applicable solely to the equipment supplied by the manufacturer to these specifications, and shall include those devices and equipment supplied by him.

C. A minimum of two (2) operation and maintenance manuals with spare parts lists shall be provided at no additional cost.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 46 23 66

SECTION 46 33 42
MOTOR DRIVEN MECHANICAL DIAPHRAGM PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Metering pumps specified herein shall be of the motor driven, mechanical diaphragm-type with a maximum published flow rate up to 71.6 gph. Pumps shall be microprocessor controlled and offer the required input and output signals as specified in 2.01B below for optimum system control. The pumps shall be located in the Grit Handling Building and shall pump alum from the poly storage tank to either the reactor basins or the influent feedwell.

B. The diaphragm metering pumps shall be the standard equipment of the supplier involved in the manufacture of similar type equipment and shall be as manufactured by ProMinent Fluid Controls, Inc. or Engineer Approved Equal.

C. Equipment of a different type, size, weight or design of that specified herein can be offered. However, such equipment shall be acceptable only on the basis of the following:

1. Any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc., due to such a substitution shall be made at no additional cost to the Owner.

2. Changes in scope of equipment shall be the responsibility of the Contractor.

3. All modifications to the scope shall be approved by the Engineer and must be determined to be the equal of that specified.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. American National Standard Institute (ANSI)

2. Occupational Safety and Health Administration (OSHA)

3. National Electrical Manufacturers Association (NEMA)

4. National Electrical Code (NEC)

5. NSF International

6. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Section 46 33 83– Skid System

B. Section 43 41 43 – Alum Tank

1.05 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples.

B. Product Data:

1. One (1) electronic copy of submittal data will be supplied.

2. Component data and shop drawings of the system will be supplied, including dimensions, weight, and parts list.

3. When applicable control panel elevation, control schematics, and component data will be supplied.

C. Record Documents:

1. Warranty: Manufacturer's warranty form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

2. Operation and Maintenance Manuals: Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01 77 00, Closeout Procedures.

1.06 QUALITY ASSURANCE

A. The chemical feed equipment shall be the product of manufacturers that have designed and manufactured similar equipment and have a record of twenty years or more of successful operation of such equipment in the field. The manufacturer must have ISO 9001 Certification.

B. All equipment provided under this section shall be obtained from a single supplier or manufacturer that shall assume full responsibility for the completeness and proper installation of the chemical feed equipment.

C. To ensure quality and unit responsibility, the chemical metering pumps must be assembled and tested by the manufacturer at its facility and be a standard regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff and fabricating personnel to complete the work specified.

D. Prior to shipment, the chemical metering pumps shall be inspected for quality of construction verifying all fasteners and fittings are tight, all wires are secure and

connections are whisker-free. All chemical metering pumps shall be tested with water under pressure to verify capacity and pressure requirements are met. If leaks are found the equipment shall be fixed and a new test shall be conducted. All pumps shall include a test report verifying the performance of the pump under testing.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Diaphragm-type metering pumps required:

The chemical feed system as designed will require **four chemical feed pumps plus one spare**, each controlled independently but with similar function and capacity. The pumps will be skid mounted and will meter alum into each of the three treatment reactor basins. The fourth pump will feed alum to a feed well which directs flow to the reactor basins. The chemical pumps will feed alum in an anticipated concentration of 10 to 100 mg/l for a plant flow up to 2.1 MGD. Each pump will pump to a single point of injection.

Prominent Fluid Controls - Chemical Metering Pumps, Model: Sigma/2 Control Version b

The five Sigma/ 2 motor-driven diaphragm metering pumps feature a high strength inner housing for the mechanically loaded parts and an additional plastic housing to protect it from corrosion. The pump capacity is adjusted via the stroke length (5 mm), in 0.5% increments, with a self-locking rotary dial. Pump stroke frequency is controlled manually, or by 4-20 mA input signal. Specifics on each of the four pumps are as follows:

Version 07220 PVT Capacity Data: - Flow Rate: 71.6 gal/Hr, max - Pressure: 100 psi, max

Selected options:

- Liquid End Materials: PVDF
- Seal: PTFE seals
- Diaphragm Type: Safety Diaphragm w/ alarm indicator
- Liquid End Options: W/ valve springs (hastelloy C)
- Hydraulic Connection: PVDF clamping nut & insert, ½" MNPT
- Voltage Supply: 115 - 230V, 1 ph, 50/60 Hz
- Cable and Plug: 5m USA / 115V
- Relay: Fault Relay, with 4-20mA output
- Control Variants: Manual, Pulse, & Analog input speed control
- Operating Unit (HMI): HMI Module (0.5m cable), longer HMI cable lengths are available
- Access Code: With Access code
- Metering pump spare parts

- Spare pump, complete
- All required cables
- Half inch ball check valves for use on discharge piping

C. SCADA Interface Panel

Provide a Prominent **Three** Pump SCADA Interface Panel allows simplified wiring termination of the individual Pump Control Cables and Alarm / Analog Output Cables, together with the plant SCADA wiring. The Interface Panel also provides enhanced local control of each pump (H-O-A switch, pump speed control & status, pump running status, pump alarm, etc.) which pumps chemical solution to the reactor basins, as shown on the drawings. Also provide a Prominent **One** Pump SCADA Interface Panel which provides the same functional capacity for the single pump which pumps solution to the reactor basin feed well, as shown on the drawings. Typically the three pump system, in Auto mode, will be controlled by the AASI PLC (via the Grit Building PLC) and will set the alum dosage rate based on parameters monitored in the AGS reactors. The single pump system in Auto mode, will set dosage based on influent flow rate and will discharge alum into the influent feed well.

Panels includes:

- NEMA 4X FRP Enclosure (27" x 21.2")
- Main 20A circuit breaker (20A, 120VAC 1ph, 60hz power) one Circuit breaker for each pump (15A)
- H/O/A selector switches (1 per pump)
- P-16 digital process controllers
  Alarm pilot lights
- Misc terminals, relays as required

Inputs:

- Analog (4-20ma) speed command per each pump
- Digital (on/off) run command per each pump

Outputs:

- Digital (on/off) run status
- Digital (on/off) alarm status
- Digital (on/off) in-remote status
- Analog (4-20ma) speed indication

D. The pump manufacturer or manufacturer's authorized distributor or representative shall be responsible for the selection of the proper pump model based on the application information above. All pumps shall be selected to meet flow, pressure, control, communication and chemical requirements based upon best selection practices.

2.02 PUMP DESCRIPTION

A. The chemical metering pump(s) shall be microprocessor-controlled, motor-driven,

reciprocating, mechanically actuated diaphragm type. The pump shall include integral motor, oil-lubricated or permanently greased bearings, gear reducer and cam-and-spring drive mounted an aluminum housing. Such housing is to be sealed into an outer plastic housing for corrosion protection.

B. All pumping functions shall be set by membrane switch keypad and click wheel and status shall be displayed on an illuminated LCD. The keypad shall allow for simple scrolling and display of programmed parameters.

C. The pump shall be fully tested by the manufacturer prior to shipment to meet rated flow and pressure.

D. The pump shall have a universal power supply that allows it to operate at a supply voltage in the range of 100-230 VAC +/-10%, 50-60Hz, single phase.

E. The diaphragm shall be constructed of a solid core, vulcanized into nylon-reinforced EPDM, with a PTFE-faced fluid contact surface. The diaphragm shall have a convex design fitting into a concave liquid end to minimize dead volume and promote the flow of solids in suspension. The pump shall also have a diaphragm failure detector with a visible indicator of a diaphragm rupture. There shall also be an option for a fault indication or pump shut down in the case of a diaphragm rupture. Diaphragm options shall be supplied as specified in 2.01 B. above.

F. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the drive if the primary diaphragm fails.

G. The liquid end shall be either virgin PVDF. Pumps with PVDF liquid ends shall be NSF 61 Certified for use with standard water treatment chemicals. Pumps with 316 stainless steel liquid ends shall have suction and discharge valves made of 316 stainless steel with Teflon seals and stainless steel valve balls. Liquid end material selection shall be based on the best compatibility with the chemicals listed in 2.01 B. above. Chemical compatibility information should be made available at the customer's request.

H. Stroke length control shall be adjustable manually by means of a stroke length knob, in increments of 1%, from 0% to 100% of stroke length. Stroke length shall be determined by a sensor within the stroke adjustment knob that provides accurate feedback to the electronics of the pump for calibration and LCD display of stroke length. The digital display and optional analog output will calculate, display, and transmit the flow of the pump based on pump speed and stroke length settings.

I. Stroke frequency control shall be done with an integral VFD and stepper motor pump controller. For the integral controller, the first 1/3 of the frequency in strokes per minute will operate with the stepper motor and frequencies greater than 1/3 of the maximum will operate with the internal VFD. When specified in 2.01 B., control shall be switchable between manual or external control. In manual mode, stroke frequency control shall be manually adjusted by the touch keypad, with the set stroke rate displayed on the pump's LCD. In external mode, the pump shall be capable of receiving a 4-20 mA input via an optional external control cable. The metering pump shall be capable of remote ON-OFF

operation using the PAUSE function via a voltage-free contact relay through an optional control cable. The pump shall include a TEFC, four-pole AC motor.

J. It shall be possible to selectively slow the discharge or the suction stroke speed of the pump to accommodate application requirements and process fluid viscosity and off-gassing conditions.

K. When specified in 2.01 B., the pump shall be equipped with an output relay which shall be programmable for any of the following indications:

1. Fault Indication
2. Fault Indication and pacing relay
3. mA Output - The current output signal indicates the pump's actual calculated metering volume.

L. For simplified operator monitoring the pump shall be equipped with a three LED Display (Red, Yellow, and Green) to locally indicate normal operation, fault conditions, and warning conditions.

M. Operating Modes – The pump shall have the following operating modes available:

1. Manual operating mode permitting the operation of the pump stroke and speed controls manually.
2. Contact operating mode providing the option of controlling the pump externally by means of potential-free contacts (e.g. by means of a contact water meter). The number of pump strokes per input contact can be scaled by a factor ranging from 0.01 to 99.99 to tailor the pump feed rate to the application.
3. Batch operating mode providing the option of working with large factors (up to 99,999). Metering can be triggered either by pressing the Click wheel or by a pulse received via the "External control" terminal or through a contact or a semiconductor switching element. It is possible to pre-select a metering volume (batch) or a number of strokes using the Click wheel in the Settings menu.
4. The Analog operating mode allows the capacity and/or stroke rate to be controlled via an analog (4-20mA) current signal via the "External control" socket. The processing of the current signal can be preselected via the control unit.

N. The chemical metering pumps shall be Sigma ‘b’ Control Type Series models as manufactured by ProMinent Fluid Controls, Pittsburgh, PA or Engineer Pre-Approved Equal per 1.02 C. above.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. The equipment shall be installed per the contract documents and manufacturer's recommendations.

1. Provide a manufacturer's certificate showing the equipment has been satisfactorily calibrated and tested.

2. An authorized manufacturer's representative shall inspect the installation of all work furnished under this section and shall provide a certificate of proper installation.

3.02 MANUFACTURER'S SERVICES

A. The manufacturer or manufacturer's authorized distributor or representative shall provide the following:

1. Services of an experienced, authorized representative who shall be present at the job site and/or classroom designated by the City/District for the minimum man-days listed for the services shown below

2. One man-day per site for inspection, start-up, functional testing and certificate of proper installation

3. One man-day per site for training and commissioning

4. All services shall be inclusive of travel and associated expenses

3.03 WARRANTY

A. The chemical metering pump manufacturer shall provide a two-year warranty on the metering pump mechanical drive and one year on the liquid end and pump accessories.

B. Damage due to makeup water particulates will not be considered as a warranty defect and will be the responsibility of the owner.

END OF SECTION 46 33 42

SECTION 46 33 83
SKID SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This specification covers the supply and testing of completely functional, skid-mounted chemical metering pump feed system. The chemical feed system shall include two (2) skid assemblies containing 4 Sigma 2 chemical metering pumps, each with an independent function, all necessary piping, valves, fittings, supports, electrical controls and accessories as shown on the attached drawing and specified herein. The chemical metering pump manufacturer shall be responsible for manufacturing the skid-mounted chemical metering pump feed system. Skids manufactured by outside system integrators shall not be acceptable.

1.02 RELATED WORK

A. Section 46 33 42 Diaphragm Pumps

B. Section 43 41 43 PE Storage Tank

1.03 QUALITY ASSURANCE

A. For the purpose of establishing quality assurance, experience, and system reliability, the products described herein are based on metering pumps and a complete skid-mounted system manufactured by ProMinent Fluid Controls, Inc. All pumps and components shall be pre-assembled onto the skid-mounted system by the pump manufacturer and shop-tested for capacity and pressure prior to shipment with documented results provided.

B. The chemical feed equipment shall be the product of a pump manufacturer who has designed and manufactured similar skid mounted feed systems and equipment, and has a record of ten years or more of successful operation of such equipment in the field. The manufacturer of the chemical feed pumps and skid systems shall be ISO 9001 certified.

1.04 WARRANTY

A. The chemical metering pump manufacturer shall provide a two-year warranty on the metering pump mechanical drive and a one-year warranty on the liquid end, pump accessories, and the skid-mounted system.

1.05 SUBMITTALS

A. Manufacturers literature, illustration, specifications and engineering data including: dimensions, materials, size, weight, performance data, flow rate, motor horsepower (or current draw) and speed.

B. Operations and Maintenance Manuals

PART 2 - PRODUCTS

2.01 Manufacturers:

A. ProMinent Fluid Controls, Inc.

B. Pre-approved equal.

2.02 SKID-MOUNTED FEED SYSTEM

A. The skid mounting of the metering pumps shall conform to the following requirements:

1. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Components to be mounted on the skid are as indicated on the drawings and shall include the metering pumps, calibration column, piping, valves, piping accessories (pulsation dampeners, strainers, back pressure valves, pressure relief valves, etc.), and wiring integral to the skid. The chemical metering pump manufacturer shall be responsible for providing all equipment, valves and piping within the skid boundary.

2. The skids shall be constructed of fusion welded black polypropylene sheets with adequate supports for all equipment and piping and a ½" drip lip. Forklift truck cut outs shall also be provided.

3. All components of the skid-mounted system (pumps, piping and controls) shall be tested as described in Part 1.03 A.

B. Skid-mounted accessories to include the following:

1. Calibration Chamber:

a. Provide one, clear plastic calibration chamber with vent for use in calibrating each metering pump.

b. The chamber shall be sized to give adequate capacity for a minimum 30 second draw down test.

c. The scale shall give direct readings in mL and GPH without the need for calculations.

d. The calibration chamber shall be piped and valved so that each pump shall be able to utilize the calibration chamber without interfering with the operation of the other pumps. Alternately, 2 columns will be provided.

e. The top of the chamber shall have a threaded fitting to allow for piping to a common vent.

2. Pulsation Dampeners:

a. Shall be of the single diaphragm design, capable of arresting water hammer in the pump discharge lines created by the metering pumps.

b. Materials of construction of diaphragm and body shall be corrosion resistant to the chemical fluid pumped.

c. Provide one dampener on the discharge side of each metering pump.

d. Each pulsation dampener shall include an integral pressure gauge.

e. Pulsation dampeners shall be sized appropriately for each pump to remove a minimum of 95% of the pulsations. The manufacturer shall provide calculations to verify sizing if requested by the ENGINEER.

3. Backpressure and Pressure Relief Valves

a. Adjustable diaphragm backpressure sustaining type valve installed on pump discharge header and set at location recommended by manufacturer. Materials to be suitable for rated chemical service.

b. Adjustable diaphragm pressure relief valve installed externally on pump discharge header and set at location recommended by manufacturer. PRV required for each pump mounted on feed system. Materials to be suitable for respective chemical service.

4. Piping, Valves and Appurtenances:

a. Skid piping shall be Schedule 80 PVC. Cement shall be as recommended by the pipe manufacturer for the service outlined in this Section.

b. True-union ball valves shall be provided for isolation of major equipment. Seals shall be compatible with the chemical being pumped.

PART 3 - EXECUTION

3.01 SHIPPING, HANDLING, DELIVERY AND STORAGE

A. Packaging: The Contractor is to assume responsibility for packaging to prevent damage during site storage

3.02 INSTALLATION

A. The Contractor shall furnish the services of competent factory representative familiar with this installation and equipment to supervise installation.

B. All materials and equipment shall be clean and free of oil, grease and/or chemical contaminations prior to installation.

3.03 START UP AND TRAINING

A. Start up and training by chemical feed equipment factory representative shall be arranged and provide by the Contractor. The Manufacturers representative shall provide the service for successful equipment start up and plant personnel training.

END OF SECTION 46 33 83

SECTION 46 41 21
SLUDGE MIXING SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions;

B. Division 31 Section “Earthwork” for all site earthwork not covered in other areas;

C. Special Provision "Site Dewatering" for lowering and disposing of ground water during construction;

D. Division 3 for installation of cast-in-place concrete mounting pads for the sludge mixing system and pipe penetration collars beneath the polypropylene liner;

E. Division 33 for installation of the insulated floating cover, baffle and anchoring system;

F. Division 46 for installation of the aeration diffusers;

G. Division 40 for installation of aeration piping.

1.02 SUMMARY

A. The Contractor shall furnish and install one (1) complete mixing system(s) consisting of eight (8) pipe-mounted mixing nozzle assemblies with two (2) associated chopper pumps and associated suction and discharge piping. The nozzles shall be designed to produce a rotational mixing pattern within the Biosolids Treatment Basin (the “Basin”), while also producing flow across the middle portion of the basin thereby preventing solids from migrating towards the center. Solids are effectively drafted by the nozzle discharge to the outer 30% of the basin where the peripheral rotation will create a homogeneous state throughout the entire process suspending both organic and inorganic solids. The mixing pattern shall effectively prevent mounding in the center of the process. The Contractor shall be responsible for determining the appropriate mixing nozzle angles. The controls for these Mixing Pumps shall be contained within a Motor Control Center (MCC) that is supplied under Specification Section 26 24 19.

1.03 PERFORMANCE CRITERIA

A. The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

B. Pumps must be designed to handle raw, screened, domestic sanitary sewage sludge. Pumps shall have 12" suction connection, and 10" discharge connection. Each pump shall be selected to perform under the following operating conditions:

1. Single Pump Capacity (gpm) 4,000
2. Single Pump Total Dynamic Head (ft) 29

C. Pump Performance Certifications

1. Solids Handling Capability

    a. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

1.04 SUBMITTALS

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit all the required copies of submittal data for review and approval.

2. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for the mixing pumps. The electrical ladder logic drawings shall illustrate motor branch and speed control circuits to the extent necessary to validate function and integration of circuits to form a complete working system.

3. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), hydraulic brake horsepower (BHP) and pump turn-down capacity using the MCC's variable frequency drives (VFD's). Electrical components used in the motor branch and liquid level control shall be fully described.

B. Operation & Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall mixing system design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

    a. Functional description of each major component, complete with operating instructions.

    b. Instructions for operating pumps and pump controls in all modes of operation.

    c. Calibration and adjustment of equipment for initial start-up, replacement, or as required for routine maintenance.

    d. Support data for commercially available components not produced by the mixing system manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the overall mixing system and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, valves and piping.

1.05 Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.06 QUALITY ASSURANCE AND PERFORMANCE AFFIDAVIT

A. The contractor shall submit manufacturer's standard warranties for equipment to be furnished in accordance with this section. The pump warranty shall be manufacturer's standard for 1 year from startup, not to exceed 18 months from factory shipment. The nozzle warranty shall be a 10-year non-prorated warranty, commencing on the initial start-up date or when the system has been certified by authorized personnel of the manufacturer as ready for operation, not to exceed 18 months from shipping.

B. A performance affidavit shall be supplied to the contractor and owner certifying that the system as provided will meet or exceed the performance requirements for the specific application. The affidavit shall also include a statement that a minimum of 90% active mixing will occur within thirty minutes or less in the Basin. The mixing system shall produce a concentration differential not to exceed 10% of the solids geometric mean.

C. Alternates shall be pre-approved no less than 30 days prior to the bid date, accompanied by a list of no less than three (3) reference installations of mixing systems in identical service applications. References shall have been used in continuous service for a period of no less than three (3) years. Only equipment that is in service at the time of referral shall be considered valid. Telephone numbers and contact names shall be provided for any/all references upon request from the Engineer. Provision of performance bonds or other means of circumventing the above requirements for historical references and verification of past performance in identical applications are not considered an acceptable means of verifying the manufacturers’ experience.

1.07 SYSTEM RESPONSIBILITY

A. The mixing system as outlined for this project shall be the complete responsibility of the approved manufacturer listed. A complete system will be provided including pumps, motors, and nozzle assemblies. The contractor unless otherwise required in this specification section, shall supply pump suction and discharge piping to nozzles, piping supports, as well as control panels, valves, anchor bolts, gauges and other specialties. All performance and warranty requirements shall also be the responsibility of the approved

manufacturer.

B. The Mixing Manufacturer shall be responsible for submitting a Computerized Fluid Dynamics (CFD) analysis that will model the flows specific to the Basin within this specification. The CFD analysis shall indicate Volume Averaged Velocities equal to or greater than 0.45 ft/sec for the proposed mixing system. With the report, backup data, including underlying CFD computer files, shall be provided by the mixing system supplier to substantiate the results obtained. Proof of a current "license key" for the software used shall also be furnished.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURER

A. Mixing System shall be Rotamix® as manufactured by Vaughan Co., Inc. or pre-approved equal.

B. Chopper Pumps shall be Model HE10R12 manufactured by Vaughan Co., Inc. or pre-approved equal.

2.02 NOZZLE CONSTRUCTION

A. Nozzles: Shall be glass-lined cast ductile iron, with 1.0" nominal wall thickness to protect against abrasive conditions, and a long straight taper length of at least 10 inches.

B. Assembly Fittings: Shall be glass-lined cast ductile iron, with 150 lb. flanged piping connection.

C. Base: Shall be fabricated carbon steel, with ¾" mounting holes for 5/8" anchor bolts.

D. Anchor bolts: Shall be 5/8" diameter, and of sufficient length to support thrust loads from nozzles. Construction shall be 316 stainless steel.

2.03 SERVICE CONDITIONS

A. The mixing system shall be sized for the following service conditions:

1. GPM: 4,000
2. TDH: 29 ft.
3. HP: 60
4. RPM: 965

2.04 PUMP CONSTRUCTION

A. The Vendor shall furnish two (2) centrifugal, dry well horizontal chopper pumps and all appurtenances as specified. The pump shall be specifically designed to pump and agitate waste solids at heavy consistencies. Materials shall be macerated and conditioned by the pump as an integral part of the pumping action. The pump must have demonstrated the ability to chop through, mix and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications.

Pump shall be Model **HE10R12** as manufactured by Vaughan Co., Inc. or pre-approved

equal

B. Casing, Back Pull-Out Adapter Plate and Wear Plate: The pump casing shall be of volute design, spiraling outward to the 125 lb. flanged centerline discharge. A ½"-NPT pressure tap shall be included on or near the discharge flange. Back pull-out adapter plate shall allow removal of pump components from outboard of the casing, and allow external adjustment of impeller-to-cutter bar clearance. Casing and adapter plate shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. The back pull-out wear plate shall be heat treated low-alloy steel plate. Backplate will include a replaceable Rockwell C 60 steel wear plate adjustable for 0.030-0.050" clearance to cut against the rotating impeller pump-out vanes for removing fiber and debris.

C. Impeller: Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a maximum set clearance between the impeller and cutter bar of 0.015" - 0.025". Impeller shall be cast steel, heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be threaded to the shaft and shall have no axial adjustments and no set screws.

D. Cutter Bar Plate: Shall be recessed into the pump bowl and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.025” - 0.050” of the rotating external cutter tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Chopper pumps utilizing individually mounted shear bars, and which do not have a rotating external cutter extending through to the opposite side of the shear bar, shall not be acceptable. Cutter bar shall be alloy steel heat-treated to minimum Rockwell C 60.

E. External Cutter: The external cutter shall be used to eliminate binding or build-up of stringy materials at the pump inlet. The external cutter shall consist of opposing cutter wings which shear against the outside surface of the shear bars on the cutter bar plate, an integral cast anvil which shears against the adjacent surface of the shear bars on the cutter bar plate, and a hex head sufficiently sized for ease of removal. The external cutter shall be cast steel and heat treated to a minimum 60 Rockwell C Hardness.

F. Upper Cutter: Shall be bolted into the back pull-out adapter plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast steel, heat treated to minimum Rockwell C 60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.6 or less.

G. Pump Shafting: The pump shaft and impeller shall be supported by oil lubricated bearings. All shafting shall be heat treated.

H. Bearings: Shaft thrust in both directions shall be taken up by two back-to-back mounted single-row angular contact ball bearings, mounted in an adjustable position thrust bearing

cartridge to permit upper cutter to impeller adjustment. A single spherical roller radial bearing shall also be provided. B10 bearing life shall be minimum 100,000 hours.

I. Bearing Housing: Shall be ductile cast iron, and machined with piloted bearing fits for concentricity of all components. Bearing housing shall be oil bath lubricated with ISO Gr. 100 turbine oil and a side-mounted site glass. Viton® double lip seals riding on stainless steel shaft sleeves are to provide sealing at each end of the bearing housing.

J. Mechanical Seal: Shall be specifically designed to require no seal flush. The mechanical seal shall be made of 316 stainless steel and shall be a cartridge-type mechanical seal with Viton® O-rings and tungsten carbide faces. This cartridge seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a ductile iron seal gland as standard.

K. Inlet Manifold: The pump assembly shall be mounted horizontally with a 150 lb. standard inlet flange, drain, cleanout and mounting feet.

L. Shaft Coupling: Bearing housing and motor stool design is to provide accurate, self-aligning mounting for a C-flanged electric motor. Pump and motor coupling shall be T.B. Woods Sureflex elastomeric type.

M. Stainless Steel Nameplates: Shall be attached to the pump and drive motor giving the manufacturer's model and serial number, rated capacity, head, speed and all pertinent data.

2.05 MOTOR REQUIREMENTS

A. Drive motor shall be 60 HP, 965 RPM, 460 volts, 3 phase, 60 hertz, 1.15/1.0 service factor, foot and C-flange mounted, premium efficient TEFC enclosure. The motor shall be suitable for inverter duty service and sized for non-overloading conditions.

2.06 SURFACE PREPARATION

A. The pump unit shall be Sandblasted and a prime coat of Tnemec Perma-Shield PL Series 431 Epoxy and a finish coat of Tnemec Perma-Shield PL Series 431 Epoxy (for a total minimum thickness of 30 MDFT). (Except Motor)

B. Nozzle Assemblies shall be SSPC-SP5 commercial sandblasted and finished with 3M™ Scotchkote™ 134 Fusion Bonded Epoxy Coating. All fasteners shall be 316 stainless steel.

END OF SECTION 46 41 21

SECTION 46 51 31
BIOSOLIDS BASIN AERATION SYSTEM PIPING
AND MEMBRANE TUBE DIFFUSERS

PART 1 - GENERAL

1.01 SUMMARY

A. The design, fabrication, supply, and installation of the diffused aeration system shall be as specified herein.

B. The work shall include furnishing equipment, material and supplies to complete the work as specified herein.

1.02 QUALIFICATIONS

A. The design and supply of the diffused aeration system shall be by Lemna Environmental Technologies, Inc. or pre-approved equal. Alternative equipment manufacturers who wish to be considered must submit to the Engineer equipment specifications and submittal drawings, equipment operation and maintenance manual, CPA audited financial data from previous (12) months, list of all installations and the name, address and contact/telephone numbers of the owners for the last (10) U.S. installations. Above information is due no later than (15) days prior to the bid opening to allow engineer adequate time to perform due diligence.

B. The diffused aeration system supplier shall be experienced in the manufacture, installation, and operation of specified aeration systems, as demonstrated by a minimum of (20) years in the aeration system business and a minimum of (50) installed aeration systems.

C. The diffused aeration system supplier shall be experienced in the fabrication, assembly, and welding of polyethylene and ductile iron piping as demonstrated by a minimum of (10) years experience in the piping business and a minimum of (50) installed diffused aeration systems.

D. The diffused aeration system supplier shall be experienced in the manufacture, design, integration, and installation of similar aeration systems when used in conjunction with modular insulated floating pond covers, as demonstrated by a minimum of (20) years experience in the aeration system business and a minimum of (10) installed diffused aeration/ modular cover systems.

E. The diffused aeration system supplier shall be experienced in wastewater treatment processes and shall be prepared to demonstrate the effect of the aeration system supplied on the client’s process through documented analysis relating to flow, hydraulic retention time, and biological contact.

F. The diffused aeration system supplier shall have full time registered engineers specializing in wastewater treatment and licensed wastewater operators employed at their place of business to provide design services, installation supervision, start-up, training, and ongoing technical operations support.

G. The diffused aeration system supplier shall have documented water and wastewater treatment and design experience for minimum of (20) years.

1.03 SUBMITTALS

A. The diffused aeration system supplier shall furnish a submittal package to the Engineer for approval prior to fabrication. The submittal package shall include diffused aeration system plan, profile and section drawings showing all appurtenances, drawings of individual components showing dimensions and materials of construction, individual component cut-sheets, and product warranty.

PART 2 - PRODUCTS

2.01 AERATION SYSTEM

A. The diffused aeration system shall consist of specified quantities of individual components, including a blower system, a diffuser system, and in-basin piping.

B. The diffused aeration system serves as an integral part of the overall biosolids treatment process. The diffused aeration system supplier shall guarantee their product provides adequate treatment capabilities and shall accept responsibility for providing adequate air delivery according to end users' requirements.

2.02 DIFFUSER SYSTEM

A. A complete diffuser system shall consist of all diffuser components, including the connection to the feedline through the hardware for connection to the anti-flotation base. One supplier shall supply all components.

B. The diffuser shall be a flexible membrane tube type diffuser.

C. The diffuser shall achieve standard oxygen transfer efficiency (SOTE) of 1.44% per foot depth of submergence.

D. Each diffuser shall be provided with a lifting point for cleaning or replacement of the membrane without lowering the pond. Each lifting point shall be equipped with a 3/8" polypropylene rope.

E. Each diffuser shall be constructed in such a manner that the membrane is held to the support tube without glues or mastics.

F. The construction of the diffuser shall allow automatic purging of water from the aeration system during start-ups without additional components.

G. Anchoring hardware for the diffuser shall be provided with each diffuser.

H. The diffuser assemblies shall be the "low rate diffuser" manufactured by Lemna Environmental Technologies or approved equal.

2.03 IN-BASIN PIPING

A. A complete aeration piping system shall include the flange adapter, aeration lateral, feedline pipe, stainless steel hose clamps, and miscellaneous fittings. One supplier shall supply all components.

B. Flange Adapter

1. Flange adapter shall consist of a flange adapter with back up plate. All nuts, bolts and washers shall be supplied with header piping.

C. Aeration Laterals

1. The aeration lateral piping and fittings shall be assembled using a butt fusion welder as directed by the diffused aeration system supplier.
2. Minimum pipe physical properties shall be as those designated by PE 3408 Industrial Piping.
3. The minimum pipe pressure ratings for different pipe size thickness shall be as follows:

Thickness	Rating
1 ¼ " (3.2mm)	SDR11 1103.2 kPa/160 psi
2” (50.8 mm)	SDR11 1103.2 kPa /160 psi
3” (76.2mm)	SDR17 689.5 kPa /100 psi
4” (101.6mm)	SDR17 689.5 kPa /100 psi
5” (127mm) or greater	SDR17 689.5 kPa /100 psi

4. All tees and crosses shall be fabricated by Sidewall Fusion or equivalent.
5. Approved lateral piping shall be High Density Polyethylene (HDPE) Driscopipe 8000 as manufactured by Phillips 66, Georg Fisher or approved equal.

D. Feedline Piping

1. Feedline piping shall be EPDM (Ethylene Propylene Diene Monomer) reinforced with spiral synthetic cords.
2. Feedline piping shall be Yeoman 250 Hose as manufactured by YEOMAN, Valuflex, Parker or equivalent.

E. Stainless Steel Hose Clamps

1. Hose clamps shall be of the worm-gear type with the entire assembly constructed of stainless steel.
2. Clamps shall be as manufactured by Dixon or equivalent.

F. Miscellaneous Fittings

1. All fittings such as elbows, reducers, tees, crosses, etc., shall be constructed of the same material as the aeration lateral.

PART 3 - EXECUTION

3.01 The diffused aeration system supplier shall provide installation supervision services as part of overall diffused aeration system supply.

3.02 The diffused aeration system supplier shall provide technological wastewater treatment start-up services as part of overall diffused aeration system supply.

PART 4 - WARRANTY

4.01 The aeration system supplier shall warrant to buyer that all components furnished will be free from defects in materials and workmanship for a period of (12) months from the date of shipment. In the event of material or workmanship failure, supplier shall either repair or replace the damaged or defective components or services or refund payments to buyer for the components or services found to be defective.

4.02 The aeration system supplier shall be responsible for guaranteeing effluent quality according to the end user's requirements, as the aeration system is an integral part of the overall treatment process.

END OF SECTION 46 51 31

SECTION 46 66 56
UV DISINFECTION SYSTEM

PART 1 - SCOPE OF WORK

1.01 The work described under this section shall cover the furnishing of a complete and operational open channel, gravity flow ultraviolet (UV) disinfection system. The system shall be complete with sloped UV modules, integral module lifting mechanism(s), electrical cabinets housing the electronic ballasts, power distribution, system control, UV detection system, automatic mechanical wiping system and water level control device(s) as shown on the drawings and specified herein.

1.02 The system described herein shall be capable of disinfecting effluent to meet the water quality standards listed in this section.

1.03 All components that do not meet the technical requirements as specified herein shall be itemized on an appropriate deviation list. Deviations of critical items shall cause disqualification of bid.

1.04 These specifications are based on the UV system type WEDECO Duron Series from Xylem Water Solutions, Inc. The Owner will consider alternates if all requirements of this specification, in the opinion of the Engineer, are met.

PART 2 - QUALITY ASSURANCE

2.01 Pre-qualification Requirements: Any alternate UV System Supplier that is not named or listed as approved equal must submit the following 15 days prior to bid to be considered for approval:

2.02 Evidence of qualification and at least ten (10) years of experience in manufacturing and delivering open channel UV disinfection systems using low pressure high output amalgam lamps.

2.03 The proposed UV System Supplier must be able to demonstrate a minimum of one hundred (100) permanent installations of open channel low pressure, high output systems in similar applications.

2.04 Submittal including UV system details, control panel, lamp and ballast descriptions, and engineering reports stating head loss. Calculation or validation of the delivered dose will also be submitted for consideration.

2.05 The UV system must utilize True Dose Pacing Control as defined in paragraph 5.5 of this specification and control based on the following dose parameters: sensor intensity, flow rate, and UV transmittance. Based on these parameters, the system shall automatically vary the UV lamp power within a range of 50% to 100% proportionally to the dose requirement.

2.06 The UV system must be equipped with a viable automatic wiping system to clean the quartz sleeves.

2.07 A statement by the UV System Supplier listing any deviations or exceptions taken to these specifications will be submitted. State specification reference and proposed alternative with reason for exception.

2.08 Description of UV System Supplier's service capabilities including local support offered for technical service and spare part availability.

2.09 All UV manufacturers will be required to prequalify, unless the manufacturer is the base bid manufacturer.

PART 3 - DESIGN CRITERIA FOR THE UV SYSTEM

3.01 Wastewater Treatment

Prior to the UV system the effluent has undergone treatment in an advanced BNR treatment process.

3.02 Design Conditions

A.	Peak Flow:	6.77 mgd
B.	Average Design Flow:	2.1 mgd
C.	Total Suspended Solids:	10 mg/L, 30 day average of grab samples
D.	Annual Effluent Temperature Range:	5 to 35°C (41 to 95 °F)
E.	Ultraviolet Transmittance @ 253.7 nm:	64% minimum
F.	Quartz Sleeve Fouling Factor (FF)	0.958
G.	End of Lamp Life Factor (EOL)	0.89
H.	Effluent disinfection standards to be achieved:	126 E.Coli/ 100 mL (30 day geometric mean)

3.03 System Configuration

The UV system shall generally conform to the following configuration. Alternate UV systems requiring significant modification to channel size and configuration will not be allowed.

A.	Total number of channels:	1
B.	Number of channels operating during at average flow:	1
C.	Overall channel length:	26.86 ft
D.	Channel width:	57.7 in
E.	Channel depth:	6.23 ft
F.	Nominal water depth in channel:	3.61ft

3.04 Performance Requirements

A. The ultraviolet disinfection system will produce an effluent conforming to the

microbiological discharge limit as specified in paragraph 3.2. Grab samples will be taken in accordance with the Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, 19th Edition.

B. The UV system shall be designed to deliver a minimum validated dose of 30 mJ/cm2 per MS2 RED at peak flow and UVT conditions as described in paragraph 3.2 after reductions for sleeve fouling and end of lamp life (EOL) and including the validation factor. The basis for evaluating the UV dose delivered by the UV system will be the manufacturer's biodosimetric performance validation testing conducted by a recognized independent 3rd party expert according to the procedures described in the US EPA UV Disinfection Guidance Manual (2006) and IUVA Uniform Protocol. Validation testing shall have been conducted with an appropriate challenge organism reflecting the UV sensitivity of the targeted pathogens. For example, challenge organisms of T1 and Qβ are appropriately matched for fecal coliforms and E. coli. For systems designed based on the MS2 challenge organism, a RED bias factor of at least 2.5 shall be applied in order to prevent under design. Site specific UV sensitivity of the targeted organism shall be determined via collimated beam tests.

C. At a minimum the following parameters shall have been considered during validation testing:

1. UVT
2. Measured UV intensity
3. Flow rate per lamp
4. Power consumption
5. UV sensitivity of challenge organism
6. Head loss across UV banks

Validation testing that does not utilize all of the above parameters is considered inadequate as it does not allow for appropriate system sizing. Bids based on inadequate validation testing shall not be considered.

To be acceptable, UV sensor data must be collected during the biodosimetry validation testing.

D. An appropriate site specific UV dose should be established by use of collimated beam tests.

E. The UV system shall be capable of dose pacing to reduce electrical energy consumption in response to the disinfection demand based on a minimum of channel flow signal (provided by others through either SCADA communications or 4-20mA signal), the UV sensor signal(s) and the online measured UV transmittance.

F. For determining UV dose during operation and for dose pacing, the UV intensity signal shall be incorporated into the UV control system's validated operating equation. This provides the most reliable method of monitoring and controlling the UV disinfection process during operation.

G. To avoid misrepresentation and possible over-reporting of UV dose during operation, equipment that does not utilize the UV sensor signal in determination of operational dose shall not be accepted.

H. Lamp aging and sleeve fouling factors shall not be allowed in lieu of UV sensor signal(s) for determination of UV dose during operation.

I. End of Lamp Life Factor

1. The UV dose will be adjusted using an end of lamp life factor of 0.5 of initial UV lamp output. The use of a higher aging factor will be considered only upon review and approval of independent 3rd party certificate submitted with the bid.

2. UV dose will be adjusted using an end of lamp life factor of 0.89. Aging factors exceeding 0.9 are considered unrealistic and shall not be accepted to prevent under design of the system.

J. Quartz Sleeve Fouling Factor

1. The UV dose will be adjusted using a quartz sleeve fouling factor of 0.8 when sizing the system in order to compensate for attenuation of the minimum dose due to sleeve fouling during operation. The use of a higher aging factor will be considered only upon review and approval of independent 3rd party certificate submitted with the bid.

2. For sizing the system, the UV dose will be adjusted using a quartz sleeve fouling factor of 0.958. Fouling factors exceeding 0.96 of clean, clear quartz sleeves are considered unrealistic and shall not be accepted.

PART 4 - DETAILS OF CONSTRUCTION

4.01 GENERAL

A. The system shall be designed for immersion of the UV lamps in the effluent within their protective quartz sleeve.

B. The UV lamp connectors shall be located above the effluent water level and shall be accessible without removing the UV module from the disinfection channel.

C. The UV lamps and sleeves shall be removable while the module is in the disinfection channel.

D. The UV lamps shall be arranged at an angle of 45° in staggered rows to assure best mixing and minimal channel depth.

E. All metal in contact with effluent will be Type 304 or 316 stainless steel.

F. All materials exposed to UV light shall be 316 stainless steel, quartz glass, PTFE, FKM, or other suitable long-term UV resistant materials.

4.02 UV LAMPS

A. Lamps shall be low-pressure mercury amalgam “doped”, high intensity type. Lamps containing liquid mercury shall not be allowed.

B. The lamp filaments shall be pre-heated prior to striking of the arc in order to promote lamp longevity.

C. Lamp types with a polychromatic UV output or UVC output efficiency of less than 30% at 254nm are not acceptable.

D. Each lamp shall be tested in UV-output, lamp current and lamp voltage from the supplier. All results shall be stored in a database referencing to the individual batch number. The lamp batch number shall be printed on the lamp surface.

E. UV output energy of the lamp shall be variable from 50 -100% of UV-C ballast power input.

F. Useful lamp life shall be guaranteed at 14,000 operating hours for each lamp under normal operation conditions. Normal operation conditions include a maximum of four on/off cycles per 24 operating hours.

G. UV lamps shall not require a long cool down period (>10 minutes) prior to re-start should the power to the UV system fail or be interrupted for a short period of time.

H. Each lamp base shall incorporate a dielectric barrier or pin isolator. The pin isolator shall consist of a non-conductive divider placed between the lamp pins to prevent direct arcing across the pins in moist conditions. The barrier shall be dielectrically tested for 2500 volts.

I. The UV manufacturer shall ensure disposal of returned lamps (old/used) at no costs to the Owner upon receipt of the returned lamps at the manufacturing headquarters.

J. Lamps longer than 1600 mm should not be allowed to avoid handling risks and breakage during maintenance.

4.03 UV MODULES

A. The UV modules shall be designed for submergence without causing failures or damage to the system or components. Ballasts for powering UV lamps shall be located in electrical enclosures located away from the channel.

B. All electrical connectors and motors located on the module and above nominal channel water level shall either rated at IP67 or located within IP67 enclosures suitable for temporary submersion.

C. Each UV module shall be equipped with an interlock switch, which will automatically disconnect power to its associated UV bank if the module is raised from the UV channel or the quick disconnect plug is removed.

D. The UV module design and mounting shall provide plug and socket quick disconnect facilities enabling non-technical personnel to carry out lamp replacement, wiper insert replacement, etc., without the need for any tools or specialist isolation procedures.

E. Lamps shall be removable with the quartz sleeve and wiper system remaining in place.

F. The UV lamp sleeve shall be a single piece of clear fused quartz circular tubing, which shall not be subject to degradation over the life of the system

G. The lamp socket shall be centered against the inside of the quartz sleeve and shall be retained by a cap nut with a ribbed exterior surface providing a positive handgrip for tightening / loosening without the need for any tools. This connection includes a self-contained O-ring, sealing the lamp and socket module (independently from the quartz sleeve).

H. Each module to be designed to allow lifting from the operating position in the channel to a maintenance / storage position above the channel using an integral lifting mechanism.

I. Actuation mechanism(s) for lifting the module from that channel shall be driven by an electric motor or similar.

4.04 WIPING SYSTEM

A. Each UV module shall be equipped with an automatic wiping system with selectable wiping frequency.

B. Systems requiring removal of the module from the channel as the only means of cleaning will not be accepted.

C. The wiping system shall be controlled by the UV system controller and provide a fully automatic, unattended operation.

D. The number of wiping strokes per interval shall be factory preset for optimum effect to 4 strokes per time interval, with time intervals being user adjustable.

E. Actuation mechanism(s) for the automatic wiping system shall be driven by an integral electric motor within the module or similar.

F. When in the raised position, all module wetted components shall be accessible.

4.05 UV MONITORING SYSTEM

A. A submersible UV sensor shall continuously sense the UV intensity produced in each bank of UV lamp modules.

B. The UV sensor shall be according to ÖNORM M 5873-1 and shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 254 nm.

C. The measured UV intensity signal shall be fed into the UV System Controller and used for continuous monitoring and control of UV dose. In automatic mode the UV Control System shall automatically adjust to draw the minimum electrical power while maintaining the prescribed minimum dose required for disinfection. The UV dose shall be displayed on the operator interface as an absolute value in mW/cm^2.

D. Systems that use theoretical data or data from laboratories to determine lamp aging or fouling in the control logic should not be allowed. Only measured intensity and flow rate should be used to determine the actual disinfection performance / dose applied according to the validation protocol or design calculation method.

E. The UV sensor shall be automatically cleaned at the same frequency as the lamp sleeves to prevent fouling of the sensor and resulting false alarms for low intensity.

F. The UV sensor design shall be such that sensor can be easily removed without the

complete removal of the module from the channel.

G. There shall be no fewer than (1) UV sensor for every bank of UV lamps.

4.06 FIXED WEIR

A. Water level control inside the UV channel shall be provided by a fixed finger weir. The weir shall provide control of water level in the UV channel and be designed such that a maximum plume of 5.0 inches over the weir will not be exceeded to guarantee safe disinfection.

B. The fixed finger weir shall have a perimeter length of 138 inches. Additional length can be added Alternate perimeter lengths will not be allowed.

C. Weir material of construction to be 11 ga. 304 SS

D. Weir to be a full height assembly without the utilization of a “ramp” or “bench” to reduce the height of the weir.

4.07 Active level controls shall not be permitted

PART 5 - ELECTRICAL AND CONTROLS

5.01 GENERAL

A. Sensitive electronic components such as electronic ballast cards shall not be exposed to the risk of being flooded.

B. All heat sensitive components shall be adequately cooled with dry air utilizing forced or natural ventilation.

C. Systems or designs that expose sensitive electrical or electronic components to excess humidity or poor air quality for cooling are not acceptable.

D. Systems that lack positive mechanical heat transfer such as fans (or air conditioning) for the sensitive electronic components are not acceptable.

E. The electrical enclosures for the UV system shall utilize Nema 4X stainless steel enclosures.

5.02 UV SYSTEM CONTROL/BALLAST CABINET

A. The UV system shall be supplied with (1) UV Control 48 Panel to house the UV system PLC, operator interface, control and instrumentation equipment and plant interface termination points as well as the ballast and lamp management system. All UV monitoring and control functions shall be carried out by the Control 48.

B. Electrical power supply (by others) to the Control 48 shall be for 480/277 volts / 60 Hz (3) three phase 5 wire (WYE) including ground. Allowable voltage tolerance is +/- 10%.

C. Full application software will be generated by the UV equipment manufacturer to operate

the UV system, using the PLC manufacturer's proprietary software package.

D. Low UV intensity alarms shall be provided to detect possible water quality problems or fouling of the system. Alarm set point shall be field adjustable.

E. The Control 48 shall monitor individual lamp status and provide specific location of any faulted lamps.

F. The Control 48 shall monitor hardwired protection circuits, e.g., Module lifted, Module unplugged, Module over current, Bank isolation, etc., which will shut the appropriate area of the system down directly to aid rapid fault finding when personnel attend site.

G. The Control 48 cabinet shall be equipped with a temperature control device, which will shut off this part of the UV system in case of surpassing the critical limit of 50°C / 122°F. UV systems which do not have temperature control protection shall not be acceptable.

H. The Control 48 shall be equipped with a cabinet heater to prevent the formation of condensation due to humidity. UV systems which do not provide heaters to protect electronic components from condensation shall not be acceptable, even if the electronic components are theoretically completely sealed from the environment.

5.03 ELECTRONIC BALLASTS

A. The electronic ballasts shall comply with the CE & UL requirements, specifically the IEEE519 and the IEC 6100-3-2.

B. The ballasts shall be electronic microprocessor controlled, designed as slot cards fitting into a rack system with a plug connector for ease of maintenance.

C. Each ballast shall drive a pair of lamps with independent control and monitoring circuits, and provide individual lamp status information to the system control.

D. The ballast shall detect lamp failures and initiate a re-strike sequence, independently from any external influence. The ballast shall attempt three re-starts before shutting off.

E. The ballast shall incorporate a galvanic separation of the input and output circuits. In case of the output circuit operating in abnormal conditions regarding voltage and/or amperage, the ballast shall shut off the lamp concerned. Ballasts without this feature shall be equipped with one GFC per ballast.

F. The ballast shall incorporate a pre-heat circuit to heat lamp filaments prior to striking the lamp arc in order to promote lamp longevity.

G. The operating power factor for the ballasts shall be minimum 0.99 over the entire power range of the ballast.

H. One power factor correction circuit shall power a maximum of two UV lamps in order to increase system reliability.

I. The ballast efficiency shall be a minimum of 95% at maximum power and less than 94% across the entire range.

J. The ballast shall be capable of varying power between 50 – 100%.

K. The lamps shall be square wave driven by the ballasts for optimum UVC output efficiency and lamp life.

L. The ballast THD shall be less than 5%. Ballast enclosures exceeding this THD value shall be equipped with an active harmonic filter.

M. The ballasts shall be tested on line disturbances up to 4000 V.

N. The ballasts shall be capable to operate down to 208 V to increase system reliability with regards to voltage fluctuations.

O. Ballasts requiring liquid closed loop re-circulating heat exchanger systems, e.g., propylene glycol, for cooling shall not be permitted.

P. Ballasts requiring a watertight seal that needs to be broken during replacement shall not be permitted.

Q. Ballasts whose replacement requires the removal of the module from the channel shall not be permitted.

5.04 CONTROL AND INSTRUMENTATION

A. A UV Disinfection Management System shall control the On/Off cycling and lamp power of the UV banks based upon a dose pacing philosophy.

B. Control system shall utilize Allen Bradley PLC with PanelView Plus HMI and SCADA communication. Operating parameters shall be calculated and viewed on the HMI with output to the SCADA system.

C. The Management System shall utilize a UV sensor located within the UV bank(s) to accurately sense any change in UV intensity. The sensor signal together with the flow rate signal and UVT shall be sent to the PLC as input parameters to accurately control and adjust UV lamp output to the required level under all operation conditions.

D. Systems that take only flow and water transmittance into account are not acceptable.

E. Systems that rely on calculated lamp intensity reduction due to aging instead of measured UV intensity for UV dose calculations and UV system control are not acceptable.

5.05 ON-LINE TRANSMITTANCE MONITOR

A. The UV system shall be equipped with an on-line transmittance measurement device specifically designed for continuous monitoring of the effluent UV transmittance.

B. The measurement device shall consist of a stainless steel housing designed to be installed in the UV channel for monitoring of the effluent transmittance in the channel.

C. Pumping of the effluent shall not be required.

D. Transmittance monitors requiring pumping and straining of the effluent out of the channel to the monitor shall not be permitted due to their fouling tendency and maintenance requirement.

E. Manual systems, which require the operator to take samples or perform lab work, are not acceptable.

PART 6 - SPARE PARTS, SAFETY, AND STORAGE EQUIPMENT

The following spare parts and safety equipment shall be supplied:

6.01 One (1) UV Intensity Sensor

6.02 10% UV lamps

6.03 5% Quartz Sleeves

6.04 5% UV Ballasts

6.05 10% Wiper Rings

PART 7 - EXECUTION AND SERVICES

7.01 GENERAL

A. All components of the UV system shall be handled with care during transportation, storage and installation. The Contractor shall follow the Manufacturer's storage & handling instructions.

7.02 INSTALLATION

A. All installation of the UV equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces and saddles, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

B. The UV System Supplier shall provide four (4) hard copies of operation and maintenance manuals. One (1) additional electronic copy shall be provided also.

C. All equipment must be installed in accordance with the Manufacturer's instructions and approved drawings. Drawings used during the bid are not to be used for construction.

D. All components shall be fully tested and verified for service by the UV System Supplier or an authorized representative.

7.03 START-UP AND FIELD SERVICES

A. A field service technician or start-up engineer of the UV System Supplier shall commission the UV equipment.

B. Local manufacturer's representatives are not acceptable to perform these tasks unless authorized by the UV System Supplier.

C. The field service technician shall certify that all equipment is properly installed and that the plant operators have been trained on proper operation and maintenance procedures.

D. The minimum recommended man-days / trips for installation inspection, system commissioning, and operator training shall be as follows:

E. Inspection of installation, Start-up/system commissioning, Operator training: a minimum of three (3) man-days / one (1) trip.

F. Additional days are available on a per diem rate.

END OF SECTION 46 66 56

APPENDIX A

Project Drawings
(See bound copy of Construction Drawings)

APPENDIX B

DEQ Stormwater & De-Watering Permit Forms

Montana Department of Environmental Quality – Water Protection Bureau
Construction Dewatering General Permit
Daily Log

Construction dewatering activities authorized under the Construction Dewatering General Permit (CDGP, MTG070000) must be monitored in accordance with the CDGP. The permittee is responsible for recording required data on a daily log -- either on the attached form ("Daily Log") or a site-specific log that includes all the data required by the CDGP.

Records, including the daily log, must be maintained for at least three (3) years and be available for inspection by the Montana Department of Environmental Quality (DEQ). Permittees do not need to submit the logs to the DEQ unless requested.

In addition to the daily log, the permittee must submit completed Discharge Monitoring Reports (DMRs) to DEQ by the 28th of the month following each reporting month, as stated in the CDGP. **Monthly DMRs must be submitted until the Construction Dewatering authorization is terminated whether or not there is a discharge.**

Once dewatering is complete and the permittee determines that authorization to discharge under the CDGP is no longer required, they must submit a request for termination to DEQ. Based on this request, DEQ will terminate the permit authorization and the corresponding requirement to complete the daily log and monthly DMRs.

Specific Instructions for Daily Log:

If no dewatering discharge occurred for any period of record, indicate "no discharge" on the daily log.

Footnotes from Daily Log form:

1) Indicate yes for any visual observations of either elevated turbidity or an oil sheen. Visual observation of either parameter triggers the need for the permittee to cease discharging, take a grab sample for analysis, investigate the cause, and address the problem.
2) If any turbidity or oil & grease off-site analysis is performed, the permittee is required to maintain records of the date the analysis was performed, the name of the individual who performed the analysis, and what 40 CFR Part 136 analytical technique/method was used [see ARM 17.30.1342(10)(c).] For instance, EPA Method 180.2 is an acceptable method for turbidity, and EPA Method 1664A is an acceptable analysis for oil & grease.
3) For any visual observations or numeric turbidity exceedances, the permittee must follow their corrective action plan and include a summary of observations and follow-up actions on additional pages.

Construction Dewatering General Permit - Daily Log

Name of Permittee:_____ Name of Project:_____

MPDES Permit Number: MTG070_____ **Outfall Number**_____ **Month** _____ **Year** _____

(one form must be filled out per permitted outfall)

Day of Month/ Time	**Name / Initials**	**Discharge Turbidity High [1]? (Visual - Y/N)**	**Discharge Turbidity [2] (NTU)**	**Oil & Grease Sheen (Visual - Y/N) [1]**	**BMP Failures Observed? (Visual - Y/N)**	**Corrective Action Report Attached? [3]**
1/						
2/						
3/						
4/						
5/						
6/						
7/						
8/						
9/						
10/						
11/						
12/						
13/						
14/						
15/						
16/						
17/						
18/						
19/						
20/						
21/						
22/						
23/						
24/						
25/						
26/						
27/						
28/						
29/						
30/						
31/						

DEQ
Montana Department of Environmental Quality

WATER PROTECTION BUREAU

Agency Use
Permit No.:
Date Rec'd
Amount Rec'd
Check No.
Rec'd By

FORM
NOI-07

Notice of Intent Form
Construction Dewatering General Permit
MTG070000

READ BEFORE COMPLETING THIS FORM:
Before completing this form, the applicant needs to read the Construction Dewatering General Permit (CDGP). Certification of this Notice of Intent (NOI) is certification with the requirements in the CDGP. This NOI must be completed by the owner/operator responsible for construction dewatering activities who are seeking coverage under the CDGP. Please read the attached instructions before completing this form. You must print or type legibly; forms that are not legible, incomplete, or unsigned will be returned. You must maintain a copy of the completed NOI Form for your records.

Section A – Application Status *(Check one)*:

- ◯ New - No prior CDGP authorization or authorization request for this project/activity.
- ◯ Resubmitted - Permit Number: M T G 0 7 0 ___ ___ ___
- ◯ Renewal - Permit Number: M T G 0 7 0 ___ ___ ___
- ◯ Modification - Permit Number: M T G 0 7 0 ___ ___ ___ (*Discuss Modification in Section I*)

Section B – Site or Activity Information:

Site Name: _____

Location (site physical address or directions): _____

Nearest City or Town: _____ Zip Code: _____ County: _____

Latitude: _____ Longitude: _____

Township/Range/Section (*optional*): T _____ / R _____ / S _____

Is this site or activity located on Tribal Lands? ◯ No ◯ Yes (*If yes, stop and read instructions*)

Standard Industrial Classification (SIC) Codes:

Provide at least one SIC code and description which best reflects the project or activity at the site described above.					
Code		**A. Primary Description**	Code		**B. Secondary Description**
1			**2**		

Section C – Applicant (Owner/Operator) Information:

Organizational Formal Name: _____

Mailing Address: _____

City, State, and Zip Code: _____

Contact Name: _____ Title: _____

Phone Number: ( ) _____ Email Address: _____

Section D – Authorized Representative:

In order for future reports, including Discharge Monitoring Reports (DMRs), to be signed by anyone other than the signatory for this NOI, a duly authorized individual(s) or position(s) must be identified. If one is not designated then all reports must be signed by the signatory until such designation is made in writing [ARM 17.30.1323(2)].(*Check the appropriate box*):

◯ I designate the Contact listed in Section C as a duly authorized individual

Or

◯ I designate the following duly authorized representative for this permit (*complete information below*):

Name and Title, or Position Title: _____

Company Name (if different than the applicant): _____

Mailing Address: _____

City, State, and Zip Code: _____

Phone Number: ( ) _____Email Address: _____

Or

◯ No duly authorized representative for this permit is designated at this time.

Section E – Outfalls and Receiving Water(s):

Provide the latitude and longitude to the nearest second for each dewatering outfall. The specified location should be after all treatment and before release to the receiving water. Provide the name of the initial receiving water. If the initial receiving water is unnamed, please also indicate the closest named drainage the receiving water flows into (i.e. unnamed tributary to Clear Creek). Attach additional sheets if necessary for more outfalls.
Each outfall to a different receiving water segment is subject to additional application fees and annual fees.

Outfall No.	Latitude	Longitude	Receiving Surface Waters (Name)
001			
___			
___			
___			
___			
___			
___			
___			

MAP: Attach a USGS topographic map or aerial photo extending one mile beyond the property boundaries of the site or facility/activity identified in Section B depicting the facility or activity boundaries, any treatment area(s), outfall(s), major drainage patterns, and the receiving surface waters stated above.

☐ Map Attached

Section F – Proximity to Contaminated Site(s):

Will construction dewatering for this project occur in or near a known contamination site (SUPERFUND, leaking tank, etc.) or do you suspect the site has contamination? (*See instructions for further guidance*)

◯ No. (*Proceed with Section G.*)

◯ Yes: distance from nearest suspected area of contamination to construction dewatering is: _____ feet.
→ **Delineate suspected area of contamination on Section E map, or provide an additional map.**

The permittee must take a pre-discharge sample of the groundwater and/or surface water that is representative of what is proposed for discharge. The sample must be analyzed for any known or suspected pollutants of concern in accordance with 40 CFR 136. The laboratory's detection level should be able to report at or below Required Reporting Value (RRV) contained in Department Circular DEQ-7. The laboratory results need to be submitted with the NOI.

☐ Copy of Lab Results enclosed. Sample date _____.

If analysis shows contaminants present at concentrations above the RRV, the authorization request for coverage under the CDGP will be denied. If there are no contaminants present at concentrations above the RRV, DEQ will continue to process the request. DEQ may require additional future testing in the authorization letter. **If any testing results show contamination at levels higher than the RRV for any contaminant contained in Circular DEQ-7, the permittee must cease discharge and notify DEQ.**

Section G – Description of Expected Discharge Duration and Mitigation Measures:

Date construction dewatering discharge is anticipated to begin: _____

Date construction dewatering discharge is anticipated to end*: _____
*(*Note that the authorized signatory is required to submit a request for termination after all construction dewatering activity is complete: any authorization that is open into a calendar year is liable for the annual fees for that year).*

Rough estimate of average discharge flow rate [gallons per minute (gpm)] _____ gpm

✔ **Dewatering Plan:** will be completed prior to beginning construction dewatering, and implemented as part of the dewatering project. The Dewatering Plan will be maintained, and available to DEQ for on-site inspection. (*DEQ does not require submittal of this Plan.*)

Dewatering discharge to state surface waters will be controlled by Best Management Practices evaluated in the Dewatering Plan, including (*indicate which of the following will be employed to the extent known*):

◯ Yes ◯ No ◯ Unknown	Run-on prevention/diversion
◯ Yes ◯ No ◯ Unknown	Pumping process pretreatment (i.e. filtering sump or submersible pump protection)
◯ Yes ◯ No ◯ Unknown	Directed through vegetated swale prior to discharge
◯ Yes ◯ No ◯ Unknown	Constructed settling pond or structure, including hay bales
◯ Yes ◯ No ◯ Unknown	Dewatering bags
◯ Yes ◯ No ◯ Unknown	Anionic polymer-based flocculants and/or coagulants in accordance with manufacturers specifications (*if yes, provide MSDS and specs*)
◯ Yes ◯ No ◯ Unknown	Erosion Control for the discharge, including rip rap or baffles.
◯ Yes ◯ No	Other, *describe*:

Section H – Selection of Dewatering Category & Mixing Zone

Outfall _____ *(*A separate Section H needs to be completed for each outfall listed in Section E)*

Category Selection: The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall (*PICK ONE CATEGORY PER OUTFALL*):

◯ A. "Minimal Impact " with discharge to (*also select one of the three subcategories if Category A*):

◯ A.1 Ephemeral waterbody ◯ A.2 Dry intermittent segment ◯ A.3 Large river

◯ B. "Discharge Turbidity Limited to Prevent Impact" – Turbidity effluent limit for discharge to rivers, lakes, wetlands.

◯ C. "Real-Time Turbidity Demonstration" – Demonstration of no increase above background.

☑ By selecting the appropriate category (above), the owner/operator certifies that they will comply with the effluent limits and monitoring requirements associated with that category for this outfall, as provided in the CDGP. (SEE INSTRUCTIONS IF THE RECEIVING WATER FOR YOUR DISCHARGE IS A-1 or A-CLOSED.)

****

Mixing Zone (for Categories A.3 and B, only):

A mixing zone for category A.3 (large rivers) or B (variable flows) is granted under ARM 17.30.516(4) for rivers, and ARM 17.30.518(3) for lakes. (*If not A-3 or B-Categories indicate "NA" for this section.*) Indicate the amount of ambient surface water, at the driest time expected for the dewatering activity.

Stream width (at lowest flow expected): _____ ft x 10 = _____ ft mixing zone length

Lake/wetland area (at lowest volume): _____ ft^2 x 5% = _____ft^2 mixing zone area (note: capped at 200 feet radius)

Section H (*con't*) – Additional Outfalls Category & Mixing Zone

Outfall _____ *(*A separate Section H needs to be completed for each outfall listed in Section E)*

Category Selection: The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall (*PICK ONE CATEGORY PER OUTFALL*):

◯ A. "Minimal Impact " with discharge to (*also select one of the three subcategories if Category A*):

◯ A.1 Ephemeral waterbody ◯ A.2 Dry intermittent segment ◯ A.3 Large river

◯ B. "Discharge Turbidity Limited to Prevent Impact" – Turbidity effluent limit for discharge to rivers, lakes, wetlands.

◯ C. "Real-Time Turbidity Demonstration" – Demonstration of no increase above background.

☑ By selecting the appropriate category (above), the owner/operator certifies that they will comply with the effluent limits and monitoring requirements associated with that category for this outfall, as provided in the CDGP. (SEE INSTRUCTIONS IF THE RECEIVING WATER FOR YOUR DISCHARGE IS A-1 or A-CLOSED.)

****

Mixing Zone (for Categories A.3 and B, only):

A mixing zone for category A.3 (large rivers) or B (variable flows) is granted under ARM 17.30.516(4) for rivers, and ARM 17.30.518(3) for lakes. (*If not A-3 or B-Categories indicate "NA" for this section.*) Indicate the amount of ambient surface water, at the driest time expected for the dewatering activity.

Stream width (at lowest flow expected): _____ ft x 10 = _____ ft mixing zone length

Lake/wetland area (at lowest volume): _____ ft^2 x 5% = _____ft^2 mixing zone area (note: capped at 200 feet radius)

Section I – Additional Information

Section J – CERTIFICATION

Applicant Information: This form must be completed, signed, and certified as follows:

- For a corporation, by a principal officer of at least the level of vice president;
- For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
- For a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.

All Applicants Must Complete the Following Certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information; including the possibility of fine and imprisonment for knowing violations. [75-5-633, MCA].

Certification of this form indicates conformance with the Construction Dewatering General Permit.

Name (Type or Print)	
Title (Type or Print)	**Phone Number**
Signature	**Date Signed**

DEQ will not process this form until all of the requested information is supplied, and the appropriate fees are paid.

Return this NOI-07 Form and the applicable fee payment to:

Department of Environmental Quality
Water Protection Bureau
PO Box 200901
Helena, MT 59620-0901
(406) 444-3080

INSTRUCTIONS FOR
Montana's Construction Dewatering General Permit (MTG070000)
Notice of Intent Form NOI-07

IMPORTANT A Notice of Intent (NOI) Form will not be considered complete unless you answer every question. If an item does not apply to you, enter "NA" (not applicable) to show that you considered the question. Responses must be self-explanatory and must not refer exclusively to attached maps, plans, or documents. The appropriate fees must accompany this NOI Form. Do not submit these items separately.

Mail the NOI Form and fee to the Montana Department of Environmental Quality (DEQ) address stated on the NOI Form. Forms and additional information on construction dewatering discharges are available from the Water Protection Bureau at (406) 444-3080 or on the DEQ website at: http://deq.mt.gov/wqinfo/MPDES/ConstructionDewatering.mcpx. Please type or print legibly; NOI Forms that are not legible, incomplete, or unsigned will be returned.

SPECIFIC ITEM INSTRUCTIONS

Section A – Application Status

Check the box that applies and provide the requested information.

- If this activity has not been authorized previously, and you have not previously requested authorization for it, check the box next to "New." DEQ will assign a permit authorization number when you submit the NOI Form. The permit authorization number is a 9-digit code beginning with MTG070 that is unique to your facility or site. If you submitted an NOI Form that the DEQ returns as incomplete the permit authorization number will be written on the upper right hand corner of the NOI Form and on any correspondence sent to you by DEQ.
- If you are resubmitting a NOI Form that DEQ returned to you as deficient or incomplete, check the box next to "Resubmitted."
- If your current discharge authorization is due to expire and you want to maintain coverage, check the box next to "Renewal."
- If there is a change in the facility or site information, check the box next to "Modification."

Please include the permit authorization number for any resubmitted, renewal, or modification applications and on any correspondence with DEQ regarding this site/activity.

Section B – Site or Activity Information

Identify the name of the site or activity that is the source of construction dewatering discharge. The location of the site is the specific area where the activity is physically conducted. Give the address or location and the geographical coordinate information. Sources for geographical coordinate information include: "CWAIC" at http://deq.mt.gov/wqinfo/CWAIC/default.mcpx, a USGS Topographic Map, GIS, a "GPS" handheld navigation device, or other locational sources. The location may be a physical mailing address or description of how the site may be accessed (PO Boxes are not acceptable).

If the facility or site is located on or within the boundaries of a federally-recognized Tribal Lands DEQ is not the permitting authority. You must contact the Environmental Protection Agency (EPA) Montana's Region 8 Operation Office in Helena at (406) 457-5000.

Nature of the Business or Activity and Standard Industrial Classification Code

List in descending order of significance, the four-digit Standard Industrial Classification SIC code(s) and corresponding description(s) that best describes the activity relative to this location. At least one SIC code and description must be provided**.**

Indicate only one SIC code in the space provided in each box (i.e., only one primary SIC code). For instance, there are different SIC codes for Building Construction (1521 through 1542), Heavy Construction (1611 through 1629), Excavation (1794), and water well drilling (1781). A complete list of SIC codes can be obtained at http://www.osha.gov/pls/imis/sicsearch.html or in paper form from the document entitled "Standard Industrial Classification Manual," Office Management and Budget, 1987.

Section C – Applicant (Owner/Operator) Information

Organizational Formal Name - give the name, as it is legally referred to, of the business, public organization, person, or other entity that owns, operates, controls or supervises the site or activity described in Section B of this form. The permit will be issued to the entity identified in this section (Section C). ***The owner or operator assumes all liability for discharges from the site and compliance with the terms and conditions of the permit and applicable regulations.***

Provide information for a contact that can provide further information to DEQ, including on-site visits.

Section D – Authorized Representative

Pursuant to ARM 17.30.1323(2) all reports required by permits and other information requested by DEQ must be signed by the appropriate signatory as described in ARM 17.30.1323(1) or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described in [ARM 17.30.1323(1)];
2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company (a duly authorized representative may thus be either a named individual or any individual occupying a named position); and
3. The written authorization is submitted to DEQ.

In the future, if the authorization made in this NOI is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new written delegation of authorization, including a written letter satisfying the requirements above, must be submitted to DEQ prior to or together with any reports, information, or applications to be signed by an authorized representative.

Any authorized representative shall make the following certification:

> I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

The Responsible Official can duly authorize the person identified as a contact in Section C or another individual or position name. All reports and DMRs may be submitted under the signature of the 'duly authorized' representative. If the Responsible Official does not duly authorize anyone, all correspondence must come from him/her until a written designation is submitted to DEQ.

Section E – Outfalls and Receiving Waters

Outfalls are defined as "a disposal system through which effluent or waste leaves the facility or site." An outfall location is considered to be a discrete channel, conveyance, structure, or flow path from which discharge leaves the facility after all treatment, prior to discharge into state surface waters.

Water bodies used solely for treating, transporting, or impounding pollutants shall not be considered surface water.

As allowed under ARM 17.30.201(6), multiple outfalls from the same source that have similar effluent characteristics may not be required to pay individual application fees, unless the discharges are to different receiving waters or stream segments, or result in multiple effluent limits or monitoring requirements. For the Construction Dewatering General Permit (CDGP), multiple discharge locations to the same stream segment, or the same receiving waters, can be considered one outfall. Provide the following information in the table on the NOI Form Section E for each outfall that you propose:

1. Assign a number to each outfall starting with 001. For existing permittees, ensure outfall numbers used are consistent with those identified in the past for the same outfall.
2. Provide the latitude/longitude of each outfall. Locations can be derived from a USGS topographic map, "CWAIC" at http://deq.mt.gov/wqinfo/CWAIC/default.mcpx, GIS, a "GPS" handheld navigation device, or other locational sources. Latitude and longitude must be accurate to the nearest second. However, if the dewatering effluent may be discharged at various points along a given stream segment, provide the mid-point for the receiving water segment on this table and indicate the maximum extent of the discharge as a range in Section J Supplemental Information.
3. Give the name of the initial receiving surface waters that receive the discharge. If the receiving water is unnamed, please also indicate the closest named drainage the receiving water flows into (i.e. unnamed tributary to Clear Creek).
4. Please attach a USGS topographic quadrangle map or USGS-based topographic map or an aerial photo extending one mile beyond the property boundaries of the site or facility/activity identified in Section B depicting the facility or activity boundaries, any dewatering effluent treatment areas, the outfall location(s) and the receiving surface waters stated above.

If additional space is necessary for more outfall locations, attach additional sheets with the requested information. An application fee needs to be included for each identified outfall. If questions develop on identifying these outfalls, call DEQ prior to completing this NOI.

Section F – Proximity to Contaminated Sites

As described in the CDGP, discharge of dewatering effluent that contains contamination from a previous release is not allowed under the CDGP. For due diligence, the applicant must review readily available information to identify known or suspected release sites, including groundwater plumes, that may be in the vicinity of the dewatering. Information sources may include:

- Leaking Underground Storage Tank (LUST) list: http://deq.mt.gov/LUST/LUSTSites.mcpx
- Abandoned Mine Lands list: http://deq.mt.gov/AbandonedMines/default.mcpx
- Federal Superfund: http://deq.mt.gov/FedSuperfund/default.mcpx
- State Superfund: http://deq.mt.gov/StateSuperfund/findasite.mcpx

If applicant has information that an area of known or suspected contamination is near the dewatering activity, the applicant must take a pre-discharge ground water sample and supply DEQ with a copy of lab results for the pollutants in question. The analyses must be capable of detecting the suspected pollutants down to the Required Reporting Value (RRV) listed in Circular DEQ-7. *If pollutants are found to be in concentrations over their RRV, then dewatering discharge cannot be authorized under the CDGP.*

If all parameters are "nondetect" at levels below the RRV, DEQ will continue to process the request, but may require periodic testing for suspected contaminants for the life of the dewatering project. If contaminants are found in any discharge samples at concentrations above the RRV, the permittee must immediately cease construction dewatering and request to terminate coverage under the CDGP. If the

owner/operator plans to have future dewatering from this location, they need to either apply for coverage under the Petroleum Clean-up General Permit or an individual MPDES permit (unless the discharge is eligible for a short-term exemption from water quality standards as provided for by 75-5-308, MCA).

Section G – Description of Expected Discharge Duration and Mitigation Measures
Please provide the following to the extent known:

- Provide the projected beginning and end dates for the construction dewatering activities at your site**.** *Please be reminded to submit a written request for termination of this authorization after all dewatering is completed, signed by the Responsible Official.* Authorizations that are not terminated are subject to annual fees accrued for every calendar year.
- Provide an estimate of the expected flow rate of the treated dewatering discharge into state surface waters, after initial purge has been completed, in gallons per minute (gpm). Use engineering assumptions to the extent available. For instance, Caltrans provides a rough estimate of pumping flow rates in their "Field Guide to Construction Site Dewatering," CTSW-RT-010:

Typical Pump Flow Rates Pump Size (submersible)	Typical Flow Rates*
1.5-inch	90 to 120 gpm
2-inch	90 to 300 gpm
3-inch	300 to 800 gpm
4-inch	400 to 1300 gpm
6-inch	400 to 1800 gpm

- The 2015 CDGP requires each applicant to certify that they will complete and implement a dewatering plan prior to initiating construction dewatering. Select all of the Best Management Practices (BMPs) that you will or might employ to reduce the turbidity/suspended sediment load. The CDGP also requires the applicant to take corrective action for failure of any BMPs.

Section H –Selection of Dewatering Category & Mixing Zones *(for each outfall):*

Dewatering Category: for each outfall, the applicant needs to review the receiving water – discharge scenario in order to select the representative dewatering category as described in the CDGP and outlined below. *By selecting a category, the applicant acknowledges that they will comply with the applicable effluent limits and monitoring requirements for that category as described in the CDGP*.

A. "Minimal Impact" category – capped at 100 NTU. If Category A is selected, the applicant also needs to indicate which subcategory applies.

A.1. Discharge to an ephemeral waterbody. Ephemeral is defined as 'a stream or part of a stream which flows only in direct response to precipitation in the immediate watershed or in response to the melting of a cover of snow and ice and whose channel bottom is always above the local water table.' Ephemeral waterbodies are not considered high quality water; therefore, the applicant is allowed to discharge to them regardless whether they are wet or dry.

A.2 Discharge to a dry intermittent segment. This subcategory includes dry intermittent streams or lakes. Intermittent stream is defined as 'a stream or reach of a stream that is below the local water table for at least some part of the year, and obtains its flow from both surface run-off and ground water discharge.' An applicant is allowed to discharge under this subcategory only if the upstream segment is dry. Dewatering discharge must cease if circumstances change and there is ambient water upstream. If the applicant wants to continue to discharge, they need to select a different category and submit a modified NOI.

A.3 Discharge to large rivers. This subcategory includes the eight rivers listed in Department Circular DEQ-12A, Table E-1. The 100 NTU effluent turbidity limit will be protective

because of the good dilution, and typically high background turbidity, associated with these rivers. A mixing zone is applicable for this category.

B. "Discharge Turbidity Limited to Prevent Impact" category – the turbidity in the discharge for authorizations under this category is limited to prevent impact on any high quality water. This category has the most conservative turbidity effluent limits and therefore could apply to any state surface water, other than A-1 and A-closed, regardless of the variability in flow regimes, background turbidity, or applicable turbidity standards. Wetlands are also covered under this category due to the great variability in their sensitivity. Applicants may decide to choose this category to be conservative even if the receiving water segment might be dry in order to ensure uninterrupted operations even if conditions change during their operations.

C. "Real-time Turbidity Demonstration" category – the turbidity in the discharge is limited to below the upstream (ambient) turbidity in order to ensure 'no increase above background.'

Note: Discharges to the most protected waterbodies, A-Closed and A-1 Classifications, include the following water quality standards under ARM 17.30.621(3)(d) and ARM 17.30.622(3)(d), respectively: " No increase above naturally occurring turbidity is allowed except as permitted in 75-5-318, MCA" and " No increase above naturally occurring turbidity or suspended sediment is allowed except as permitted in 75-5-318, MCA." Therefore, unless permitted otherwise under the 318 Authorization, authorization requests for these waterbodies are limited to either Category A.1 or A.2 (dry waterbodies) or Category C (no greater than background). If the discharge may be to a more protected waterbody and the classification is unknown, applicants can check the regulations under ARM 17.30 Subchapter 6 or the Clean Water Act Information Center (CWAIC) at http://deq.mt.gov/wqinfo/CWAIC/default.mcpx.

Mixing Zone: For any discharge under subcategory A.3 (discharge to large rivers) or category B (discharge turbidity limited to prevent impact for variable receiving waters), the applicant needs to provide information to calculate the approved mixing zone at the driest time that will be encountered for the proposed project.

- For flowing water, a mixing zone length based on 10 times the receiving water width will be automatically applied for these dischargers.
- For standing water such as lakes or wetlands, the mixing zone area will be the smaller of 200 feet radius or 5% of the wetted area.
- Other discharges do not need and will not be authorized for mixing zones, and "NA" should be indicated.

Section I– Additional Information

Use this space to provide additional information explaining the basis for a proposed permit modification being submitted, further description of linear projects, etc.

Section J – Certification

The NOI Form certification must be completed by the applicant (owner/operator) responsible for the authorization as identified in Section C, and as described in ARM 17.30.1323. Certification of this NOI is certification that the applicant will comply with the applicable terms of the CDGP.

The NOI-07 Form and other forms for water discharge permitting or authorization are available at DEQ's website: http://deq.mt.gov/wqinfo/MPDES/ConstructionDewatering.mcpx. If you have any questions concerning how to fill out this form, or other forms related to the Montana Pollutant Discharge Elimination System (MPDES) discharge permitting program, please contact DEQ at (406) 444-3080. Mail the package to the address provided in Section J.

AGENCY USE ONLY				
PERMIT NO.:	Date Rec'd.:	Amount Rec'd.:	Check No.:	Rec'd By:

WATER PROTECTION BUREAU

FORM **NOT**

Notice of Termination
Non-Storm Water General Permit Authorizations

This form is to be submitted when a discharge permit is no longer required or necessary. The Montana Department of Environmental Quality (DEQ) will notify the permittee in writing of the date termination is effective. This form may not be used to request termination of coverage under any storm water general permit. You must type or print legibly; forms that are not legible or are unsigned will be returned. Do not leave blank spaces. It is recommended that you maintain a copy of the completed form for your records.

Section A - Site Information

Permit/Authorization Number: MTG __ __ __ __ __ __

Facility or Site Name: _____

Facility or Site Location (physical address or Township/Range/Section):_____

Facility or Site Mailing Address (if available)_____

Nearest City or Town _____ State_____ Zip Code_____ County_____

Latitude: _____ Longitude: _____

Section B - Owner/Operator (Regulated Entity) Information

Owner/Operator Name: _____

Signatory Name and Position Title: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Phone: _____ Email: _____

Section C - Annual Fees

There are no fees associated with terminating permit coverage. However, the permittee is responsible for payment of annual fees for each calendar year in which the discharge is authorized, and annual fees are billed in arrears. You may contact DEQ at (406) 444-3080 to receive an invoice for the outstanding annual fees associated with your effective permit coverage, or one will be mailed to you.

Section D – Required Reports

You are required to comply with all conditions and reporting requirements until notified by DEQ that your general permit authorization is terminated, including submission of Discharge Monitoring Reports.

Section E - Explanation

Indicate the reason for the termination of above referenced permit by checking the most appropriate box, and provide a detailed description in the space provided below:

- (●) Discharge terminated or will be terminated by DATE _____;
- ( ) Discharge permanently terminated by connection to a wastewater treatment plant (WWTP);
  Date discharge connected or will connect to WWTP: _____
  Provide name and MPDES permit number of WWTP:_____
- ( ) Other_____

Please provide a detailed explanation in the space below (attach additional pages if needed) of why the permit/authorization is no longer needed. Please refer to the Standard Conditions section of your permit and include any information specified in your permit required for permit termination.

Section F - CERTIFICATION

Permittee Information: This form must be completed, signed, and certified as follows:

- For a corporation, by a principal officer of at least the level of vice president;
- For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
- For a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.

All Applicants Must Complete the Following Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information; including the possibility of fine and imprisonment for knowing violations. [75-5-633, MCA]

A. Name (Type or Print)	
B. Title (Type or Print)	C. Phone No.
D. Signature	E. Date Signed

Return this form (NOT) to:

Department of Environmental Quality
Water Protection Bureau
P.O. Box 200901
Helena, MT 59620-0901
(406) 444-3080

AGENCY USE ONLY				
PERMIT NO.:	Date Rec'd.:	Amount Rec'd.:	Check No.:	Rec'd By:

Montana Department of
ENVIRONMENTAL QUALITY

WATER PROTECTION BUREAU

FORM

NOI

2012

Notice of Intent (NOI) Storm Water Discharge Associated With Construction Activity MTR100000

The NOI form is to be completed by the owner or operator of construction activity eligible for coverage under the Department's *General Permit for Storm Water Discharges Associated with Construction Activities*. You must print or type legibly; forms that are not legible or are not complete or are unsigned will be returned. You must maintain a copy of the completed NOI form for your records.

Section A - NOI Status *(Check one)*:

☐ New — No prior NOI submitted for this site.

☐ Resubmitted — Permit Number: MTR10 __ __ __ __

☐ Renewal — Permit Number: MTR10 __ __ __ __

☐ Modification — Permit Number: MTR10 __ __ __ __ (Discuss Modification in Section I)

Section B – Facility or Site Information *(See instruction sheet)*:

Site Name _____

Site physical address, mailing address at location, or directions to the site

_____

Township/Range/Section *(optional)*: _____

Nearest City or Town _____ Zip Code _____ County _____

Latitude _____ Longitude _____

Is this facility or site located on Indian Lands? ☐ Yes ☐ No

Section C – Applicant (Owner/Operator) Information:

Owner or Operator Name (Organization Formal Name) _____

Mailing Address _____

City, State, and Zip Code: _____

Phone Number _____ Email _____

Is the entity listed above the construction project owner? ☐ Yes ☐ No

Status of Applicant *(Check one)* ☐ Federal ☐ State ☐ Private ☐ Public ☐ Other (specify)_____

Section D – Existing or Pending Permits, Certifications, or Approvals: ☐ None

☐ MPDES _____ ☐ RCRA _____

☐ PSD (Air Emissions) _____ ☐ Other _____

☐ 404 Permit (dredge & fill) _____ ☐ Other _____

Section E - Standard Industrial Classification (SIC) Codes:

Select at least one SIC code which best reflects the type of construction work.

A. Primary	B. Second
C. Third	**D. Fourth**

Section F – SWPPP Administrator

Primary:

Name and Title or Position Title _____

Mailing Address _____

City, State, and Zip Code _____

Phone Alternate Phone

Email _____

Secondary:

Name and Title or Position Title _____

Mailing Address _____

City, State, and Zip Code _____

Phone Alternate Phone

Email _____

Section G – Receiving Surface Water(s):

Storm Water Outfall/Discharge Locations: For each outfall, list latitude and longitude in the decimal degrees format (00.0000; -000.0000) and the name of the receiving waters. **This section must not be left blank and N/A is not acceptable.**

Outfall Number	Latitude	Longitude	Receiving Surface Waters
001			
002			
003			
004			
005			

Map: Attach a USGS topographic quadrangle map extending one mile beyond the property boundaries of the site or activity identified in Section B depicting the facility or activity boundaries, major drainage patterns, and the receiving surface waters stated above.

Section H – Describe the Construction Activity or Project

Please describe the Construction Activity or Project

Please provide a summary of Best Management Practices (BMPs) in the SWPPP

Total site area (acres) _____

Area of Construction Related Disturbance (acres) _____

Estimated Project Start Date _____ Estimated Project Completion Date _____

Estimated Project Final Stabilization Date _____

Does the project discharge to listed impaired waterbody? Yes ☐ No ☐

Does the project discharge to a regulated Small Municipal Separate Storm Sewer System (MS4)? Yes ☐ No ☐

If yes, please select the receiving regulated Small MS4

If yes, will the SWPPP be submitted to the regulated Small MS4? Yes ☐ No ☐

Section I – Supplemental Information ***(For Permit Modification Only – leave blank except for modification)***

Section J – Fee:

☐ **NEW PROJECTS:**

Indicate the acreage of construction related disturbance indicated in Section H of this NOI form. The fee for new projects includes the application and the annual fee for the calendar year in which the permit authorization is effective.

☐	1-5 acres	$ 900.00
☐	>5-10 acres	$1,000.00
☐	>10-25 acres	$1,200.00
☐	>25-100 acres	$2,000.00
☐	>100 acres	$3,500.00

☐ **RESUBMITTAL** — **$ 500.00**

☐ **RENEWAL** — **$ Amount specified in Rule** *(only required if > four years since date the permit authorization is effective)*

☐ **MODIFICATION** — **$ 500.00** *(minor modification, only if < six months from date the permit authorization is effective)*

Section K - CERTIFICATION

Authorized Signatories: This form must be completed, signed, and certified as follows:

- For a corporation, by a principal officer of at least the level of vice president;
- For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
- For a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.

All Applicants Must Complete the Following Certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information; including the possibility of fine and imprisonment for knowing violations. [75-5-633, MCA]

A. Name (Type or Print)	
B. Title (Type or Print)	C. Phone No.
D. Signature	E. Date Signed

The Department will not process this form until all of the requested information is supplied, and the appropriate fees are paid. Return this form and the applicable fee to:

Department of Environmental Quality
Water Protection Bureau
PO Box 200901
Helena, MT 59620-0901
(406) 444-3080

ATTACHMENT A - Delegation of Authority Form *(Parts 3.2. and 4.15.)*

This form is for use by permittees under the MPDES "General Permit for Storm Water Discharges Associated with Construction Activity". The owner/operator information and "site name" provided below must be the same as the information provided on the NOI and SWPPP Form. This form can be used for an additional and/or new SWPPP Administrator person/position not identified on the NOI Form.

Delegation of Authority

I, _____ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the MPDES "General Permit for Storm Water Discharges Associated with Construction Activity" (General Permit), at the _____ construction site. The designee is authorized to sign any reports, Storm Water Pollution Prevention Plan, and all other documents required by the General Permit.

Name of Person or Position: _____

Owner/Operator:_____

Mailing Address: _____

City, State, Zip Code: _____

Phone Number: _____

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in Part 4.15. of the General Permit, and that the designee above meets the definition of a "duly authorized representative" as set forth in Part 4.15.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: _____

Title: _____

Signature: _____

Date: _____

EPA United States Environmental Protection Agency

Rainfall Erosivity Factor Calculator for Small Construction Sites

EPA's stormwater regulations allow NPDES permitting authorities to waive NPDES permitting requirements for stormwater discharges from small construction sites if:

- the construction site disturbs less than five acres, and
- the rainfall erosivity factor ("R" in the revised universal soil loss equation, or RUSLE) value is less than five during the period of construction activity.

If your small construction project is located in an area where EPA is the permitting authority and your R factor is less than five, you qualify for a low erosivity waiver (LEW) from NPDES stormwater permitting. LEW certifications are submitted through the electronic Notice of Intent (eNOI) system. Several states that are authorized to implement the NPDES permitting program also accept LEWs. Check with your state NPDES permitting authority for more information.

- List of states, Indian country, and territories where EPA's 2012 Construction General Permit (CGP) and Multi-Sector General Permit (MSGP) Apply
- EPA's CGP eNOI System

The period during which small construction sites qualify for the waiver generally occurs during a relatively short time in arid and semi-arid areas. If your small construction project does not qualify for a waiver, then NPDES stormwater permit coverage is required.

To use the Rainfall Erosivity Factor Calculator to determine your eligibility for the LEW, you will need your project's location (either latitude/longitude or address) and the estimated start and end dates of construction. The period of construction activity begins at initial earth disturbance and ends with final stabilization.

- Construction Rainfall Erosivity Waiver Fact Sheet
- Appendix C of the 2017 CGP – Small Construction Waivers and Instructions

For questions or comments, email EPA's CGP staff at cgp@epa.gov.

Facility Information

- Start Date: 07/23/2018
- End Date: 08/27/2018
- Latitude: 48.458333333333
- Longitude: -114.35222222222

Erosivity Index Calculator Results

An erosivity index value Of **3.17** has been determined for the construction period of **07/23/2018 - 08/27/2018**.

A rainfall erosivity factor of less than 5.0 has been calculated for your site and period of construction. Contact your permitting authority to determine if you are eligible for a waiver from NPDES permitting requirements. If you are covered under EPA's construction general permit then you can use eNOI to submit your low erosivity waiver certification.

If your construction activity extends past the project completion date you specified above, you must recalculate the R factor using the original start date and a new project completion date. If the recalculated R factor is still less than 5.0, a new waiver certification form must be submitted before the end of the original construction period. If the new R factor is 5.0 or greater, the operator must submit a Notice of Intent to be covered by the Construction General Permit before the original project completion date.

Start Over

AGENCY USE ONLY			
PERMIT NO.:		Date Rec'd.:	Rec'd By:

Montana Department of
ENVIRONMENTAL QUALITY

WATER PROTECTION BUREAU

STORM WATER RAINFALL EROSIVITY WAIVER FORM for Exclusion from MPDES Permitting for Storm Water Discharges Associated with Construction Activity

Important: The attached instructions must be referenced in order to complete this form properly. Please print or type. This Form must be filled out completely. This Form cannot be submitted electronically. This Form can only be used for construction projects initiating construction-related ground disturbance no earlier than March 1st and completing construction work and achieving "final stabilization" no later than November 30th of the same calendar year.

A. Name and Address of Applicant (Owner or Operator):

Applicant (Owner or Operator) Name: _____

Mailing Address: _____

City, State, and Zip Code: _____

Email Address (optional): _____

Phone Number: _____

Who is applying (check): Construction Project Owner ☐ Contractor ☐

Contact Person (familiar with facility):

Name: _____

Title: _____ Phone Number: _____

B. Location of the Construction Activity Site:

Street Address or Location Description:

_____

City, State, and Zip Code: _____

County: _____

Site Name of Construction Activity or Facility: _____

Latitude of the Construction Activity Site: _____

Longitude of the Construction Activity Site: _____

C. Briefly Describe the Nature of the Construction Activity:

D. Area of Construction-Related Disturbance at the Construction Activity Site:

E. Indicate the name of the receiving surface water(s): Attach a USGS topographic map showing the construction activity location and receiving surface waters. If storm water from the construction activity site enters a storm sewer system, identify that system and indicate the ultimate named receiving surface water for the storm sewer system.

F. Rainfall Erosivity Factor:
Indicate the determined Rainfall Erosivity Factor, otherwise known as "R Factor", rounded to the nearest tenth of a decimal place (this value must be less than five in order to qualify for the use of this Form): _____

The Department reserves the right to revoke or refuse to grant the waiver based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to state waters.

The Department may not grant waivers for construction sites located in areas where snow cover can exist at the site for extended periods of time, particularly if the construction site will remain active and unstabilized during the snowmelt runoff periods. The Department will make the decision on whether or not a project qualifies for the waiver based on information provided by the permittee, and other sources, such as local government agencies.

Check which one of the following two methods was used to determine the Rainfall Erosivity Factor:

Method #1 - Environmental Protection Agency Website Online Calculator; or

Method #2 - Using Tables & Maps from EPA's Storm Water Phase II Final Rule Fact Sheet 3.1: Low Rainfall Erosivity Waiver (EPA 833-F-00-014, published 01/01/2001)

For all applicants (using either Method #1 or #2), referring to the instructions, please provide the following information which was used in the Rainfall Erosivity Factor determination:

1.	The start date of the construction project.	**Start Month / Day / Year**
2.	The end date of the construction project (after "final stabilization" is achieved).	**End Month / Day / Year**
3.	The county the project is located in. If the project is in two or more counties, the county that the majority of the project lies within must be used.	**County**

For those applicants which used Method #1, please submit an original print-out of the result page (from the website's online R Factor calculator) demonstrating the above provided information, and which indicates the R Factor is below five. If Method #1 was used, Items #4 through #11 below do not need to be completed.
For those applicants using Method #2, then items #4 through #11 do need to be completed, and the result indicated in Item #11 is the determining R Factor.

APPENDIX C

Geotechnical Reports

PIONEER
TECHNICAL SERVICES, INC.

RESTORING OUR ENVIRONMENT ● DESIGNING OUR FUTURE

City of Whitefish
Wastewater Treatment Plant
Geotechnical Report

Whitefish, Montana

Prepared for:

Anderson-Montgomery Consulting Engineers
1064 North Warren Street
Helena, MT 59601-3413

Prepared by:

Pioneer Technical Services, Inc.
1309 Cole Avenue
Helena, MT 59601

February 2018

City of Whitefish
Wastewater Treatment Plant
Geotechnical Report

Whitefish, Montana

Prepared for:

Anderson-Montgomery Consulting Engineers

1064 North Warren Street

Helena, MT 59601-3413

Prepared by:

Pioneer Technical Services, Inc.

1309 Cole Avenue

Helena, MT 59601

Contents

Tables

Figures

Appendices

Revision No.	Author	Version	Description	Date
Rev 0	Mike Browne	Internal Review	Draft Geotechnical Report	1/29/2018
Rev 1	Mike Browne	Client Review	Geotechnical Report	2/8/2018

1 INTRODUCTION

Anderson-Montgomery Consulting Engineers (AMCE) contracted Pioneer Technical Services Inc. (Pioneer) to complete a geotechnical investigation for the City of Whitefish Wastewater Treatment Plant (WWTP). The existing wastewater facility will be upgraded with new structures, including a grit removal unit, SBR reactor plant, and UV/Admin Building.

The purpose of the geotechnical investigation was to explore subsurface conditions at the proposed construction area and provide information on soil characteristics, groundwater conditions, lateral loads, settlement, and foundation and earthwork design recommendations. This report provides conclusions of the investigation, logs of borings, results of laboratory testing and analysis, and design recommendations.

Pioneer reviewed the 2007 TD&H *Report of Geotechnical Investigation for Waste Water Treatment Plant Improvements* (TD&H, 2007). Specifically, the report provided geotechnical design recommendations for a 75-foot diameter clarifier, slitter structure, and rotary screen building. These structures are located west of the proposed WWTP.

2 DATA SUMMARY

2.1 Site Description

The project site is located at the existing Whitefish WWTP at 350 Monegan Road in Flathead County, Montana. The site is relatively flat and bounded by the Whitefish River to the west, undeveloped City of Whitefish land to the north, Monegan Road to the east, and agricultural land to the south. The Whitefish River is located approximately 700 feet west of the western edge of Cell 3.

The existing WWTP consists up three active treatment ponds (Cells 1, 2, and 3), two 75-foot diameter clarifiers, and miscellaneous support structures. The proposed grit removal unit, SBR reactor plant, and UV/Admin Building will be set within the existing Cell 3 footprint. To facilitate this construction, Cell 3 will be deactivated and drained.

2.2 Geology

The site is located in Pleistocene glacial and fluvioglacial (meltwater created when glacier melts) deposits (USGS, 2000). Whitefish area was glaciated and ice upwards of 4,000 feet thick covered the valley floor. The glacial action of this ice retreating resulted in 'valley floors being covered by rock materials (glacial till) transported and deposited by glacial ice, glacial meltwaters (outwash), or the cold winds that blow off the glaciers (Blood, 2017). The fine-grained soils logged in the upper portions of each borehole is considered fluvioglacial deposits.

2.3 Geotechnical Investigation

The proposed scope of work called for two boreholes (BH-01 and BH-02) drilled on the south and north dikes of Cell 3; each with an anticipated depth of 75 feet. The proposed structures will be located between the boreholes. Drilling at the exact location of the proposed structures could not be performed due to Cell 3 being an active wastewater treatment pond at this time.

Buried utilities were located in the vicinity of BH-01. The City of Whitefish used a vacuum truck to waterjet the top 2 feet of BH-01 and clear the location for utilities.

BH-01 and BH-02 were drilled on July 24 and 25, 2017. The drilling work was performed by Boland Drilling of Great Falls, Montana under subcontract to Pioneer. The boreholes were advanced with hollow stem augers using a Mobile B-59 truck-mount drill rig. BH-01 was advanced to 66.5 feet where auger refusal was encountered. BH-02 was advanced to 98 feet were auger refusal was encountered. Standard Penetration Tests (SPTs) were conducted to gauge the soils' consistency and to collect samples from the testing depths. Shelby tube samples were collected at Pioneer's discretion to obtain relatively undisturbed soils samples. Samples were field classified in general accordance with the Visual-Manual Procedure (ASTM D2488).

Figure 1 displays a site vicinity with approximate borehole locations. Appendix A contains photographs of the site investigation.

2.4 Soil Lithology

The soil lithology predominantly consists of lean clay in the upper 50 to 55 feet of the boreholes, underlain by granular soils. The lean clay has low to medium plasticity characteristics. Moisture contents generally ranged between 20 and 30 percent above the water table and between 30 and 40 percent below the water table. The consistency of the clay ranges from medium stiff (near the surface) to very soft (below the water table) based on SPT blow counts. SPTs performed below the groundwater table frequently resulted in the static weight of the 140-pound hammer producing enough force to push the split spoons partly or entirely into the 18-inch sample length. Pocket Penetrometer (PP) measurements were also performed in the field as samples were collected and ranged between 4.5 tons per square foot (tsf) to less than 0.25 tsf.

The granular soils underlying the lean clay were visually classified from drill rig auger cuttings as poorly graded sand with varying amounts of gravel. Based on observations of the drill rig performance, it is likely that gravel content fluctuates and intermittent gravel seams are within the poorly graded sand. Limited soil samples were collected from the granular soil layers due to heaving sand occurring at most SPT intervals below the groundwater table. Heaving phenomenon typically occurs in non-plastic soil under a hydrostatic head. As the aquifer is breached by the drill bit, hydrostatic pressure causes sand to flow upward into the drill stem. The measured heave ranged between 2 and 6 feet. SPT samples were not performed through the heave.

Auger drill rig refusal was encountered in BH-01 and BH-02 at 66.5 and 98.0 feet, respectively. Based on review of Thickness of Quaternary Basin Fill (MBMG, 2005), bedrock depth in the Flathead valley is upwards of 1,000 feet thick. Auger refusal is likely due to encountering cobbles or boulders associated with glacial till deposition.

Detailed descriptions of the site soils are listed in the borehole logs in Appendix B.

2.5 Groundwater

Groundwater was encountered in BH-01 and BH-02 during drilling operations at a depth of 19 feet (elevation 3023.0). The boreholes were each completed with 1-inch diameter standpipe PVC piezometers. Groundwater measurements were recorded post drilling at the following elevations:

1. 17.3 feet (elevation 3024.7) in BH-01 approximately 20 hours after the piezometer was installed.
2. 6.0 feet (elevation 3036.0) in BH-02 approximately 3 hours after the piezometer was installed. Treatment pond Cell 3 was active and had a full pool of water during the investigation. Pioneer speculates the 6-foot reading is a measurement of the phreatic surface between Cell 3 pool and the groundwater table.

The groundwater table likely fluctuates seasonally and with changes in flow/elevation of the Whitefish River. Pioneer suggests continued piezometer monitoring be conducted to better understand groundwater depth fluctuations and assist in construction dewatering design.

2.6 Laboratory Testing

Selected samples were tested for their index, engineering, and chemical characteristics. Appendix C contains the laboratory testing data sheets.

2.6.1 Index and Engineering Properties

A summary of soil index properties is provided in Table 1 on the following page.

Table 1: Index and Engineering Results

TEST HOLE NO.	DEPTH (ft)	WATER CONTENT (percent)	DRY UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	GRADATION ANALYSIS			USCS SYMBOL	CONSOLIDATION TEST			UNCONFINED COMPRESSION	
								GRAVEL (%)	SAND (%)	FINES (%)		INITIAL VOID RATIO	COMPRESSION INDEX* C_c	RE-COMPRESSION INDEX* C_r	COMPRESSIVE STRENGTH, q_u (psf)	SHEAR STRENGTH, C_u (psf)
BH-01	10	22	99	2.7	-	-	-	-	-	-	CL	0.697	0.136	0.022	-	-
BH-01	12	-	-	-	30	15	15	0	2	98	CL		-	-	-	-
BH-01	35	31	91	-	-	-	-	-	-	-	CL	-	-	-	1,427	713
BH-01	36	37	86.5		-	-	-	-	-	-	CL	0.912	0.173	0.035	-	-
BH-01	37	-	-	-	33	21	12	0	0	100	CL	-	-	-	-	-
BH-02	9	27	92	-	-	-	-	-	-	-	CL	-	-	-	1,480	740
BH-02	19	38	83	2.7	40	22	18	0	0	100	CL	1.043	0.239	0.071	-	-
BH-02	25		-	-	35	20	15	0	0	100	CL	-	-	-	-	-
BH-02	40	32	93.1	-	31	23	8	0	0	100	CL	0.777	0.103	0.028	-	-
BH-02	41	36	85.3	-	-	-	-	-	-	-	CL	0.975	-	-	791	395

* Value based on Pioneer's interpolation laboratory data using Casagrande method.

2.6.2 Chemical Properties

Corrosivity testing (soluble sulfate, pH, marble pH, and conductivity) was conducted on two samples from across the site, near the anticipated foundation and utility trench depths. The soluble sulfate testing was subcontracted to Alpine Analytical in Helena. A summary of corrosivity testing results is presented in Table 2 and discussed in the following subsection.

Table 2: Corrosivity Testing

LOCATION	DEPTH (ft.)	pH	MARBLE pH	CONDUCTIVITY (mmhos/cm)	RESISTIVITY (ohm-cm)	SOLUBLE SULFATE (%)
BH-01	20	8.00	7.72	0.10	10,300	0.0022
BH-02	6	7.41	7.65	0.14	7,300	0.0024

Note: Resistivity values empirically estimated from conductivity value. They did not undergo physical resistivity testing due to inadequate sample volume.

Criteria from the American Water Works Association (AWWA) and the Portland Cement Association (PCA, 2007) were used to evaluate corrosivity potential of site soils. The PCA criteria is presented in Table 3.

Table 3: PCA Concrete Sulfate Exposure Criteria

SULFATE (SO_4) CONTENT IN SOIL (%)	SULFATE EXPOSURE	RECOMMENDED CEMENT TYPE	MAXIMUM WATER/CEMENT RATIO
Less than 0.10	Negligible	No special type required	--
0.10 to 0.20	Moderate	Type II cement	0.50
0.20 to 2.00	Severe	Type V cement	0.45
Over 2.00	Very Severe	Type V cement plus pozzolan or slag	0.40

Native site soils are not considered corrosive to buried metallic elements. No extraordinary measures are needed to protect buried metallic elements.

The sulfate testing results indicate the on-site soils have a Class 0 exposure to concrete sulfate attack. Type I or Type I/II cement is acceptable for all cast-in-place structural concrete exposed to the native soils.

3 ANALYSIS AND RECOMMENDATIONS

3.1 Proposed Construction

The proposed WWTP will be set within the existing Cell 3 footprint, which will be decommissioned and dewatered to facilitate construction. Pioneer understands the WWTP will consist of the following structures:

1. SBR reactor plant:
    a. Composed of four basins.
    b. Length of 185 feet and width of 130 feet.
    c. Wall height of 21 feet.
    d. Bottom of SBR set at elevation 3,023.2. This elevation corresponds approximately with bottom of Cell 3. Majority of the SBR will be set below finish grade.
    e. Following construction of SBR, backfill will be placed around SBR walls to fill in Cell 3.
2. UV/Admin building will be a single-story building adjacent to the SBR. Finish floor elevation will approximately match SBR backfill finish grade elevation.
3. Grit removal unit will be located on the SBR reactor's north side and will house aerated grit removal and washing equipment. The bottom elevation of the grit removal unit will be approximately 8 feet higher than the SBR unit.

3.2 Subsurface Materials Discussion

3.2.1 Settlement

SBR subgrade soils consist of soft to very soft lean clays. These clays extend approximately 31 to 36 feet below the SBR foundation (total depth of 50 to 55 feet from existing ground surface) to where granular soils were encountered at elevation 2987.0 and 2991.5 in BH-01 and BH-02 respectively. Laboratory consolidation testing was performed to evaluate clay behavior under applied loads. Settlement analysis was performed for primary consolidation based on the following parameters:

1. Most probable consolidation values from BH-02 at elevation 3020,
2. Anticipated structural load of 1,500 psf,
3. Flexible slab,
4. Mat foundation dimensions of 175 feet by 160 feet (preliminary dimensions which vary from dimensions reported in Section 3.1),
5. Foundation elevation of 3023.2, and
6. Analyses with and without structural fill below the foundations.

Anticipated settlement was estimated at 6 inches without the use of structural fill and could be reduced to 3 inches with use of 10 feet of structural fill below mat foundation. Settlement calculations are included in Appendix D. Based on these settlement estimates and discussions

with design team, Pioneer recommends founding the SBR on a deep foundation. The deep foundation will transfer the structural loads to competent underlying soils.

3.2.2 Groundwater

Groundwater was encountered in each of the boreholes near the proposed footing elevation of 3,023.2. Subsequent piezometer measurements in BH-01 and BH-02 indicated groundwater had risen to elevations 3,025 and 3,036, respectively. Groundwater is anticipated to be a construction concern. Pioneer recommends Contractor have an approved dewatering plan in place prior to initiating construction.

3.3 Foundation

Due to the underlying soft clays and associated settlement estimates in excess of 3 inches, Pioneer recommends founding the SBR, administrative building, and grit removal structure on deep foundations. Deep foundation is suggested for the administrative building and grit removal structure as well to provide a uniform bearing surface that will minimize differential settlement between the individual components.

Suitable deep foundations may include helical piers, micropiles, driven piles, or engineered aggregate piers. Drilled shaft foundations would likely require being cased during installation due to the soft soils and groundwater. Cased, drilled shafts are typically expensive and consequently were not considered cost effective. These deep foundation options have been discussed with AMCE. AMCE has contacted foundation contractors and is performing preliminary cost analysis of deep foundation alternatives. Engineered aggregate piers are the preferred option, but final selection will made upon review of the cost analysis.

3.3.1 Engineered Aggregate Piers

Engineered aggregate piers are a deep foundation alternative used to improve/reinforce the foundation soils to increase bearing capacity, minimize settlement, and mitigate liquefaction potential (within the reinforced zone). Engineered aggregate piers are constructed by auguring holes (likely 21 to 30 inches in diameter) through the subgrade soils to a specified depth. The augured holes are backfilled with lifts of compacted aggregate. This process provides a uniform bearing stratum for the building and densifies the *in situ* soils. The piers are spaced in a grid pattern and will be used to support the structure's foundations and slab-on-grades.

AMCE engaged GeoTech Foundation Company–West (GTFC-West), an engineered aggregate pier design/build contractor, regarding the site's suitability for engineered aggregate piers. GTFC-West indicated the engineered aggregate piers are a viable foundation system to found the structure upon (based on review of preliminary laboratory data and draft borehole logs). Please note additional laboratory testing has been completed subsequent to GTFC-West initial review. GTFC-West supplied the design team, via email on December 7, 2017, with preliminary design parameters:

1. Provide 5,000 psf bearing capacity with allowable 1/3 increase for transient loading
2. Support the contact bearing pressures on the foundation elements.

3. Limit total and differential static settlement in the pier-reinforced zone to 1-inch and ½-inch, respectively.
4. Provide coefficient of sliding friction of 0.5.

If engineered aggregate piers are selected as the preferred foundation, GTFC-West will provide final design upon review of subsequent laboratory testing, review of geotechnical report, and contract documents.

Pioneer offers the following preliminary recommendations pertaining to engineered aggregate piers:

1. Construct building platform per Section 3.4 (following). Pioneer understands the engineered aggregate piers can be installed through the recommended structural fill and geosynthetics.
2. Use engineered aggregate piers to support SBR, administration building, and grit removal structure. Each of these structures have different foundation elevations. The difference in elevations can be accounted for by either:
    a. Multiple building platforms. Construct a building platform at required elevation for each of the structures.
    b. One building platform. Construct one uniform-grade building platform at SBR foundation elevation (lowest structure). Provide, place, and compact structural fill on top of engineered aggregate piers to design grade of administration building and grit removal structure. Structural fill to meet gradation requirements listed in Table 4. Place lifts in 8-inch (maximum) loose lifts and compact each lift to standard relative compaction of at least 98 percent.

Table 4: Structural Fill
(MPW 4-inch Minus Sub Base Course)

SIEVE SIZE	PERCENT PASSING
4-inch	100
No. 4	25 – 60
No. 40	10 – 30
No. 200	10 Maximum

    Alternative structural fill gradations may be acceptable provided they are reviewed and approved by Engineer through the submittal process.
3. Engage engineered aggregate pier contractor to design and install piers. Anticipated engineered aggregate pier contractor submittals include the following:
    a. Design calculations, subgrade/ground improvement drawings (if required), material specifications, and shop drawings. Design to be prepared and sealed by Professional Engineer licensed in state of Montana.
    b. Modulus/load test requirements.
    c. Quality assurance plan and on-site quality control.
    d. Daily installation reports and record drawings.

4. A representative of project geotechnical engineer and/or owner's representative must be on site to observe engineered aggregate pier installation and confirmation installation complies with quality assurance plan.
5. The tops of the engineered aggregate piers must be compaction-tested prior to placement of building foundation or slab-on-grade.

3.3.2 Micropiles / Helical Piers

From a geotechnical perspective, micropiles and/or helical piers are a viable deep foundation to found the WWTP structures upon. Due to the soft site soils, Pioneer suggests helical pulldown micropiles in lieu of traditional helical piers. Helical pulldown micropiles are constructed with a grout column around the shaft of the standard helical pier to offer increased section properties of the shaft. Specifically the helical pulldown micropile offers greater resistance to buckling in weak soils, higher load capacity, and a stiffer pile over traditional helical piers.

The design team has engaged Montana Helical Pier to provide preliminary design considerations and cost analyses. Specific geotechnical design for micropiles and/or helical pulldown micropiles will be provided at a later date if these are selected as the preferred foundation option.

3.3.3 Driven Piles

Driven piles are a suitable deep foundation alternative to found the WWTP structures upon and have been discussed with the design team. Driven piles are not being pursed as the preferred foundation alternative at this point in time, based on anticipated cost. Specific geotechnical design of driven piles will be provided at a later date if these are selected as the preferred foundation alternative.

3.4 Subgrade Stabilization

Treatment Cell 3 will need to be dewatered to facilitate construction of the proposed structures. The bottom of Cell 3 is anticipated to consist of very soft, saturated, native clays; a bentonite liner (unknown thickness, presumed 12-inches thick); and pond sediments. The groundwater table is anticipated to be a construction concern and will likely need to be drawn down to facilitate construction of working platform.

GTFC-West indicated they will need stable work platform to facilitate construction of the engineered aggregate piers. Pioneer offers the following recommendations to construct a working platform. These recommendations are intended to create work pad and blanket drainage system to help facilitate construction dewatering.

1. Dewater Cell 3. Drawdown groundwater table as warranted.
2. Overexcavate subgrade.
    a. Extend excavation to minimum depth 2 feet below foundation elevation.
    b. The excavation should be extended at a minimum of 1 Horizontal to 1 Vertical (1H:1V) ratio beyond the perimeter of the structure (i.e., overexcavation depth of 2 feet should be extended 2 feet horizontally). Excavation may need to be extended beyond building footprint at select locations to facilitate equipment access and/or dewatering needs.

   c. Bottom of excavation may be sloped/graded to drain towards dewatering well point(s). Slope shall be 5 percent or less.
3. If moisture conditions allow, compact subgrade soils using static compaction methods. Compaction to be discontinued if pumping soils are observed. Perform proof rolling test to verify compaction.
4. Geosynthetic separation stabilization.
   a. Provide a non-woven, separation/stabilization geotextile meeting or exceeding the engineering properties of Propex Geotex 401. Place geotextile across the excavation footprint and up excavation sidewalls in accordance to Manufacturer's recommendations and have a minimum overlap of 1.5 feet at all joints.
   b. Provide structural geogrid meeting or exceeding the engineering properties of Propex Gridpro BXP11, Type 1. Place geogrid across the excavation footprint, on top of the geotextile, in accordance to Manufacturer's recommendations and have a minimum overlap of 1.5 feet at all joints.
5. Provide crushed drainage aggregate meeting the gradation listed in Table 5. Place and compact drainage aggregate (static compaction methods) across excavation footprint. Drainage aggregate intended to function as blanket drain and to have a compacted lift thickness of 12 inches.

Table 5: Drainage Aggregate (ASTM C33 #56 Aggregate)

SIEVE SIZE	PERCENT PASSING
1 ½-inch	100
1-inch	90 – 100
¾-inch	40 – 85
½-inch	10 – 40
3/8-inch	0 – 15
No. 4	0 – 5

   Alternative drainage aggregate gradations may be acceptable provided they are reviewed and approved by Engineer through the submittal process.
6. Provide structural fill meeting the gradation listed in Table 4. Place and compact structural fill in 8-inch (maximum) loose lifts to meet design grade. Compact each lift to a standard relative compaction (ASTM D698) of at least 95%.

These recommendations are intended to provide temporary construction access and dewatering drainage layer. If blanket drain will be used to provide dewatering capabilities throughout the lifetime of the facility, a second layer of separation geotextile should be installed on top of the drainage aggregate to fully encapsulate blanket drain.

Pioneer recommends Contractor have an approved dewatering plan prior to initiating construction. Foundation Subcontractor should review plans prior to construction to ensure recommendations are acceptable with their construction approach and capabilities. Specifically, Foundation Subcontractor should verify they can install selected foundation alternative through

recommended geosynthetics, drainage aggregate, and structural fill. Pioneer can provide alternative recommendations to aid Foundation Subcontractor if warranted.

3.5 Foundation Walls

Due to the expansive characteristics of the on-site clay, Pioneer recommends backfilling adjacent to the WWTP structures with structural fill from the bottom of the footing to 18 inches below finish grade. The native clay soils can be used to backfill the top 18 inches where its use is intended to inhibit surface water from penetrating into the ground. The structural fill should extend horizontally minimum of 3 feet from the exterior of the wall. Native clay soils may be used to backfill beyond the 3-foot mark. Place the backfill in 8-inch maximum loose lifts and compact each lift to a standard relative compaction of at least 95 percent.

Lateral earth pressure coefficients for reinforced concrete wall design are listed in Table 6. Lateral earth coefficients assume level backfill, a compacted soil unit weight of 135 pcf, and effective friction angle of 30 degrees. Structural design should also incorporate hydrostatic groundwater pressure. Groundwater table elevations are listed in Section 2.5.

Table 6: Lateral Earth Coefficients and Pressures

LATERAL EARTH PRESSURE	COEFFICIENT (K)	EQUATION
Active	0.33	23 pcf x H^2
Passive	3.00	203 pcf x H^2
At-Rest	0.50	32 pcf x H^2
Seismic (Mononobe-Okabe)	1.21	81 pcf x H^2

Where H = height of retaining wall or foundation wall in feet.

3.6 Underground Utilities and Trench Stability

The trench soils meet the Occupational Safety & Health Administration's (OSHA) 29 CFR Part 1926 requirements for a Type B soil if trench is above the groundwater table or Type C if the trench is below the groundwater table. The steepest unsupported slope within a Type B soil is set at 1 horizontal to 1 vertical (1H: 1V). The steepest unsupported slope within a Type C soil is set at 1.5H: 1V.

Use Type I bedding soils beneath and up to 6 inches above the top of the pipe. Type I bedding soils are ¾-inch minus granular soils having soluble sulfate content less than 0.1 percent and a resistivity greater than 3,000 ohm-centimeters.

Soil compaction in utility trenches deeper than 5 feet should be performed using a remote-controlled trench compactor or a Felco-style bucket on an excavator and observed by a qualified inspector. Perform compaction testing on each lift from a depth of 5 feet to the top of the trench. Place the trench soils in 8-inch (maximum) loose lifts and compact to a standard relative compaction of at least 95 percent.

3.7 Seismic Considerations

3.7.1 Seismic Coefficients

Whitefish is within the Northern Intermountain Seismic Belt zone, which is a relatively active zone. Multiple mapped Quaternary faults are in the region. Seismic coefficients were estimated using the 2012/2015 International Building Code, which uses the 2008 United States Geological Survey hazard data. These parameters are for a Risk Category I/II/III and are a function of the site's seismicity and soil and are presented in Table 7. The seismic coefficients data sheet is included in Appendix E.

Table 7: Seismic Coefficients

Site Class Definition	E
Mapped Spectral Response Acceleration Parameter, S_S for 0.2 second	0.627g
Mapped Spectral Response Acceleration Parameter, S_1 for 1.0 second	0.179g
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S_{MS}	0.907g
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S_{M1}	0.583g
Design Spectral Response Acceleration Parameter, S_{DS}	0.604g
Design Spectral Response Acceleration Parameter, S_{D1}	0.389g
PGA (475 yr return period)	0.131g

The Modal Magnitude earthquake for Whitefish is estimated at 6.0 to 6.4 for a 475 year return period (MBMG, 2005).

3.7.2 Liquefaction

Liquefaction is defined as the sudden strength loss of saturated, loose, non-plastic to low plasticity soils due to a build-up of excess pore pressures when a load is applied rapidly to the soils. Liquefaction is commonly associated with cyclic earthquake loading. The objective of the liquefaction potential evaluation is to assess the risk of liquefaction of the saturated foundation soils during an earthquake event. Liquefaction susceptibility was evaluated for both fine-grained and coarse-grained soils.

3.7.3 Fine-Grained Soils

Fine-grained soils may undergo cyclic softening during seismic events which results in similar behavior to liquefaction. Three methods were evaluated to screen the liquefaction potential of the fine-grained soils. For each method, five soils samples were evaluated (BH-01 at 12 and 37 feet, BH-02 at 19, 25, and 40 feet). Each method is listed below:

1. Andrews-Martin Criteria (2000) use liquid limits and fines contents to evaluate if fine-grained soils are potentially susceptible to liquefaction. The soils are not considered susceptible to liquefaction if the clay content (finer than 0.002 mm) is greater than or equal to 10 percent and the liquid limit is greater than 32. If soils do not meet this criteria, further studies are required. BH-01 at 12 feet and BH-02 at 40 feet have liquid limits of 30 and 31 percent, respectively, indicating further study is required. The other three samples are not considered susceptible to liquefaction.

2. Chinese Criteria (Wang, 1979) evaluates liquefaction based on soil fraction finer than 0.005 mm, liquid limit, water content, and liquidity index. The soil must meet specified ranges for each parameter to be considered liquefiable. Whitefish soil samples do not satisfy all the specified ranges; hence they are not considered liquefiable per the Chinese Criteria.
3. Idris and Boulanger (2008). Fine-grained soils with a plasticity index of 7 or more are anticipated to exhibit clay-like which is not considered liquefiable. Each of the five samples have a plastic index greater than 7, indicating they are not expected to liquefy.

Upon review of the fine-grained soil characteristics; the fine-grained soils are not anticipated to be susceptible to liquefaction.

3.7.4 Coarse-Grained Soils

Geologically the soils were deposited during the Pleistocene epoch of the Quaternary period (age of the soils) (Vuke et. al., 2007). Likelihood of cohesionless soils susceptible to liquefaction is considered low for soils deposited in the Pleistocene epoch (Youd and Perkins, 1978).

An SPT-based triggering assessment was also performed at two SPT intervals in BH-01. Sample intervals which could be analyzed were limited due to heave occurring during the drilling operations. The assessment is an empirical procedure which uses SPT blow counts corrected for soil overburden pressure, estimated percentage of fines in the soils, soil profile, depth to the groundwater table, estimated soil unit weight, earthquake magnitude, and peak ground acceleration (PGA) to calculate a factor of safety (FS) associated with liquefaction (Youd and Idriss, 2001). Liquefaction is anticipated to occur at a given earthquake magnitude if the FS is less than 1.0. The two estimated FS at the Whitefish site were greater than 1, indicating liquefaction is not anticipated.

3.8 Shrink/Swell Characteristics

The expansion characteristics of the fine-grained soils were estimated from index classification data and a probable degree of expansion potential using United States Bureau of Reclamation criteria (USBR, 1998). Details of the index data and estimated expansion potential are listed below:

1. Plasticity indices range between 8 and 18 percent, which is indicative of a low to medium probable degree of expansion.
2. Shrinkage limits were estimated at 13 to 20 percent, which are indicative of a low to medium degree of expansion.
3. Colloidal contents (fraction of the soil finer than 0.001 millimeters) were measured from 6 to 52 percent, with an average of 25 percent - indicative of a high probable degree of expansion.
4. Activity values range between 0.2 and 0.4. Activity values coupled with clay content indicate low to medium swelling potential.

Probable expansion is measured as a percentage of the total volume change going from a dry to a saturated soil condition. A high degree of expansion could experience a probable expansion of

20 to 30 percent. A medium degree of expansion could experience a probable expansion of 10 to 20 percent. A low degree of expansion could experience a probable expansion of less than 10 percent.

Reviewing the expansion characteristic values as a whole indicate expansions upwards of 30 percent can be expected as moisture content of the soils fluctuate. The expansion characteristic values also indicate a differential amount of movement, since some of the soils appear to be more susceptible to volume changes than others. Pioneer recommends the following measures be incorporated into the design to minimize shrinkage and swelling:

1. Placement of structural fill adjacent to foundation walls.
2. Roof runoff water is to be collected in a gutter/downspout system and routed at least 10 horizontal feet away from the structures.
3. Grades are to be designed and constructed to promote positive drainage away from the entire structure perimeter.
4. Avoid placing plantings and irrigation systems immediately adjacent to the building.
5. Sequence construction to limit exposure time of the native clay soils exposed in the excavations. To the extent possible, the excavated clay surfaces should be capped with a minimum of one lift of fill within the same working day of the excavation.

4 EARTHWORK TESTING

During construction, Pioneer recommends compaction testing be performed by a qualified inspector for subgrade, structural fill, and backfill. The suggested minimum testing frequency is listed in Table 8.

Table 8: Compaction Testing Frequency

LOCATION	FREQUENCY
Beneath Strip Footings	1 test per 25 lineal feet of footing per lift
Beneath Column Footings	1 test per footing per lift
Beneath Interior Slab-On-Grade, Mat Foundations, or Subgrade Stabilization Pad	1 test per 400 square foot per lift
Foundation Wall Backfill	1 test per 50 lineal feet per lift
Pavement Section and Exterior Concrete Flatwork	1 test per 1,000 square feet per lift

Material compaction specifications are summarized in Table 9. Compaction testing should be performed on subgrade, structural fill, backfill, base course, and asphalt. Fill should be placed in 8-inch (maximum) loose lifts.

Table 9: Required Relative Compaction*

LOCATION	REQUIRED MINIMUM RELATIVE COMPACTION	STANDARD
Beneath Foundation Footings	98 %	ASTM D698
Beneath Interior Slab-On-Grade and Subgrade Stabilization Pad	95 %	ASTM D698
Foundation Wall Backfill[1]	95 %	ASTM D698
Pavement Typical Section Soils and Exterior Concrete Flatwork	95 %	ASTM D698
Asphalt	93 %	AASHTO T209

*Native clay soils shall be moisture conditioned to plus or minus 2% of optimum moisture content.

Note: compaction testing frequency and relative compaction specifications pertaining to footings and slab-on-grades supported by engineered aggregate piers are preliminary suggestions. Specific testing criteria and frequency to be provided by engineered aggregate pier design-build Contractor.

The excavation must be kept free of standing water at all times. If construction occurs during winter, fill shall not be placed on frozen ground. Fill shall be free of all frozen particles or clumps. When site grading is interrupted by heavy precipitation or freezing events, filling operations should not resume until a geotechnical engineer or their representative approves the moisture and density conditions of the previously placed fill.

Concrete testing frequency should be performed in accordance to project specifications and/or structural engineering requirements.

5 BASIS OF RECOMMENDATIONS

The analyses and recommendations submitted in this report are based on data obtained from the boreholes drilled during the investigation. Often variations occur between boreholes, the nature and extent of which do not become evident until additional exploration or construction is conducted. Pioneer requests that, during earthmoving operations, a qualified geotechnical engineer be present to evaluate the foundation soils to verify their resemblance to those encountered during the investigation.

5.1 Review of Design

The geotechnical investigation, analyses, and report were initiated based on Pioneer's understanding of the proposed WWTP upgrades. If the design changes and foundation design is required, please consult Pioneer to verify that these recommendations are still applicable.

5.2 Use of Report

This report is for the exclusive use of AMCE and their design team. In the absence of Pioneer's written approval, Pioneer makes no representation and assumes no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. Other parties contemplating other structures or purposes should contact Pioneer.

5.3 Level of Care

Services performed by Pioneer personnel for this project have been conducted with the level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is made.

Professional Certification
I hereby certify that this report was prepared
by me and that I am a duly Licensed Professional
Engineer under the laws of the State of Montana.

Michael Browne, P.E.
Geotechnical Engineer

6 REFERENCES

Andrews, D.C.A. and Martin, G.R., 2000, "Criteria for Liquefaction of Silty Soils, 12th World Conference on Earthquake Engineering", Proceedings, Auckland, New Zealand.

Blood, 2017. Flathead Watershed Sourcebook – A Guide to an Extraordinary Place Website, Geology of the Flathead, www.flatheadwatershed.org, Dr. Lex Blood, accessed September 8, 2017.

Idris and Boulanger, 2008. Soil Liquefaction During Earthquakes, I.M. Idriss, R.W. Boulanger, Earthquake Engineering Research Institute, Monograph 12, July.

MBMG, 2005. Probabilistic Earthquake Ground Shaking Maps of the State of Montana, Montana Bureau of Mines and Geology, 2005.

TD&H, 2007. Report of Geotechnical Investigation for Waste Water Treatment Plant Improvements, Whitefish, Montana, Thomas, Dean, & Hoskins, Inc., September.

USBR, 1998. Earth Manual, Part 1, Third Edition, U.S. Department of the Interior, Bureau of Reclamation.

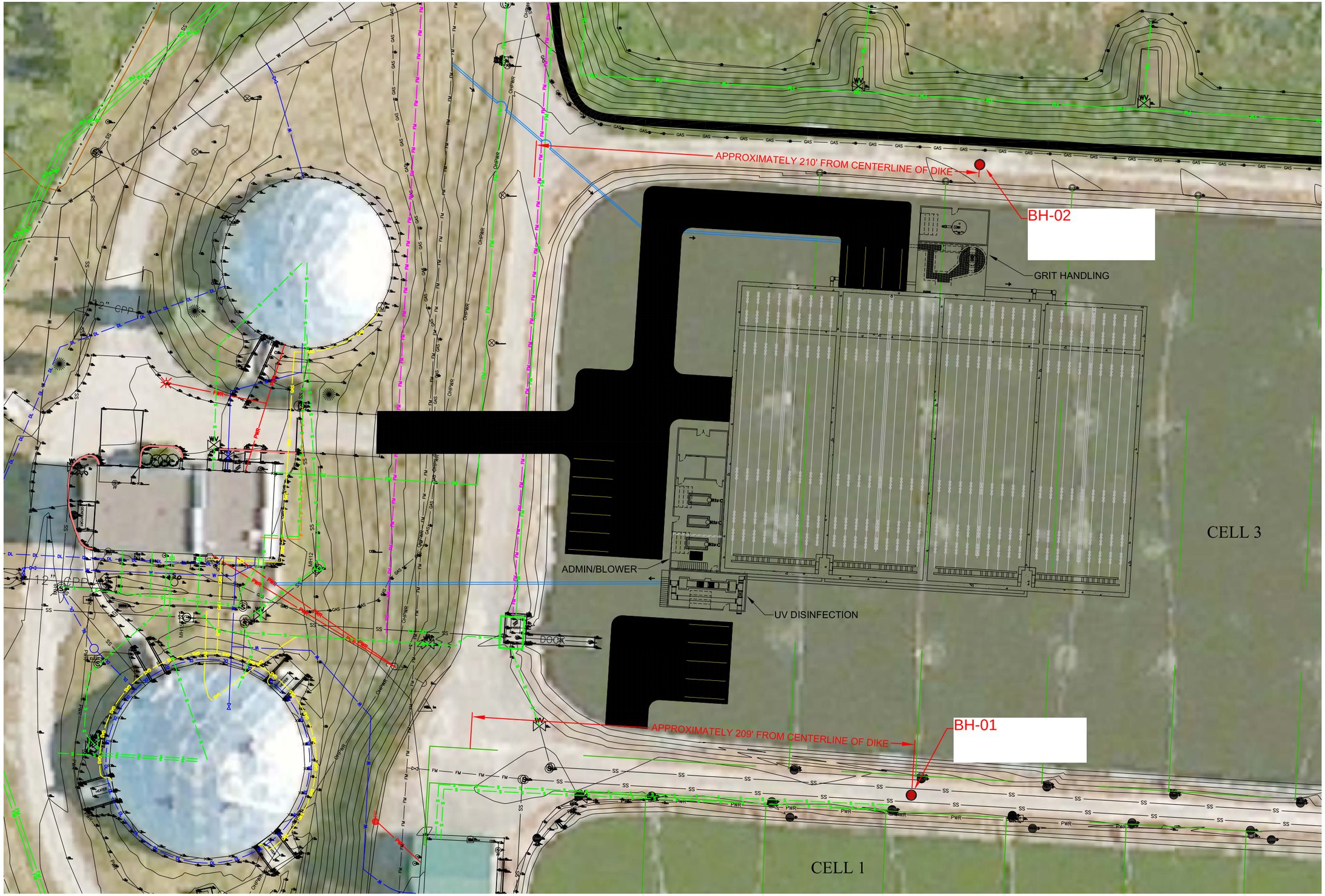
USGS, 2000. Geologic and Structure Maps of the Kalispell 1°x2° Quadrangle, Montana, and Alberta and British Columbia; A Digital Database, Miscellaneous Investigations Series Map I-2267, Database, version 1.0, J.E. Harrison et. al., U.S. Geological Survey.

Vuke et al., 2007. Geologic Map of Montana, Edition 1.0, Geologic Map 62, S.M. Vuke, K.W. Porter, J.D. Lonn, and D.A. Lopez, Montana Bureau of Mines and Geology.

Wang, 1979. Some Findings in Soil Liquefaction, Water Conservancy and Hydroelectric Power Scientific Research Institute, Beijing, China.

Youd, T.L., and Idriss, I.M., 2001, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils', *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Vol. 127 No. 4, April.

Youd, T.L., and Perkins, M., 1978. Mapping liquefaction-induced ground failure potential, J. Geotechnical Eng. Div., ASCE 104 (G4).



MONTANA
Scott Anderson
7978PE
REGISTERED
PROFESSIONAL ENGINEER

Revision	Date	By
Draft	1-2017	SA
Final		

Revision: Draft
Plot Scale: 1:2
Drawn By: A. Eckhart
Approved By: S.Anderson, P.E.
Checked By: P.Montgomery, P.E.
Designed By: S.Anderson, P.E.
Project Number:

Engineer
Anderson~Montgomery
CONSULTING ENGINEERS
1064 N. Warren
Helena, Mt 59601
RPA

Owner
City of Whitefish, Montana

Project Title
Whitefish WWTP Alternatives

Sheet Title
Site Plan - Proposed Borehole Locations

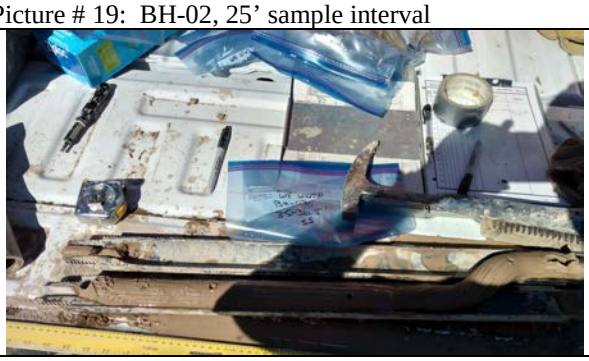
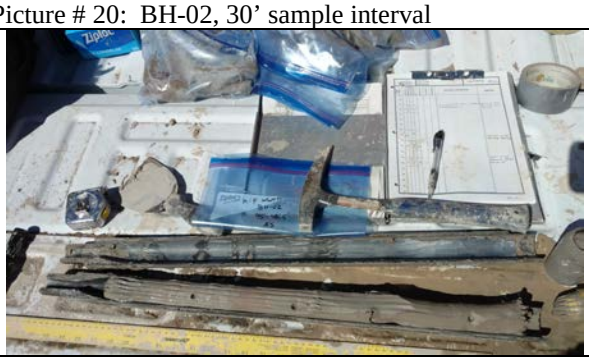
Sheet
1
Of 2

X:\Adam\Whitefish\WWTP\Design Drawings\WF – Design – 2017.dwg SAVED:6/28/17 PRINTED:6/28/17 BY: ADAM

Appendix A
Photographs

	
Picture # 1: BH-01 site overview looking west	Picture # 2: BH-01. Utility locate “pothole”.
	
Picture # 3: BH-01, 2’ sample interval	Picture # 4: BH-01, 12’ sample interval
	
Picture # 5: BH-01, 15’ sample interval	Picture # 6: BH-01, 20’ sample interval
	
Picture # 7: BH-01, 25’ sample interval	Picture # 8: BH-01, 30’ sample interval

	
Picture # 9: BH-01, 37’ sample interval	Picture # 10: BH-01, 40’ sample interval
	
Picture # 11: BH-01, 45’ sample interval	Picture # 12: BH-01, 50’ sample interval
	
Picture # 13: BH-01, 55’ sample interval	Picture # 14: BH-01, 60’ sample interval
	
Picture # 15: BH-02, site overview looking west	Picture # 16: BH-02, 10’ sample interval

	
Picture # 17: BH-02, 15’ sample interval	Picture # 18: BH-02, 20’ sample interval
	
Picture # 19: BH-02, 25’ sample interval	Picture # 20: BH-02, 30’ sample interval
	
Picture # 21: BH-02, 35’ sample interval	Picture # 22: BH-02, 45’ sample interval
	
Picture # 23: BH-02, 50’ sample interval	

Appendix B
Borehole Logs

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	CA:	Casing Advancer
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	DA:	Drill Auger
CB:	California Sampler - 2" I.D., 2.5" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", NX, unless otherwise noted	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	GS:	Grab Sample

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". The field blow counts are reported for each 6-inch interval, or portion thereof if greater than 50 blows are required to advance the full 6-inch interval. For over-sized split spoon samplers, non-standard hammers, or non-standard drop heights, the field penetration values are reported on the bore log. The values must be corrected to obtain the N-value.

WL:	Water Level	WS:	While Sampling	NE:	Not Encountered
WCl:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System, Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: gravel or sand. Cobbles and boulders are not part of the USCS system but are included, when present, as percentages. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; depending on their plasticity, they are described as clays or silts. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	< 2	Very Soft
500 - 1,000	2 - 4	Soft
1,001 - 2,000	5 - 8	Medium Stiff
2,001 - 4,000	9 - 15	Stiff
4,001 - 8,000	16 - 30	Very Stiff
8,000 +	30 +	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	California Barrel (CB) Blows/Ft.	Relative Density
0 - 4	0 - 6	Very Loose
5 - 10	7 - 18	Loose
11 - 30	19 - 58	Medium Dense
31 - 50	59 - 98	Dense
50 +	99 +	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

USCS* GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

*For AASHTO grain size the #4 sieve is replaced with the #10 sieve

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-Plastic	0
Slightly	1 - 5
Low	6 - 10
Medium	11 - 20
High	21 - 40
Very Highly	> 40

PIONEER TECHNICAL SERVICES, INC.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	$Cu \geq 4$ and $1 \leq Cc \leq 3$		GW	Well-graded Gravel [F]
			$Cu <$ and/or $1 > Cc > 3$		GP	Poorly graded gravel [F]
		Gravels with Fines More than 12% fines	Fines classify as ML or MH		GM	Silty Gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey Gravel [F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	$Cu \geq 6$ and $1 \leq Cc \leq 3$		SW	Well-graded Sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$		SP	Poorly graded Sand [I]
		Sands with Fines More than 12% fines	Fines classify as ML or MH		SM	Silty Sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey Sand [G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line		CL	Lean Clay [K,L,M]
			PI < 4 or plots below "A" line		ML	Silt [K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OL	Organic Clay [K,L,M,N]
			Liquid limit - not dried			Organic Silt [K,L,M,Q]
	Silts and Clays Liquid Limit 50 or more	inorganic	PI plots on or above "A" Line		CH	Fat Clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OH	Organic Clay [K,L,M,P]
			Liquid limit - not dried			Organic Silt [K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt. GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60} / D_{10} \quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or " with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.

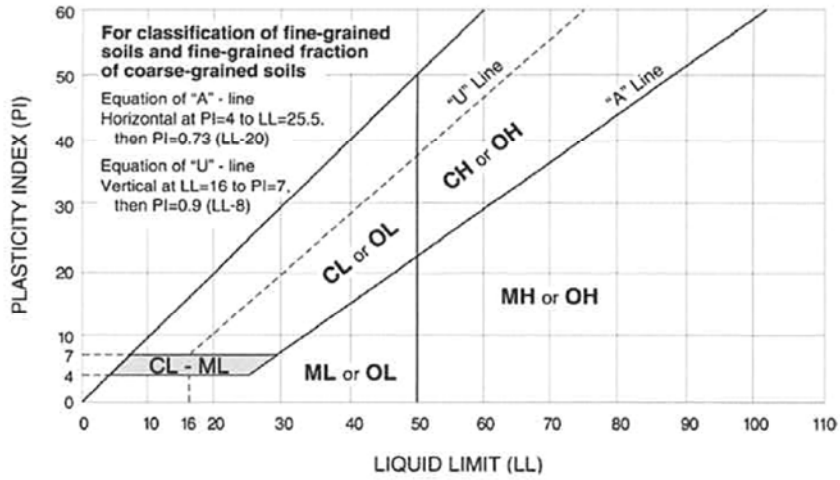
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



PIONEER TECHNICAL SERVICES, INC.

201 E Broadway Ste C
Helena, MT 59601
Phone: 406-457-8252
Fax: 442-1158

LOG OF BORING

Boring BH-01

PIONEER TECHNICAL SERVICES, INC.

Project: Whitefish WWTP	**Rig:** B-59 **Hammer:** Auto	**Boring Location** N 1,546,099.7 ft **Coordinates:** E 790,855.3 ft	**Station:** **Offset:**
Project Number: / **UPN:**	**Boring Diameter:** 6 in	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Boring Elevation:** 3042 ft
Date Started: 7/24/17 / **Date Finished:** 7/24/17	**Drilling Fluid:** None	**Location Source:** Handheld GPS, Uncorrected	**Elevation Source:** Plans
Driller: Boland **Logger:** A. Klein	**Abandonment Method:** N/A	**Township Range and Section:** 30N 21W 5	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft)	MC (%)	LL	PL	-200 (%)	DD (pcf)	Remarks and Other Tests
														Borehole started at 2'; prebored for utilities.
			70		2 - 3 - 4		Lean CLAY (CL), medium stiff, moist, brown. Medium plastic.							Pen: 1.5 tsf
5 / 3037.0			70		1 - 4 - 4				24					Pen: 2 tsf
10 / 3032.0									22				99	Consol: See lab data
			80		3 - 2 - 2				25	30	15	98		Pen: 1 tsf
15 / 3027.0			100		4 - 5 - 9				28					Pen: 4.5 tsf
								19.0						
20 / 3022.0			100		1 - 1 - 1		Poorly-Graded SAND (SP), very loose, wet, brown. Non plastic.		33					Proposed botom SBR at Elev. 3023.2 (~19' depth).
							Lean CLAY (CL), soft, moist to wet, brown. Medium plastic.	21.1	33					
25 / 3017.0			100		WH - WH - 2		Lean CLAY (CL), soft to very soft, wet, brown. Medium to low plasticity.	25.0	40					Pen: 0.5 tsf WH=Weight of Hammer. Static weight of 140 lb SPT hammer pushed sampler through soil.
30 / 3012.0			100		WH - WH - WH				37					Pen: 0.5 tsf
35 / 3007.0									31 37				91	UCS: 1427 psf Consol: See lab data
			100		WH - WH - WH					33	21	100		Pen: 0.25 tsf
40 / 3002.0			100		WH - WH - WH				37					Pen: 0.25 tsf
45 / 2997.0			100		WH - WH - WH									
50 / 2992.0														

Water Level Observations

- During Drilling: 19.0 ft
- After Drilling: 17.3 ft, +20 hrs
- After Drilling:

Remarks: Completed borehole with 1" Ø piezometer.

201 E Broadway Ste C
Helena, MT 59601
Phone: 406-457-8252
Fax: 442-1158

LOG OF BORING

Boring BH-01

PIONEER TECHNICAL SERVICES, INC.

Project: Whitefish WWTP	**Rig:** B-59 **Hammer:** Auto	**Boring Location** N 1,546,099.7 ft **Coordinates:** E 790,855.3 ft	**Station:** **Offset:**
Project Number: / **UPN:**	**Boring Diameter:** 6 in	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Boring Elevation:** 3042 ft
Date Started: 7/24/17 / **Date Finished:** 7/24/17	**Drilling Fluid:** None	**Location Source:** Handheld GPS, Uncorrected	**Elevation Source:** Plans
Driller: Boland **Logger:** A. Klein	**Abandonment Method:** N/A	**Township Range and Section:** 30N 21W 5	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft)	MC (%)	LL	PL	-200 (%)	DD (pcf)	Remarks and Other Tests
55			100		WH - WH - WH				37					Pen: 0.25 tsf
2987.0			35		5 - 9 - 10		Poorly-Graded SAND with gravel (SP), medium dense to loose, wet, brown to green, medium grained, subangular.	55.0	1					
60														
2982.0			10		2 - 3 - 3									2.5' heave measured pre SPT. SPT performed through heave.
65														
2977.0			15		7 - 23 - 42			66.5						Auger refusal at 65'.

Boring Depth: 66.5 ft, *Elevation: 2975.5 ft*

Water Level Observations		Remarks: Completed borehole with 1" Ø piezometer.
After Drilling:	During Drilling: 19.0 ft	
	After Drilling: 17.3 ft, +20 hrs	

201 E Broadway Ste C
Helena, MT 59601
Phone: 406-457-8252
Fax: 442-1158

LOG OF BORING

Boring BH-02

PIONEER TECHNICAL SERVICES, INC.

Project: Whitefish WWTP	**Rig:** B-59 **Hammer:** Auto	**Boring Location** N 1,546,380.1 ft **Coordinates:** E 796,866.8 ft	**Station:** **Offset:**
Project Number: / **UPN:**	**Boring Diameter:** 6 in	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Boring Elevation:** 3042 ft
Date Started: 7/25/17 / **Date Finished:** 7/25/17	**Drilling Fluid:** None	**Location Source:** Handheld GPS, Uncorrected	**Elevation Source:** Plans
Driller: Boland **Logger:** A. Klein	**Abandonment Method:** N/A	**Township Range and Section:** 30N 21W 5	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft)	MC (%)	LL	PL	-200 (%)	DD (pcf)	Remarks and Other Tests
5 3037.0			55		1 - 3 - 3		Silty Lean CLAY (CL-ML), medium stiff, moist, brown. Low plastic.		25					Pen: 1.75 tsf
							Lean CLAY (CL), soft, moist, brown. Medium plastic.	8.0	27				92	UCS: 1480 psf
10 3032.0			85		2 - 1 - 3				22					Pen: 1.5 tsf
15 3027.0			95		3 - 4 - 4				21					Pen: 2 tsf
									38	40	22	100	83	Consol: See lab data
20 3022.0			100		1 - 1 - 2		Silty, Clayey SAND (SC-SM), very loose, wet, brown, fine grained. Non-plastic.	20.0 20.5	32 38					Proposed botom SBR at Elev. 3023.2 (~19' depth). Pen: 0.75 tsf
25 3017.0			100		WH - WH - 2		Lean CLAY (CL), soft to very soft, wet, brown. Medium to low plasticity.			35	20	100		Pen: 0.75 tsf WH=Weight of Hammer. Static weight of 140 lb SPT hammer pushed sampler through soil.
30 3012.0			100		WH - WH - WH									Pen: 0.5 tsf
35 3007.0			100		WH - WH - 2				37					Pen: 0.25 tsf
40 3002.0			75						32 36	31	23	100	93 85	Consol: See lab data UCS: 791 psf
			100		WH - WH - WH				8					Pen: <0.25 tsf
45 2997.0			100		WH - WH - WH									Pen: 0.25 tsf
50 2992.0									35					

Water Level Observations

- ▽ During Drilling: 19.0 ft
- ▼ After Drilling:
- ▼ After Drilling: 6.0 ft, +3 hrs

Remarks: Completed borehole with 1" Ø piezometer.

201 E Broadway Ste C
Helena, MT 59601
Phone: 406-457-8252
Fax: 442-1158

LOG OF BORING

Boring BH-02

PIONEER TECHNICAL SERVICES, INC.

Project: Whitefish WWTP		**Rig:** B-59 **Hammer:** Auto	**Boring Location** N 1,546,380.1 ft **Coordinates:** E 796,866.8 ft	**Station:** **Offset:**
Project Number:	**UPN:**	**Boring Diameter:** 6 in	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Boring Elevation:** 3042 ft
Date Started: 7/25/17	**Date Finished:** 7/25/17	**Drilling Fluid:** None	**Location Source:** Handheld GPS, Uncorrected	**Elevation Source:** Plans
Driller: Boland **Logger:** A. Klein		**Abandonment Method:** N/A	**Township Range and Section:** 30N 21W 5	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft)	MC (%)	LL	PL	-200 (%)	DD (pcf)	Remarks and Other Tests
			100		WH - 1 - 3		Silty, Clayey SAND (SC-SM), very loose, wet, brown.	50.5	36					Pen: <0.25 tsf
							Fat CLAY (CH), wet, brown. Highly plastic.	51.0	35					Poorly graded sand classification based on drill cuttings and observation of heave.
55 2987.0							Poorly-Graded SAND with gravel (SP), wet, brown. Occasional gravel lenses..	51.5						6' heave measured pre SPT. No SPT performed.
60 2982.0														4' heave measured pre SPT. No SPT performed.
65 2977.0														7' heave measured pre SPT. No SPT performed.
70 2972.0														7' heave measured pre SPT. No SPT performed.
75 2967.0														
80 2962.0														6' heave measured pre SPT. No SPT performed. Gravels encountered with auger and observed in cuttings.
85 2957.0														
90 2952.0														6' heave measured pre SPT. No SPT performed.
95 2947.0														Auger & SPT refusal at 98' depth.
			0		25/0.0ft			98.0						

Boring Depth: 98.0 ft, *Elevation: 2944.0 ft*

Water Level Observations		Remarks: Completed borehole with 1" Ø piezometer.
After Drilling:	During Drilling: 19.0 ft After Drilling: 6.0 ft, +3 hrs	

Appendix C
Laboratory Data

PIONEER
TECHNICAL SERVICES, INC.

January 4, 2018

Mr. Michael Browne
Pioneer Technical Services

RE: Whitefish Waste Water Treatment Plant

Dear Mr. Browne,

Additional testing was requested for the Whitefish Waster Water Treatment, the attached results are in addition to results previously reported on August 16, 2017.

The testing was performed in general accordance with the following Standards:

- One dimensional consolidation of soils (ASTM D2435);
- Unconfined Compressive Strength of Cohesive Soil (ASTM D2166);
- Atterberg Limits (ASTM D4318); and
- Particle Size Analysis with Hydrometer (ASTM D422).

Table 1

Lab No.	Sample Identification
20253	BH-01 (35-37')
20256	BH-02 (40-42')

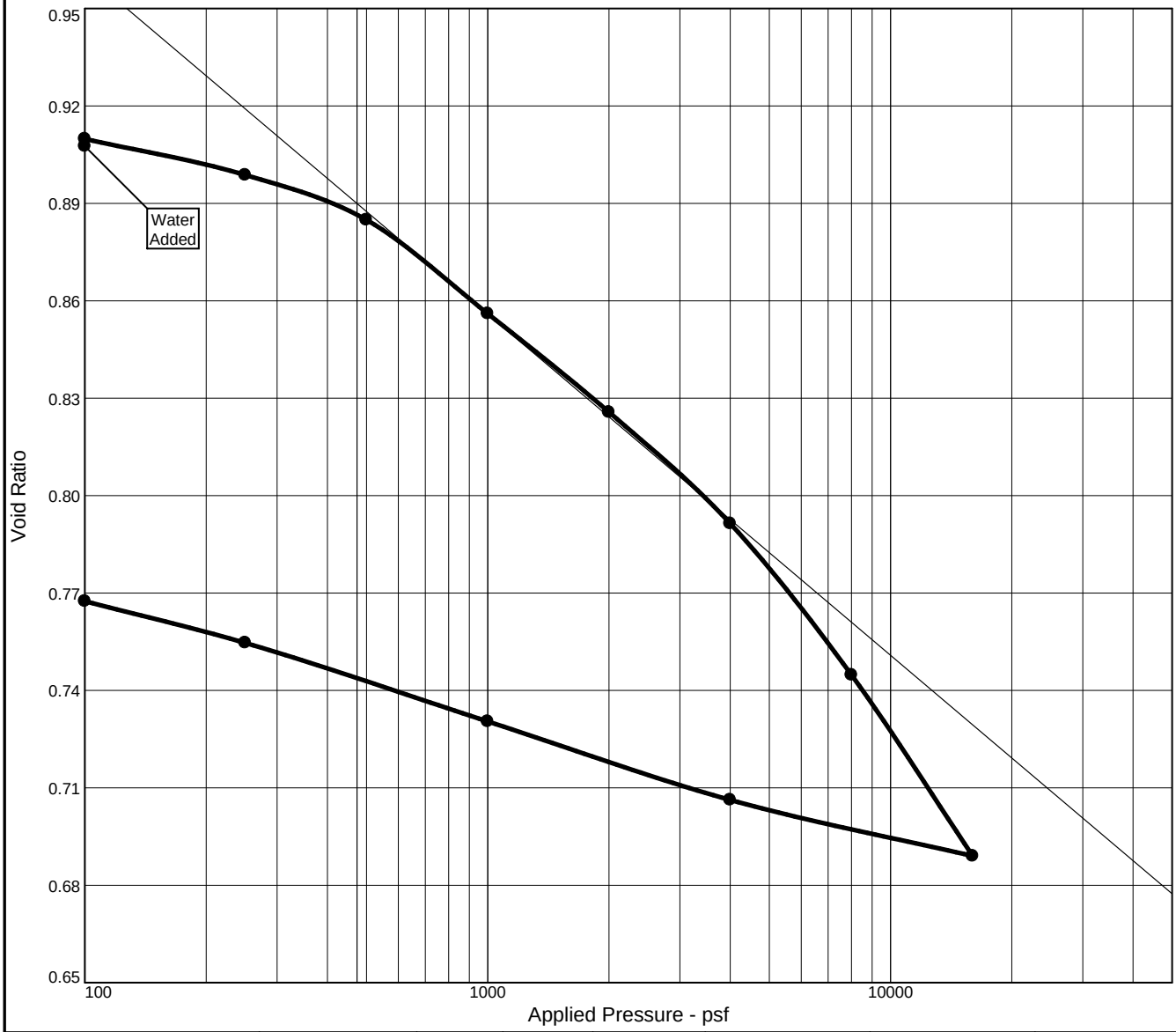
A one-dimensional consolidation test was performed on samples BH-01(35-37') and BH-02 (40-42') with incremental loads from 100 psf to 16,000 psf and unload points of 4000, 1000, 250, and 100 psf. The samples were saturated at 100 psf. The void ratio curve, percent strain and deformation curves are attached.

Thank you for using Pioneer Technical Services, Inc. for your geotechnical and materials testing requirements. If you have any questions regarding these results, please contact us at (406) 388-8578.

Sincerely,

Niki Griffis
Project Scientist/Laboratory Manager

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
108.3 %	37.3 %	86.5			2.65			0.912

MATERIAL DESCRIPTION

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-01 **Depth:** 35-37' **Sample Number:** 20253

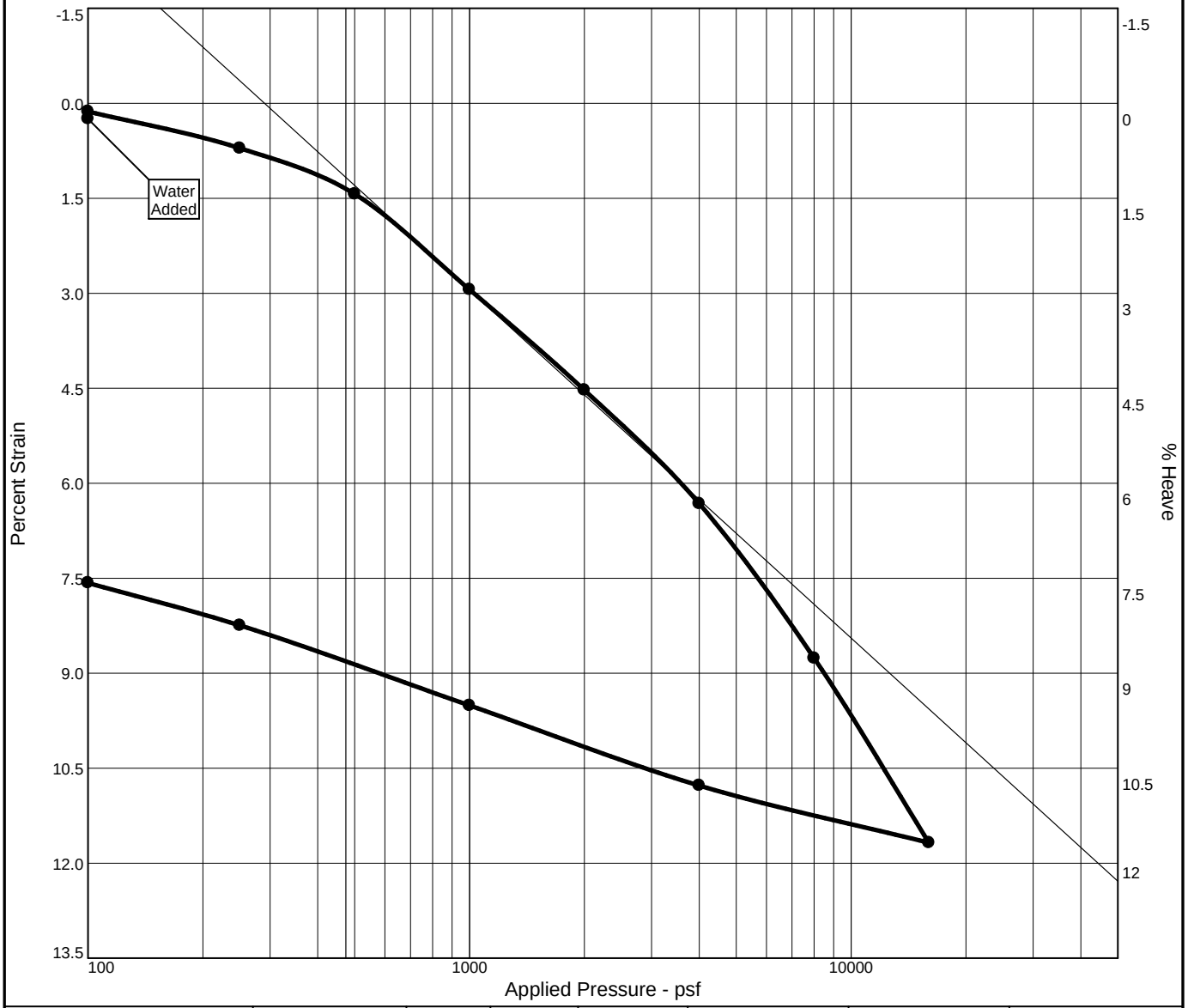
Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: NG

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
108.3 %	37.3 %	86.5			2.65			0.912

MATERIAL DESCRIPTION

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-01 **Depth:** 35-37' **Sample Number:** 20253

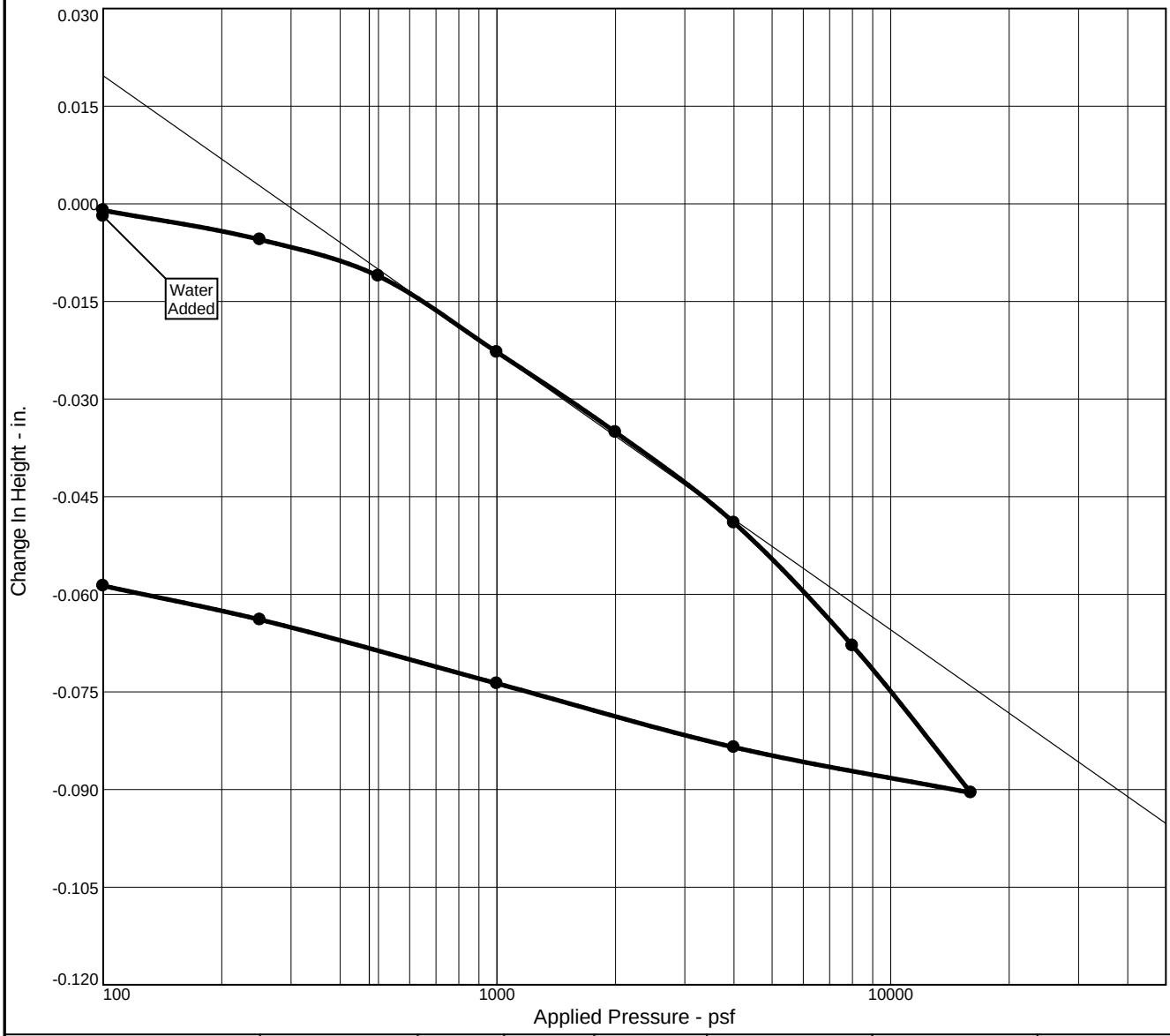
Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: NG

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
108.3 %	37.3 %	86.5			2.65			0.912

MATERIAL DESCRIPTION

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-01 **Depth:** 35-37' **Sample Number:** 20253

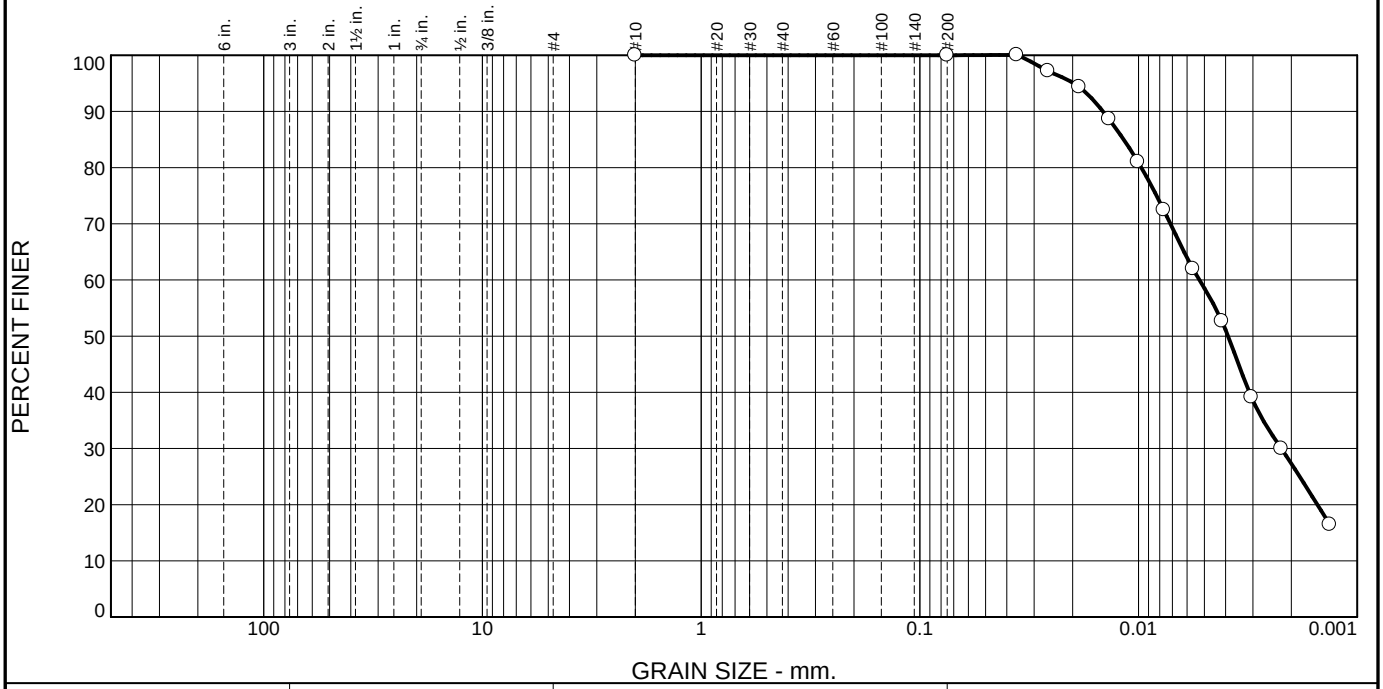
Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: NG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
				0	0	41	59

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100		
#200	100		
0.0360 mm.	100		
0.0259 mm.	97		
0.0187 mm.	94		
0.0136 mm.	89		
0.0101 mm.	81		
0.0077 mm.	72		
0.0056 mm.	62		
0.0042 mm.	53		
0.0030 mm.	39		
0.0022 mm.	30		
0.0013 mm.	16		

* (no specification provided)

Material Description

lean clay

Atterberg Limits (ASTM D 4318)

PL= 23 **LL=** 31 **PI=** 8

Classification

USCS (D 2487)= **AASHTO (M 145)=** A-4(8)

Coefficients

D_{90}= 0.0145 D_{85}= 0.0117 D_{60}= 0.0053
D_{50}= 0.0039 D_{30}= 0.0022 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: **Date Tested:** 1-4-18

Tested By: CA

Checked By: NG

Title: Laboratory Manager

Source of Sample: BH-02 **Depth:** 40-42'
Sample Number: 20256

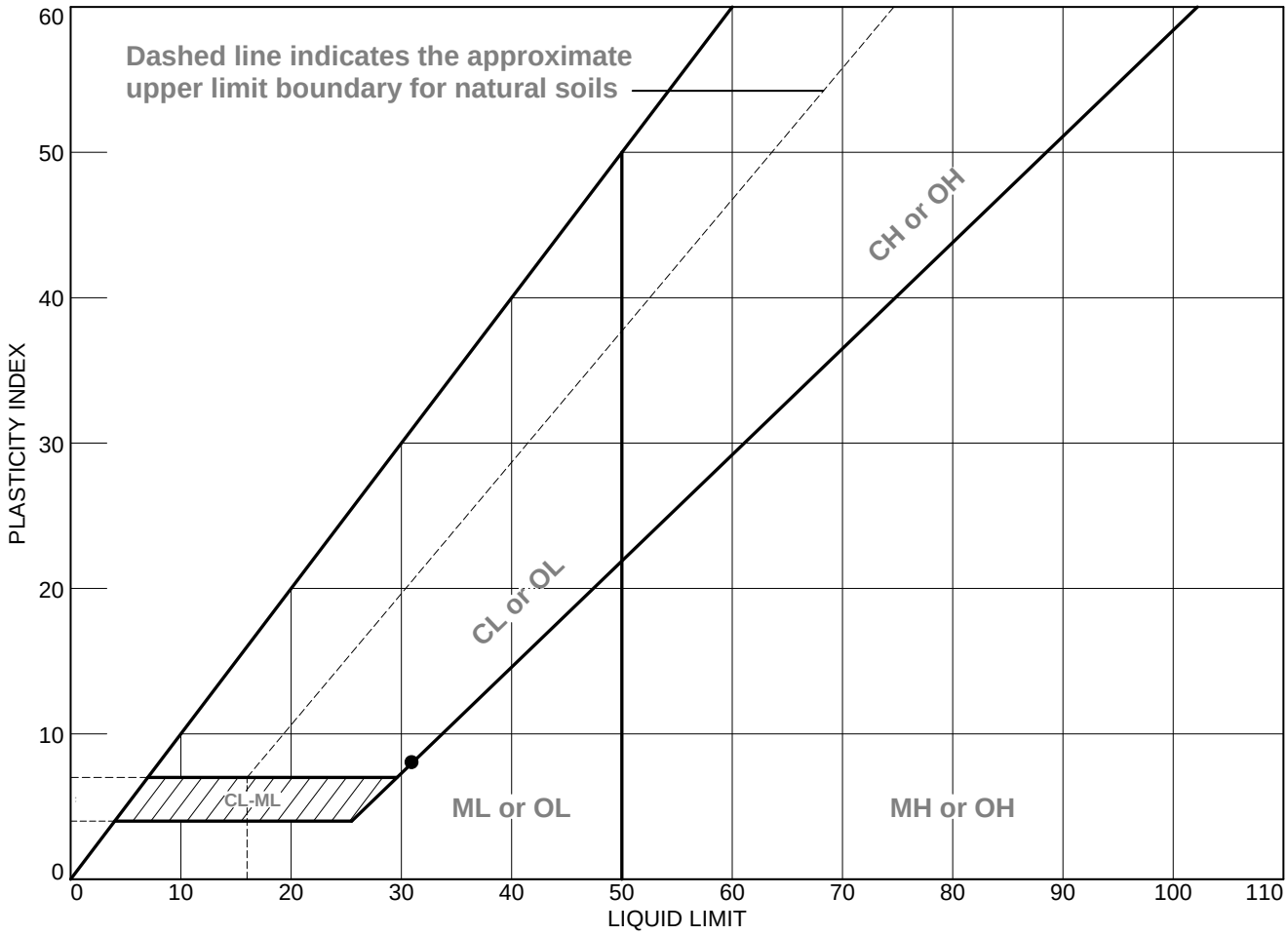
Date Sampled:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Client:
Project: Whitefish WWTP

Project No: **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	BH-02	20256	40-42'		23	31	8	

Pioneer Technical Services, Inc.

106 Pronghorn Trail, Suite A - Bozeman, MT 59718

Ph. 406-388-8578 - Fax 406-388-8579

Client:

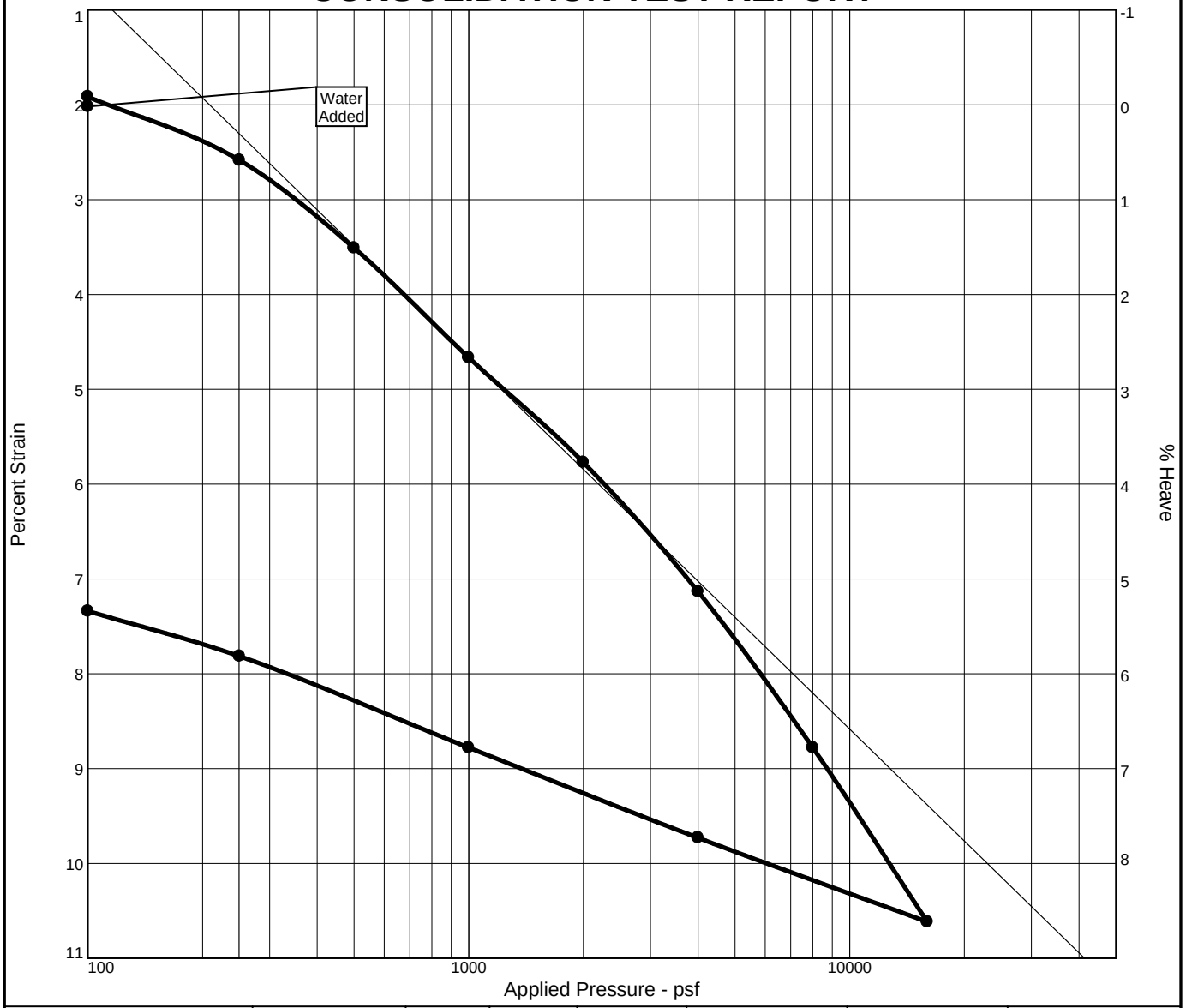
Project: Whitefish WWTP

Project No.:

Figure

Tested By: NG

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
109.2 %	32.0 %	93.1	31	8	2.65		A-4(8)	0.777

MATERIAL DESCRIPTION

lean clay

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 40-42' **Sample Number:** 20256

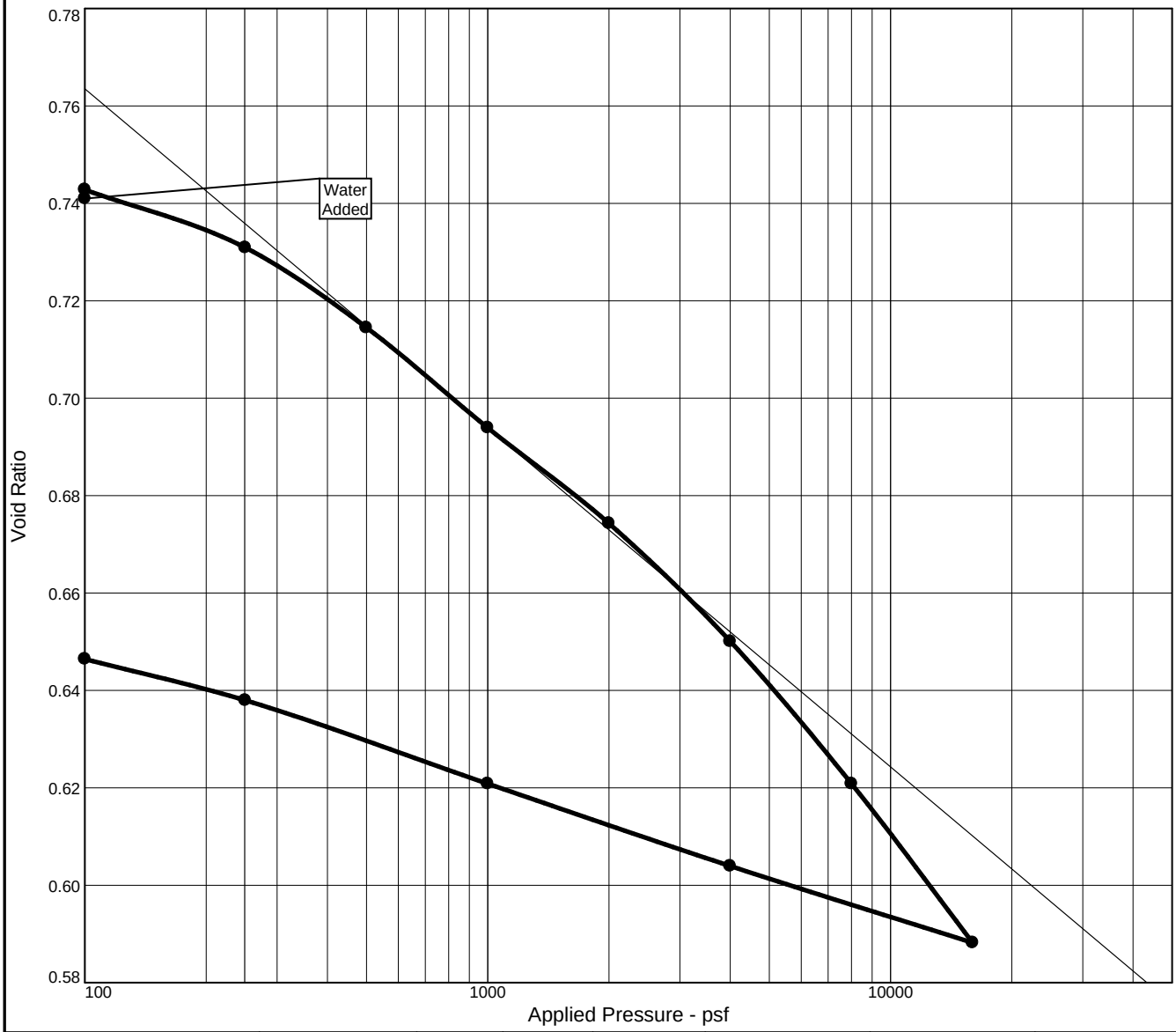
Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Remarks:

Figure

Tested By: NG

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
109.2 %	32.0 %	93.1	31	8	2.65		A-4(8)	0.777

MATERIAL DESCRIPTION

lean clay

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 40-42' **Sample Number:** 20256

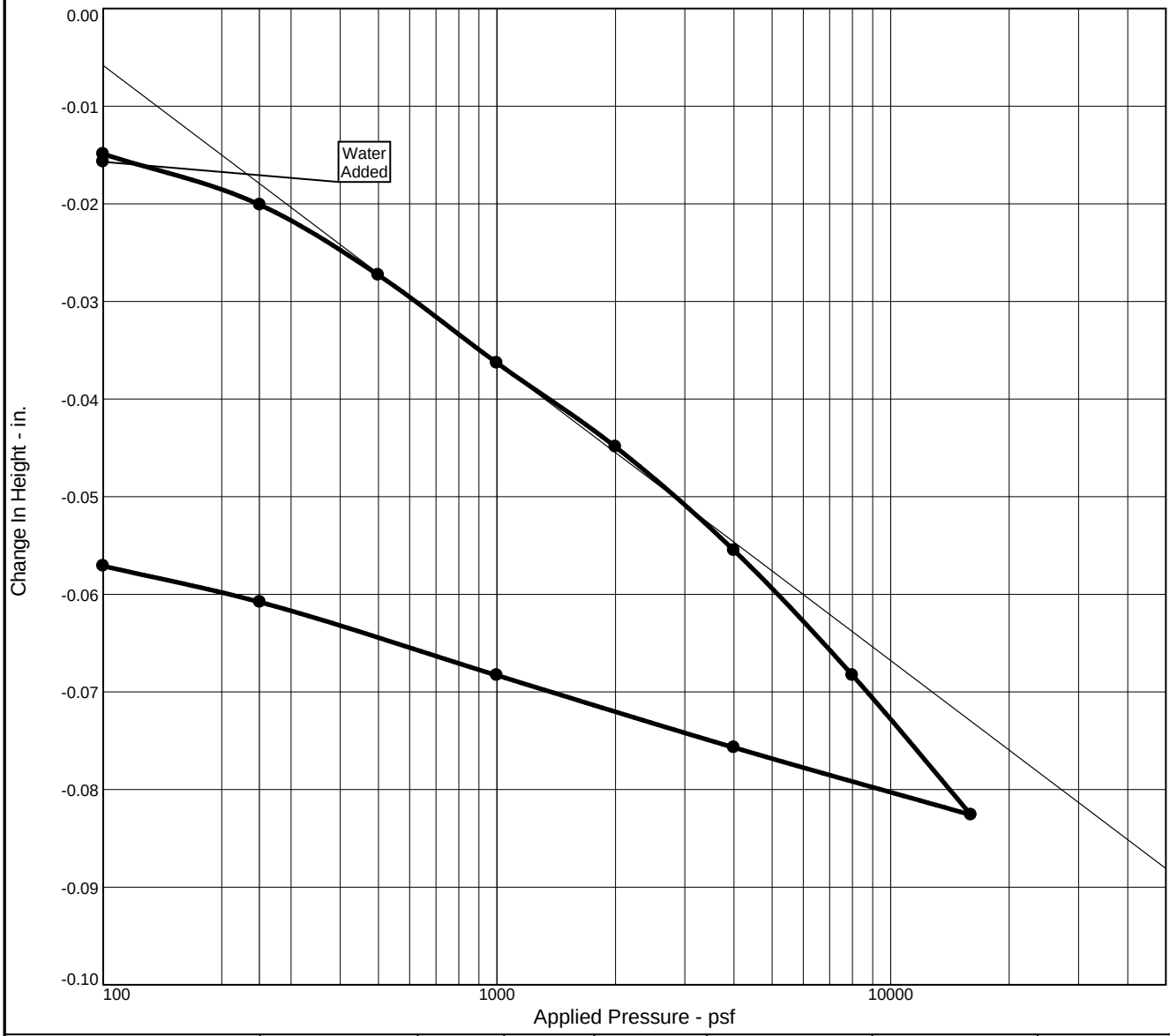
Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: NG

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
109.2 %	32.0 %	93.1	31	8	2.65		A-4(8)	0.777

MATERIAL DESCRIPTION

lean clay

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 40-42' **Sample Number:** 20256

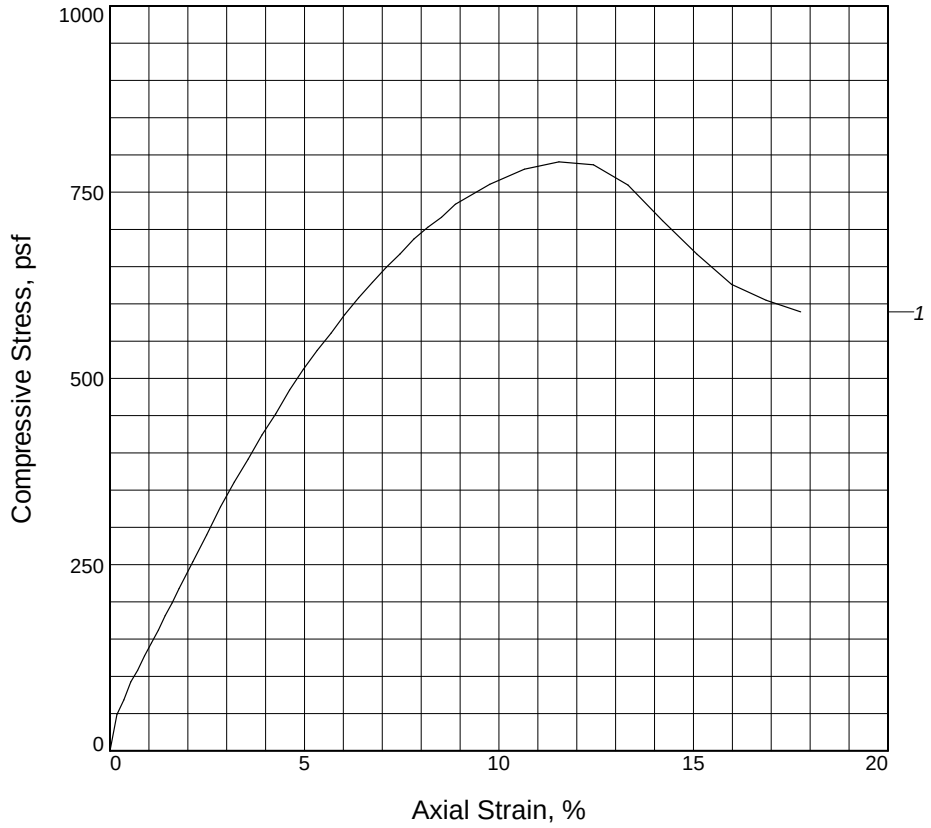
Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: NG

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	791			
Undrained shear strength, psf	395			
Failure strain, %	11.5			
Strain rate, in./min.	0.050			
Water content, %	36.0			
Wet density, pcf	116.0			
Dry density, pcf	85.3			
Saturation, %	99.6			
Void ratio	0.9751			
Specimen diameter, in.	2.88			
Specimen height, in.	5.63			
Height/diameter ratio	1.96			

Description: lean clay

LL = 31	**PL =** 23	**PI =** 8	**Assumed GS=** 2.7	**Type:** Undisturbed

Project No.:
Date Sampled:
Remarks:

Figure _____

Client:

Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 40-42'
Sample Number: 20256

UNCONFINED COMPRESSION TEST
Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718

Tested By: CA

PIONEER
TECHNICAL SERVICES, INC.

August 16, 2017

Mr. Michael Browne
Pioneer Technical Services

RE: Whitefish Waste Water Treatment Plant

Dear Mr. Browne,

On July 29, five samples from the Whitefish Water Treatment Plant project were delivered to our Bozeman geotechnical testing laboratory. The samples were identified as indicated in Table 1. The samples were assigned Lab Nos. 20252 to 20256.

The testing was performed in general accordance with the following Standards:

- One dimensional consolidation of soils (ASTM D2435);
- Unconfined Compressive Strength of Cohesive Soil (ASTM D2166);
- Atterberg Limits (ASTM D4318); and
- Particle Size Analysis with Hydrometer (ASTM D422).

Table 1

Lab No.	Sample Identification
20252	BH-01 (10-12')
20253	BH-01 (35-37')
20254	BH-02 (8-10')
20255	BH-02 (18-20')
20256	BH-02 (40-42')

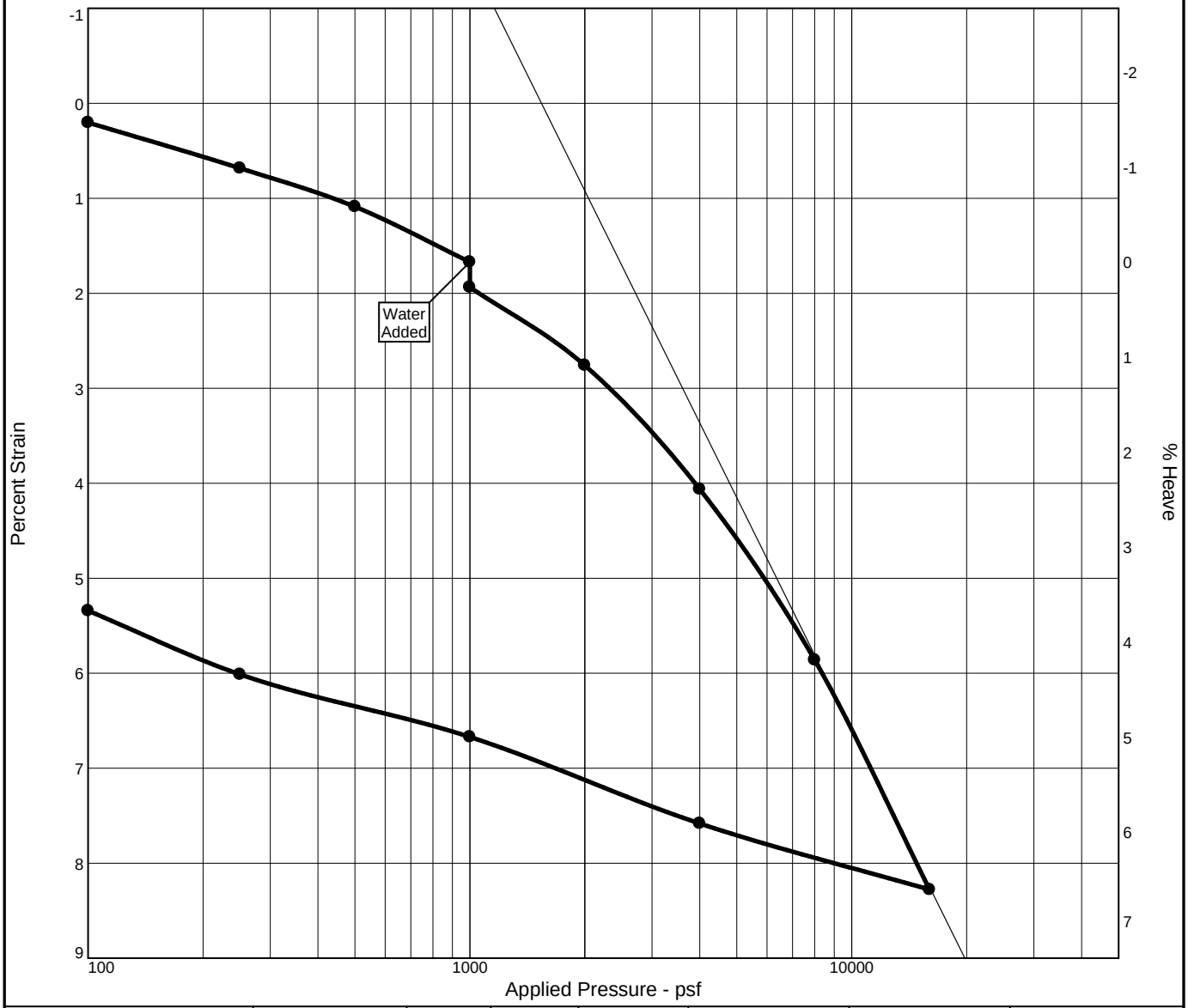
A one dimensional consolidation test was performed on samples BH-01(10-12') and BH-02 (8-10') with incremental loads from 100 psf to 16,000 psf and unload points of 4000, 1000, 250, and 100 psf. The samples were saturated at 1000 psf. The void ratio curve, percent strain and deformation curves are attached.

Thank you for using Pioneer Technical Services, Inc. for your geotechnical and materials testing requirements. If you have any questions regarding these results, please contact us at (406) 388-8578.

Sincerely,

Niki Griffis
Project Scientist/Laboratory Manager

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
86.4 %	22.3 %	99.3			2.7			0.697

MATERIAL DESCRIPTION

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-01 **Depth:** 10-12' **Sample Number:** 20252

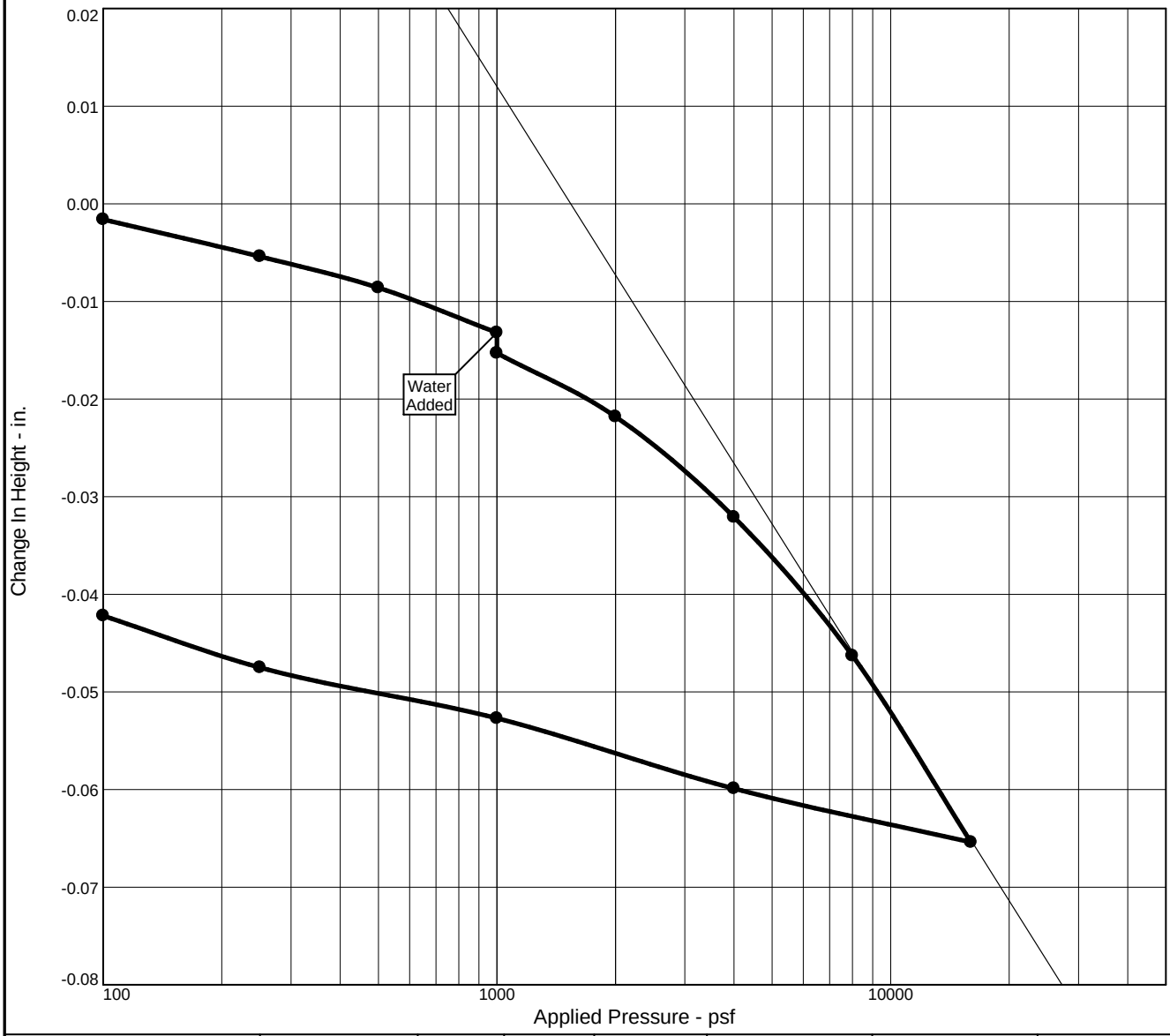
Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: NG

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
86.4 %	22.3 %	99.3			2.7			0.697

MATERIAL DESCRIPTION

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-01 **Depth:** 10-12' **Sample Number:** 20252

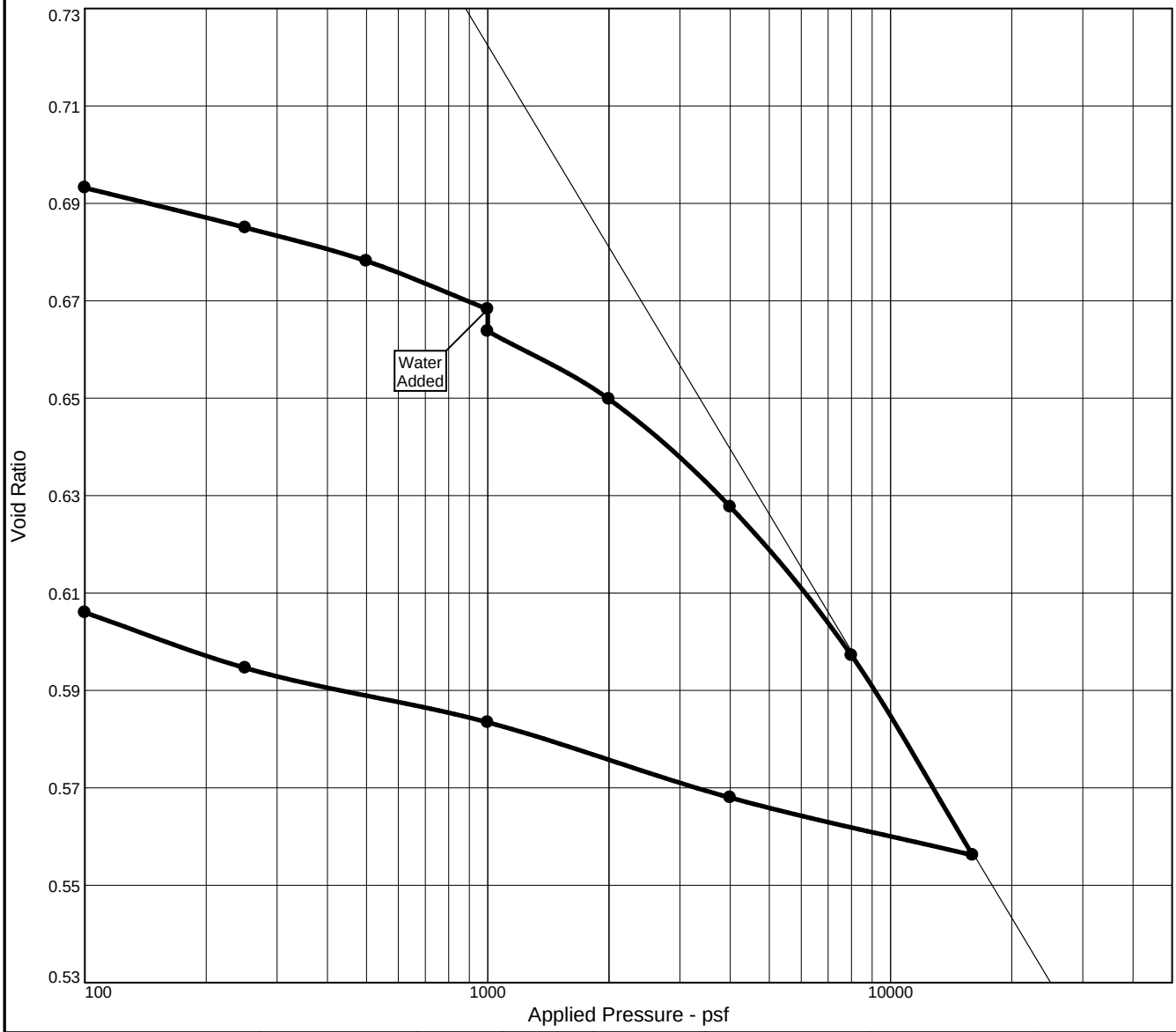
Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Remarks:

Figure

Tested By: NG

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
86.4 %	22.3 %	99.3			2.7			0.697

MATERIAL DESCRIPTION

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-01 **Depth:** 10-12' **Sample Number:** 20252

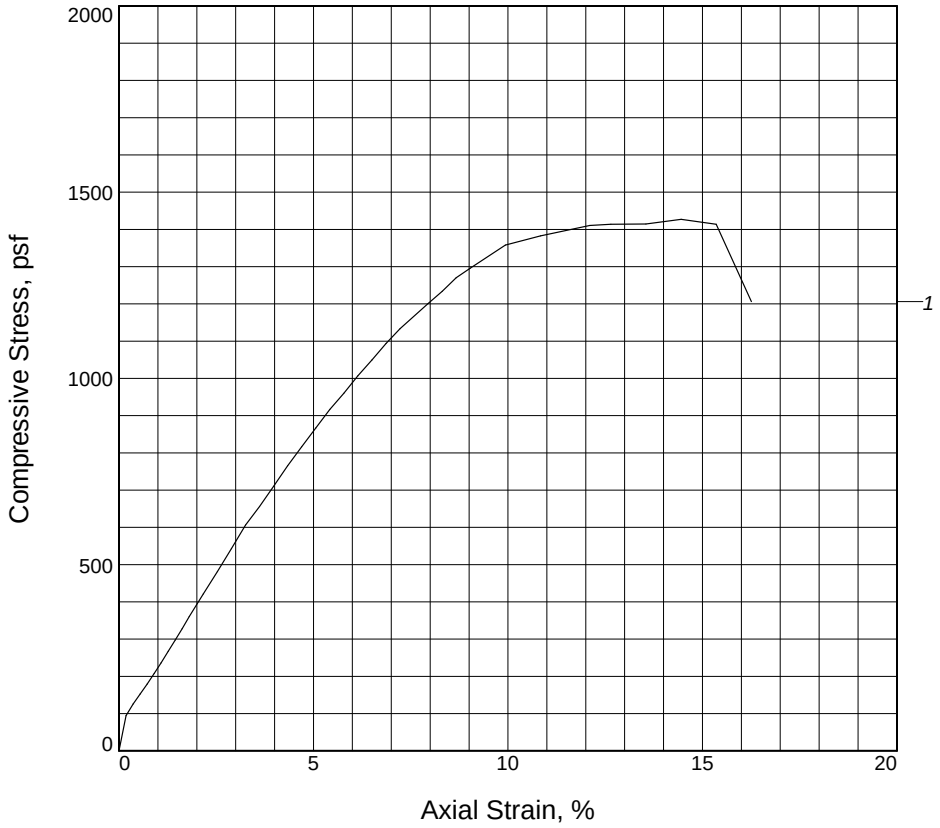
Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Remarks:

Figure

Tested By: NG

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	1427			
Undrained shear strength, psf	713			
Failure strain, %	14.5			
Strain rate, in./min.	0.05			
Water content, %	31.3			
Wet density, pcf	119.9			
Dry density, pcf	91.3			
Saturation, %	100.0			
Void ratio	0.8454			
Specimen diameter, in.	2.85			
Specimen height, in.	5.54			
Height/diameter ratio	1.94			

Description:

LL =	**PL =**	**PI =**	**Assumed GS=** 2.7	**Type:** Shelby Tube

Project No.:
Date Sampled:
Remarks:

Figure _____

Client:

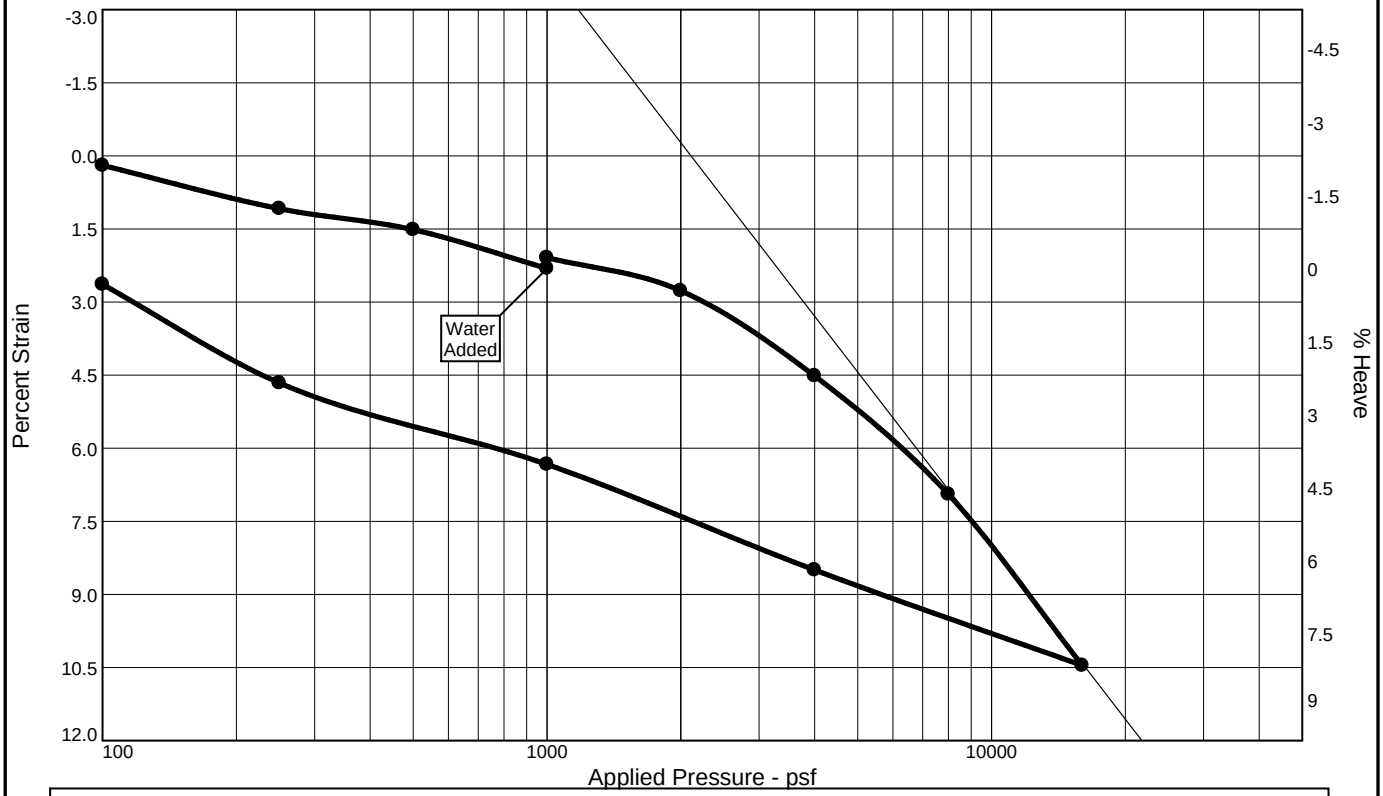
Project: Whitefish WWTP

Source of Sample: BH-01 **Depth:** 35-37'
Sample Number: 20253

UNCONFINED COMPRESSION TEST
Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718

Tested By: NG

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (psf)	C_v (ft.^{2}/day)	C_α	No.	Load (psf)	C_v (ft.^{2}/day)	C_α	No.	Load (psf)	C_v (ft.^{2}/day)	C_α
6	2000	0.637	0.001								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
97.0 %	37.5 %	82.5	40	18	2.7	CL	A-6(20)	1.043

MATERIAL DESCRIPTION

lean clay

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 18-20' **Sample Number:** 20255

Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

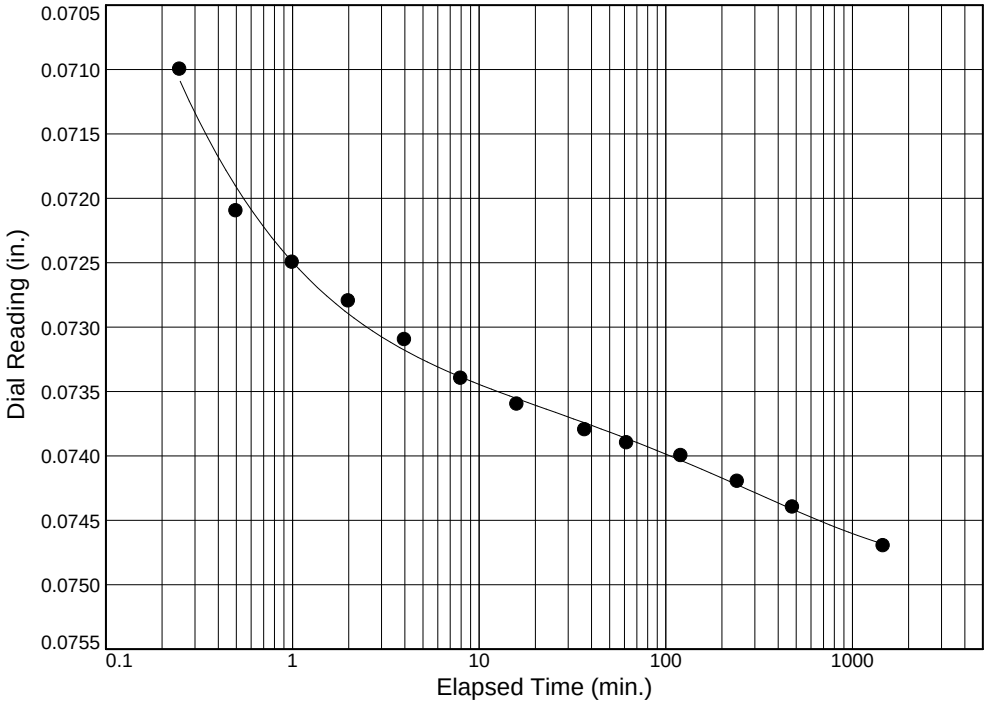
Figure

Tested By: NG

Dial Reading vs. Time

Project No.:
Project: Whitefish WWTP

Source of Sample: BH-02 Depth: 18-20' Sample Number: 20255



Load No.= 6

Load= 2000 psf

D_0 = 0.0695

D_{50} = 0.0718

D_{100} = 0.0740

T_{50} = 0.43 min.

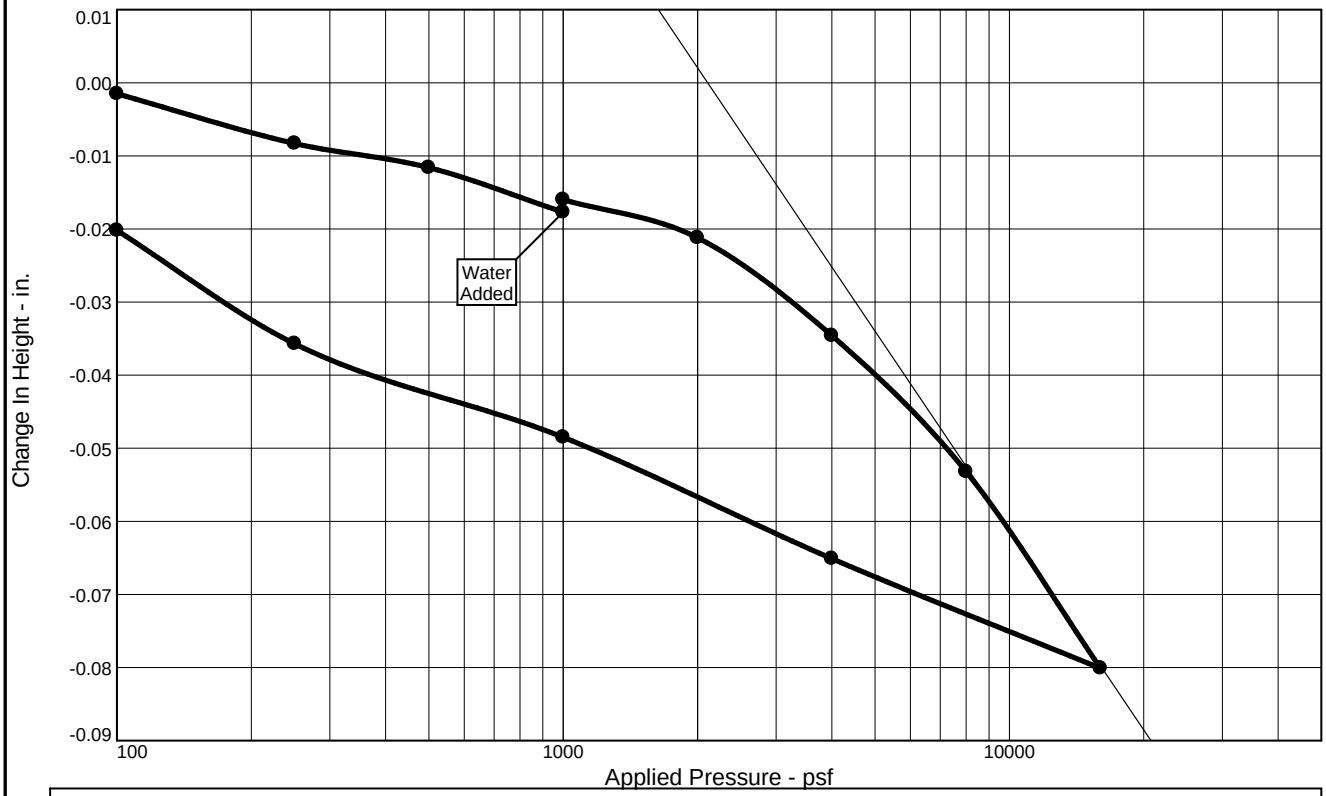
C_v @ T_{50}
0.637 ft.^{2}/day

C_α = 0.001

Figure

Pioneer Technical Services, Inc.

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (psf)	C_v (ft.^{2}/day)	C_α	No.	Load (psf)	C_v (ft.^{2}/day)	C_α	No.	Load (psf)	C_v (ft.^{2}/day)	C_α
6	2000	0.637	0.001								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
97.0 %	37.5 %	82.5	40	18	2.7	CL	A-6(20)	1.043

MATERIAL DESCRIPTION

lean clay

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 18-20' **Sample Number:** 20255

Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

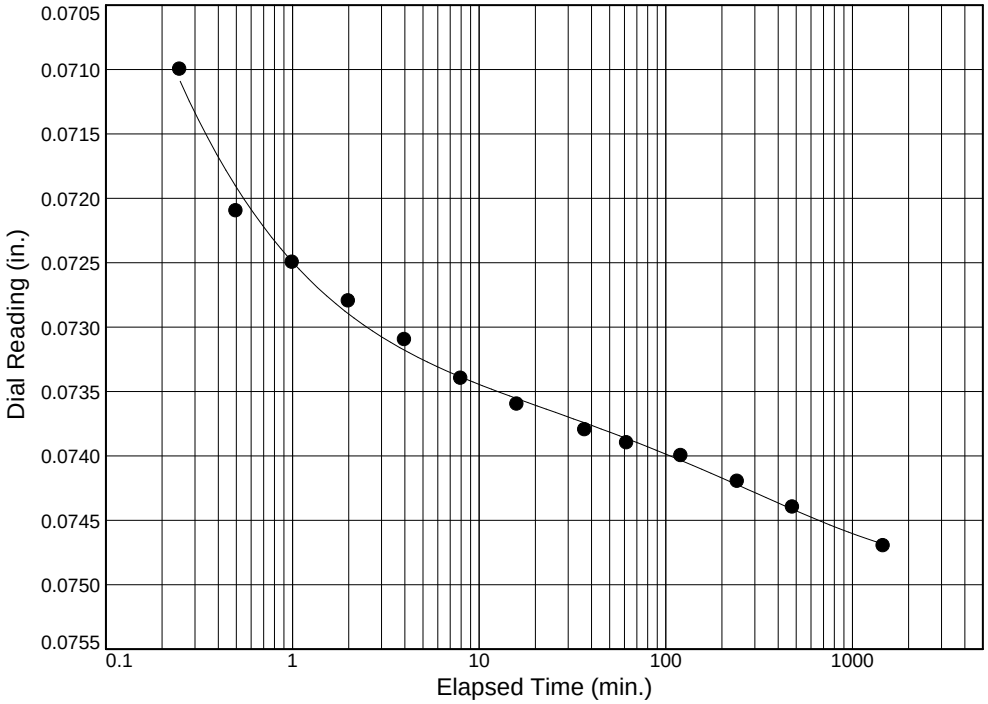
Figure

Tested By: NG

Dial Reading vs. Time

Project No.:
Project: Whitefish WWTP

Source of Sample: BH-02 Depth: 18-20' Sample Number: 20255



Load No.= 6

Load= 2000 psf

D_0 = 0.0695

D_{50} = 0.0718

D_{100} = 0.0740

T_{50} = 0.43 min.

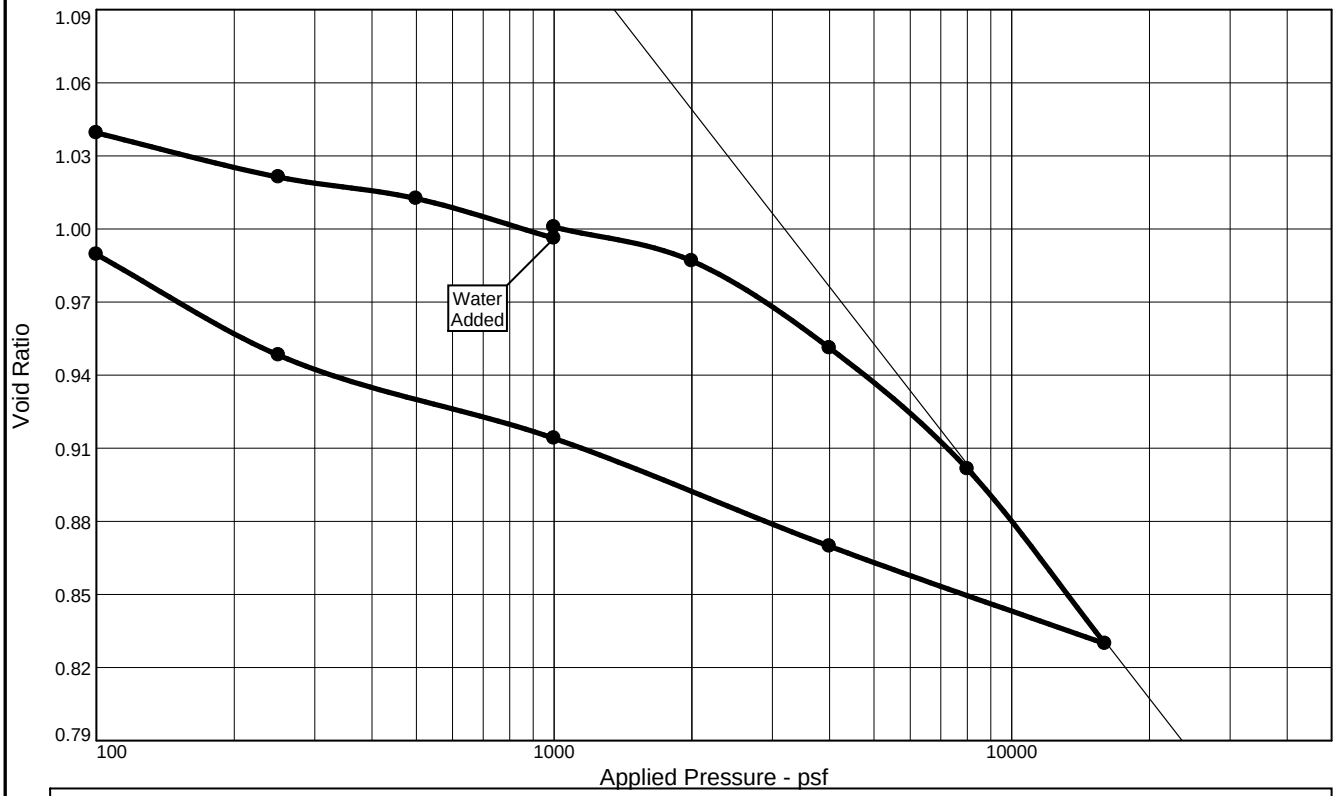
C_v @ T_{50}
0.637 ft.^{2}/day

C_α = 0.001

Figure

Pioneer Technical Services, Inc.

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (psf)	C_v (ft.^{2}/day)	C_α	No.	Load (psf)	C_v (ft.^{2}/day)	C_α	No.	Load (psf)	C_v (ft.^{2}/day)	C_α
6	2000	0.637	0.001								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
97.0 %	37.5 %	82.5	40	18	2.7	CL	A-6(20)	1.043

MATERIAL DESCRIPTION

lean clay

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 18-20' **Sample Number:** 20255

Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

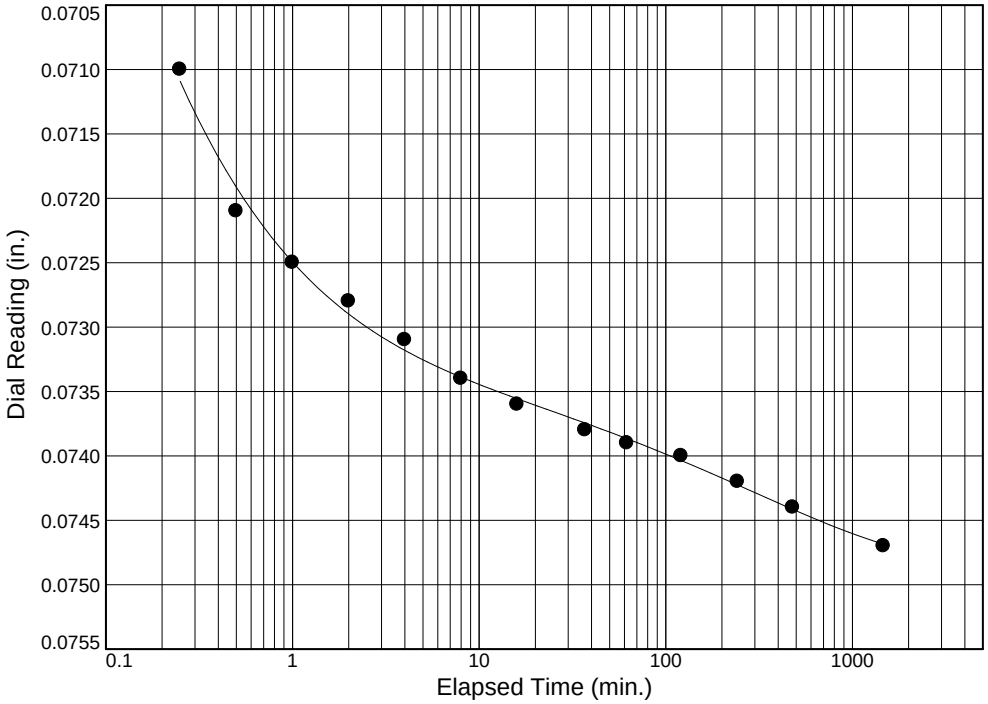
Figure

Tested By: NG

Dial Reading vs. Time

Project No.:
Project: Whitefish WWTP

Source of Sample: BH-02 Depth: 18-20' Sample Number: 20255



Load No.= 6

Load= 2000 psf

D_0 = 0.0695

D_{50} = 0.0718

D_{100} = 0.0740

T_{50} = 0.43 min.

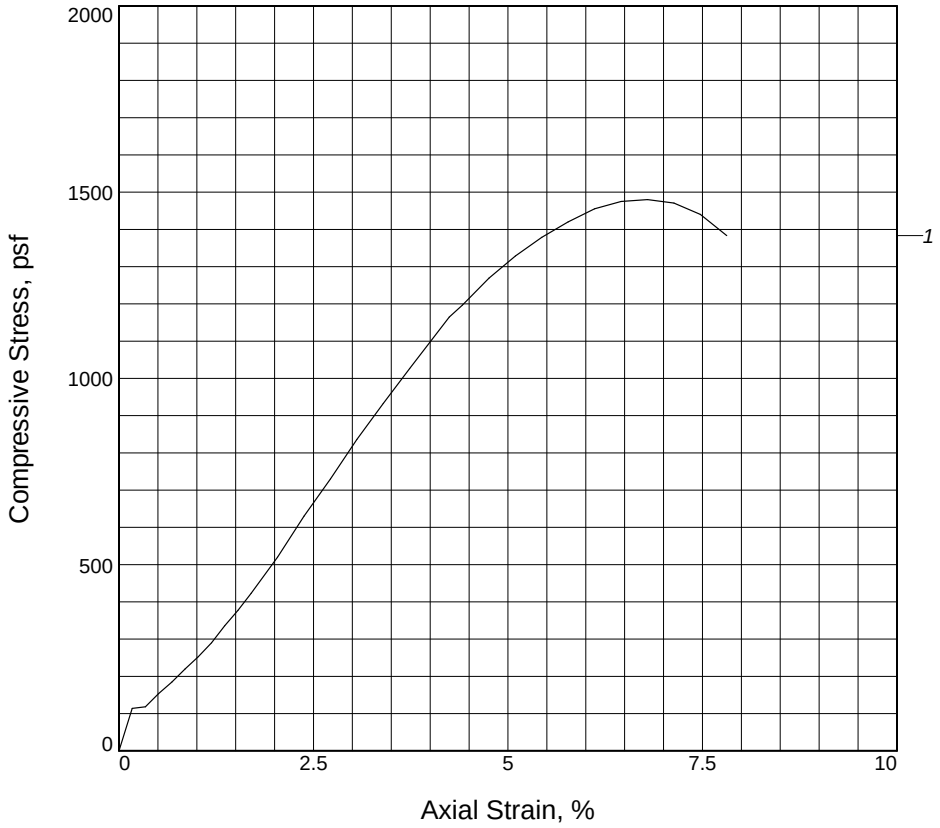
C_v @ T_{50}
0.637 ft.^{2}/day

C_α = 0.001

Figure

Pioneer Technical Services, Inc.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	1480			
Undrained shear strength, psf	740			
Failure strain, %	6.8			
Strain rate, in./min.	0.06			
Water content, %	27.3			
Wet density, pcf	116.6			
Dry density, pcf	91.6			
Saturation, %	87.7			
Void ratio	0.8406			
Specimen diameter, in.	2.86			
Specimen height, in.	5.89			
Height/diameter ratio	2.06			

Description:

LL =	**PL =**	**PI =**	**Assumed GS=** 2.7	**Type:** Undisturbed

Project No.:
Date Sampled:
Remarks:

Figure _____

Client:

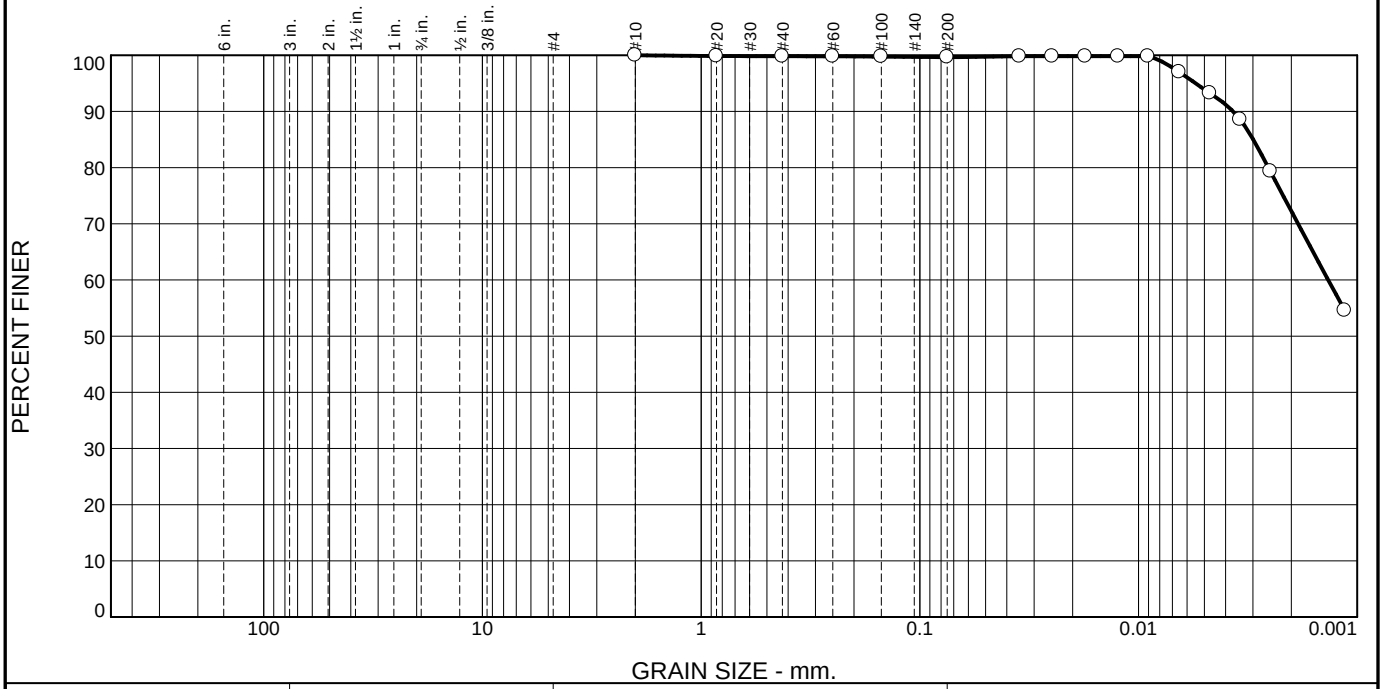
Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 8-10'
Sample Number: 20254

UNCONFINED COMPRESSION TEST
Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718

Tested By: NG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	0	6	94

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100		
#20	100		
#40	100		
#60	100		
#100	100		
#200	100		
0.0350 mm.	100		
0.0248 mm.	100		
0.0175 mm.	100		
0.0124 mm.	100		
0.0090 mm.	100		
0.0065 mm.	97		
0.0047 mm.	93		
0.0034 mm.	89		
0.0025 mm.	79		
0.0011 mm.	55		

* (no specification provided)

Material Description

lean clay

Atterberg Limits (ASTM D 4318)

PL= 22 **LL=** 40 **PI=** 18

Classification

USCS (D 2487)= CL **AASHTO (M 145)=** A-6(20)

Coefficients

D_{90}= 0.0037 D_{85}= 0.0030 D_{60}= 0.0014
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: **Date Tested:** 8-10-17

Tested By: NG/LS

Checked By: NG

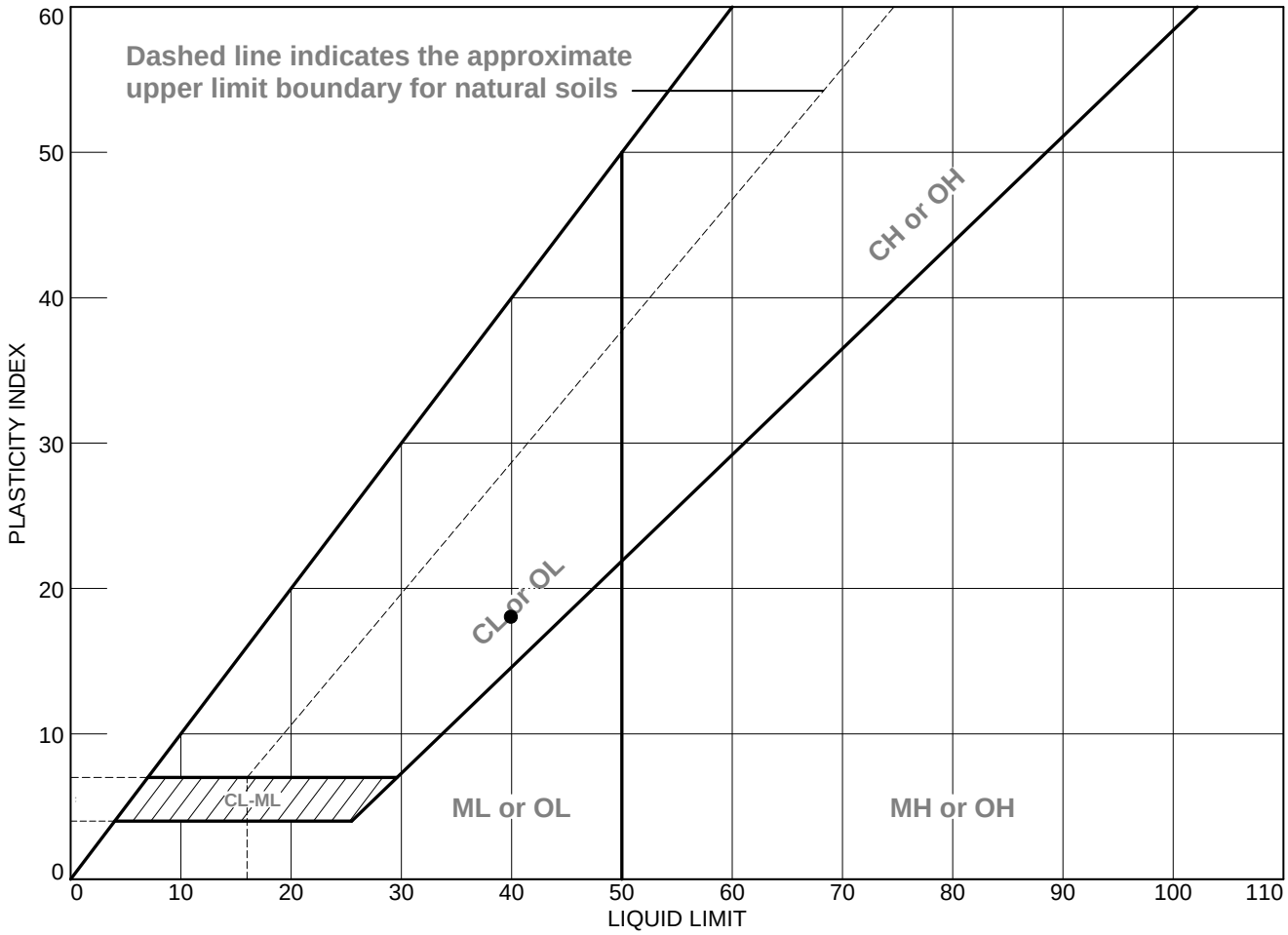
Title: Laboratory Manager

Source of Sample: BH-02 **Depth:** 18-20'
Sample Number: 20255 **Date Sampled:**

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Client:
Project: Whitefish WWTP
Project No: **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	BH-02	20255	18-20'		22	40	18	CL

Pioneer Technical Services, Inc.

106 Pronghorn Trail, Suite A - Bozeman, MT 59718

Ph. 406-388-8578 - Fax 406-388-8579

Client:

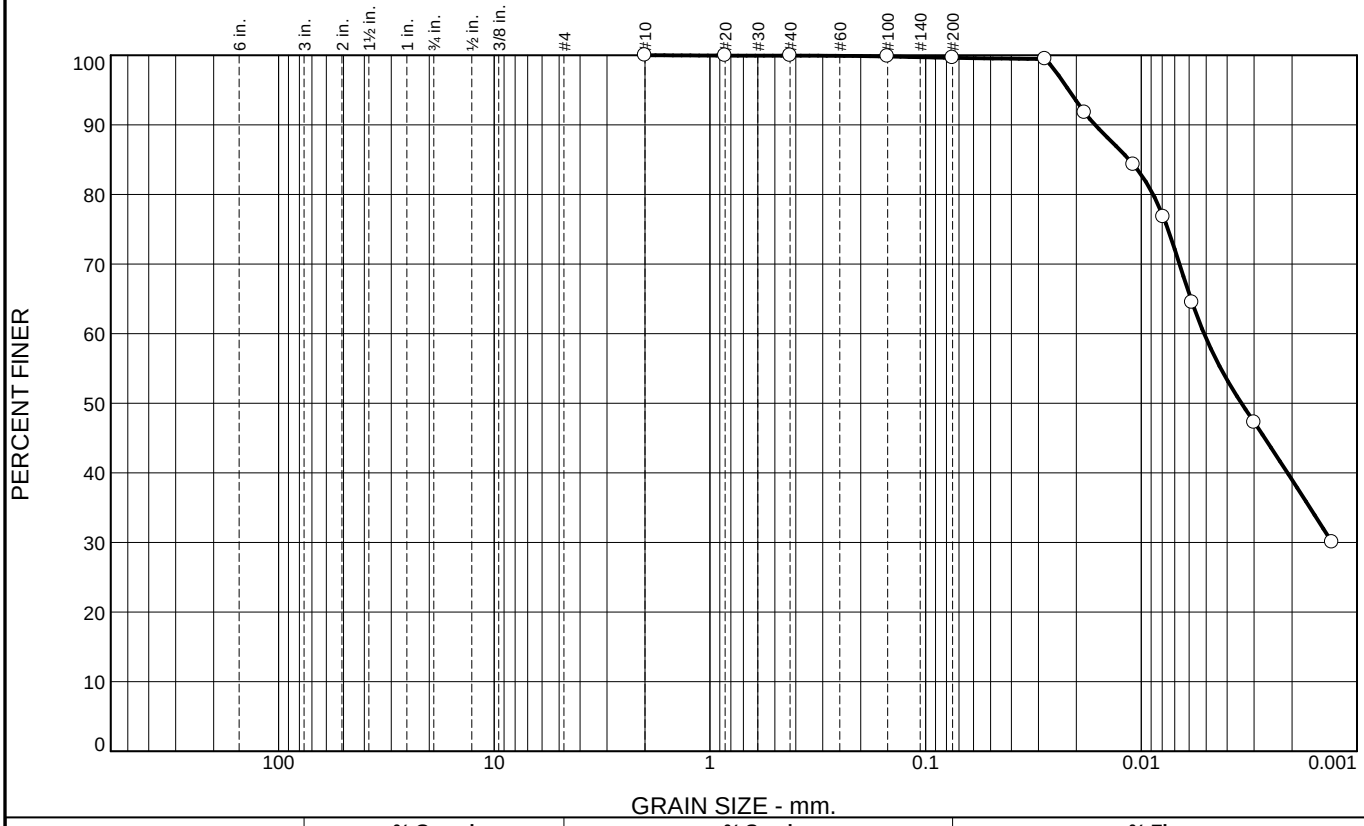
Project: Whitefish WWTP

Project No.:

Figure

Tested By: LS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	0	41	59

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#20	100		
#40	100		
#100	100		
#200	100		
0.0279 mm.	99		
0.0183 mm.	92		
0.0109 mm.	84		
0.0079 mm.	77		
0.0058 mm.	64		
0.0030 mm.	47		
0.0013 mm.	30		

* (no specification provided)

Soil Description

Lean Clay

Atterberg Limits

PL= 20 LL= 35 PI= 15

Coefficients

D_{90}= 0.0164 D_{85}= 0.0114 D_{60}= 0.0051
D_{50}= 0.0034 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(16)

Remarks

F.M.=0.00

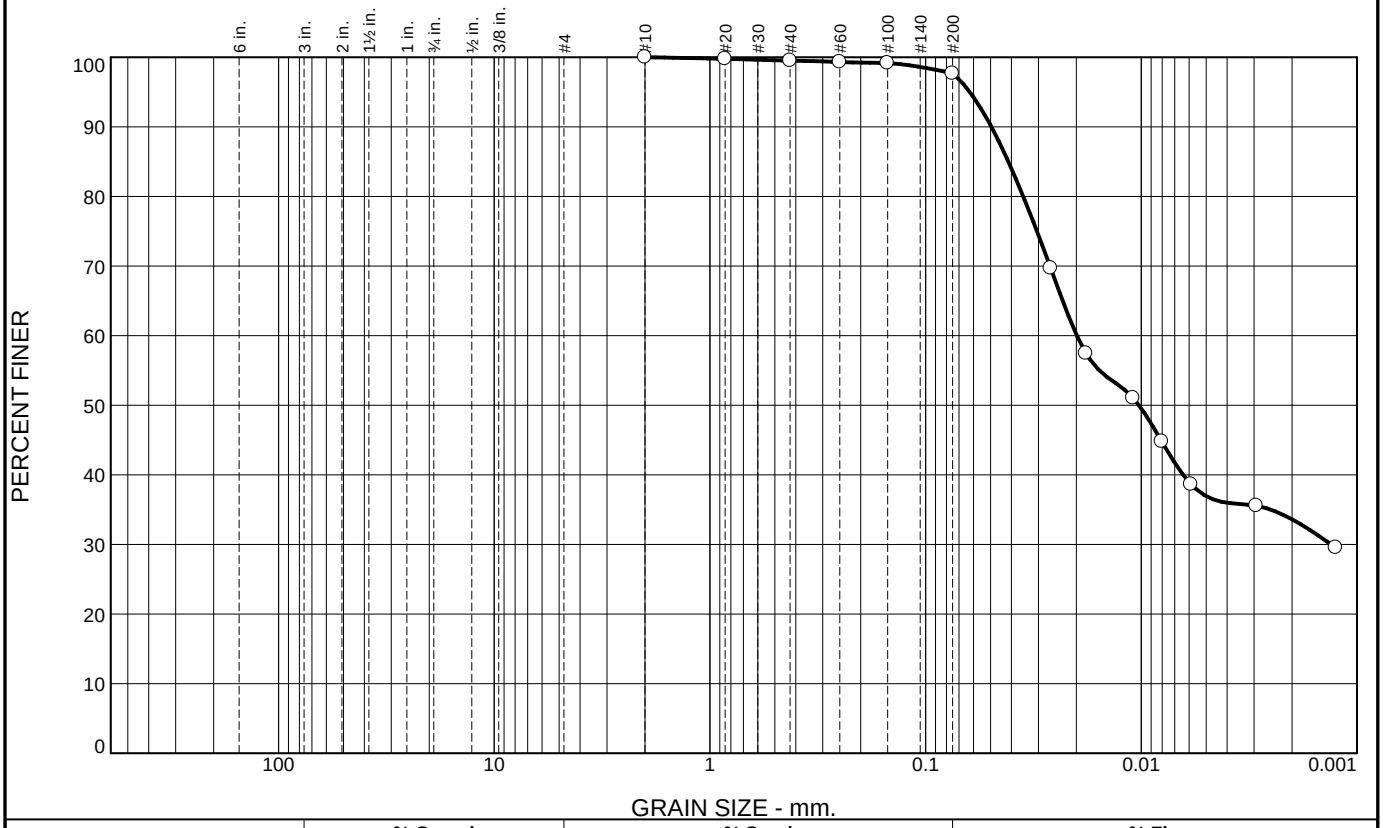
Source of Sample: BH-02 **Depth:** 25-26.5
Sample Number: 20242 **Date:**

PIONEER TECHNICAL SERVICES, INC.

Client: Anderson-Montgomery
Project: Whitefish WWTP

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	2	61	37

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#20	100		
#40	100		
#60	99		
#100	99		
#200	98		
0.0263 mm.	70		
0.0180 mm.	57		
0.0109 mm.	51		
0.0080 mm.	45		
0.0059 mm.	39		
0.0029 mm.	36		
0.0013 mm.	30		

* (no specification provided)

Soil Description

lean clay

Atterberg Limits

PL= 15 LL= 30 PI= 15

Coefficients

D_{90}= 0.0495 D_{85}= 0.0413 D_{60}= 0.0199
D_{50}= 0.0102 D_{30}= 0.0013 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(14)

Remarks

F.M.=0.02

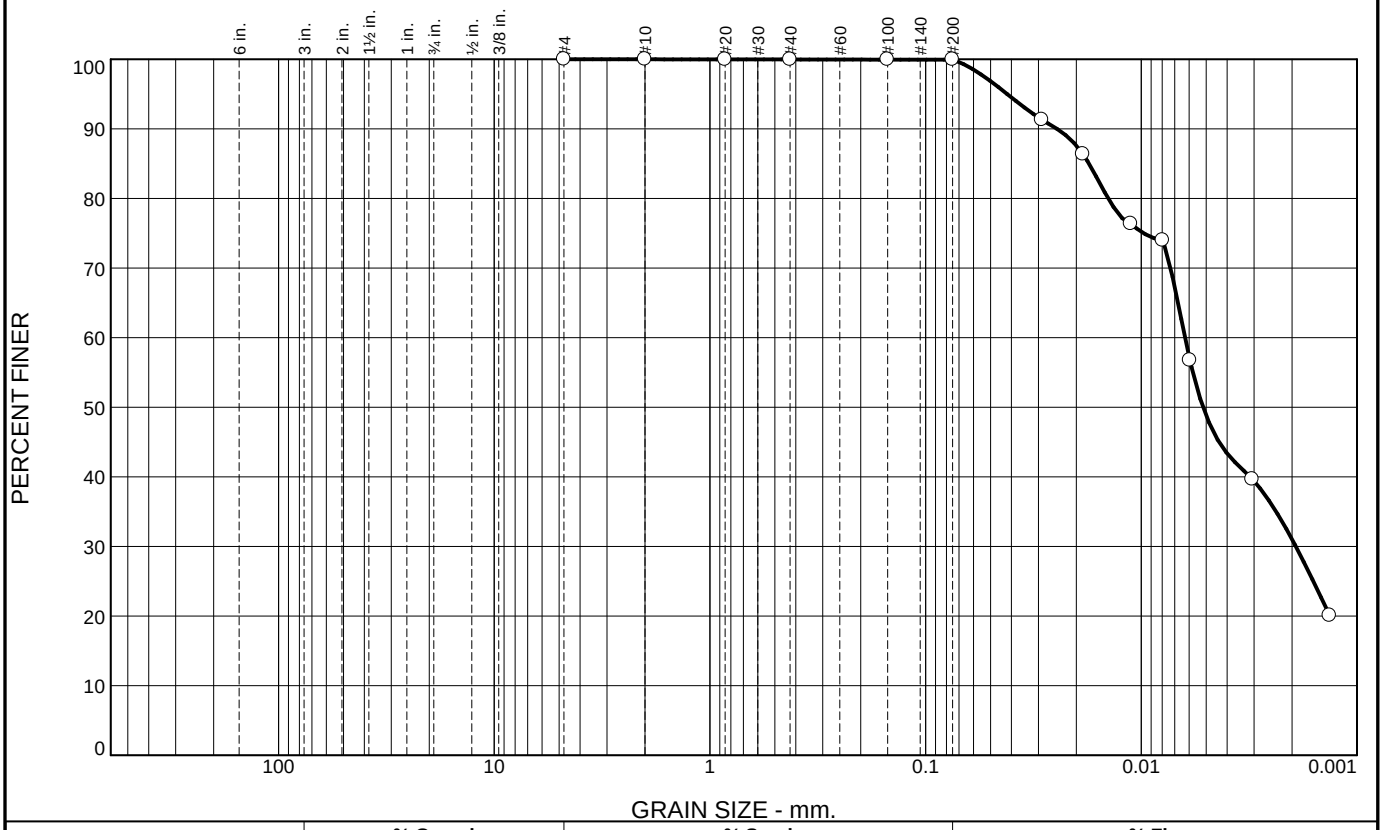
Source of Sample: BH-01 **Depth:** 12-13.5
Sample Number: 20224 **Date:** 08-03

PIONEER TECHNICAL SERVICES, INC.

Client: Anderson-Montgomery
Project: Whitefish WWTP

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	0	51	49

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#10	100		
#20	100		
#40	100		
#100	100		
#200	100		
0.0289 mm.	91		
0.0186 mm.	86		
0.0112 mm.	76		
0.0080 mm.	74		
0.0059 mm.	57		
0.0031 mm.	40		
0.0013 mm.	20		

* (no specification provided)

Soil Description

Lean Clay

Atterberg Limits

PL= 21 LL= 33 PI= 12

Coefficients

D_{90}= 0.0246 D_{85}= 0.0175 D_{60}= 0.0063
D_{50}= 0.0052 D_{30}= 0.0019 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(12)

Remarks

F.M.=0.00

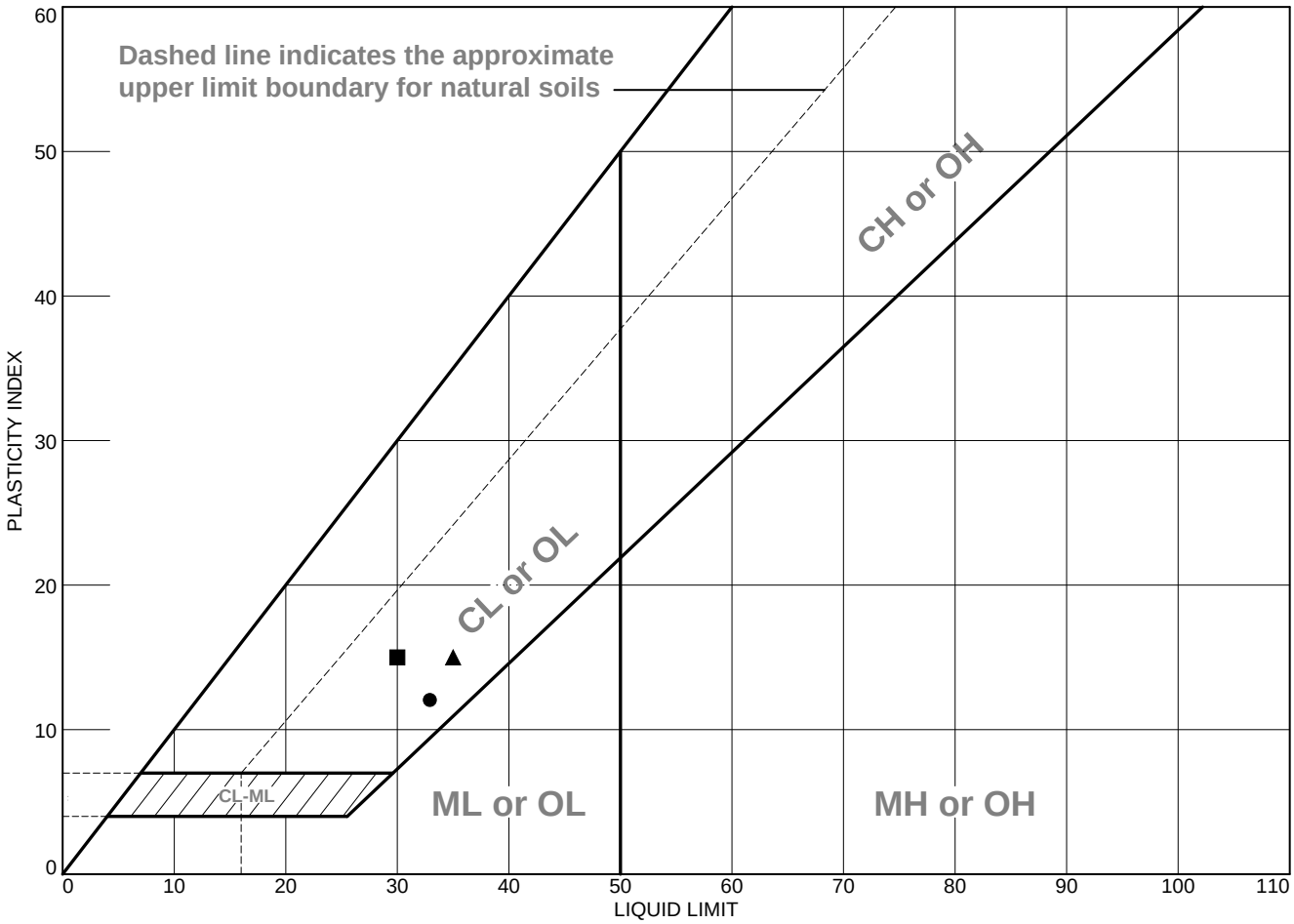
Source of Sample: BH-01 **Depth:** 37-38.5
Sample Number: 20230 **Date:**

PIONEER TECHNICAL SERVICES, INC.

Client: Anderson-Montgomery
Project: Whitefish WWTP

Project No: **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean Clay	33	21	12	100	100	CL
■	lean clay	30	15	15	100	98	CL
▲	Lean Clay	35	20	15	100	100	CL

Project No. **Client:** Anderson-Montgomery

Project: Whitefish WWTP

●**Source of Sample:** BH-01 **Depth:** 37-38.5 **Sample Number:** 20230

■**Source of Sample:** BH-01 **Depth:** 12-13.5 **Sample Number:** 20224

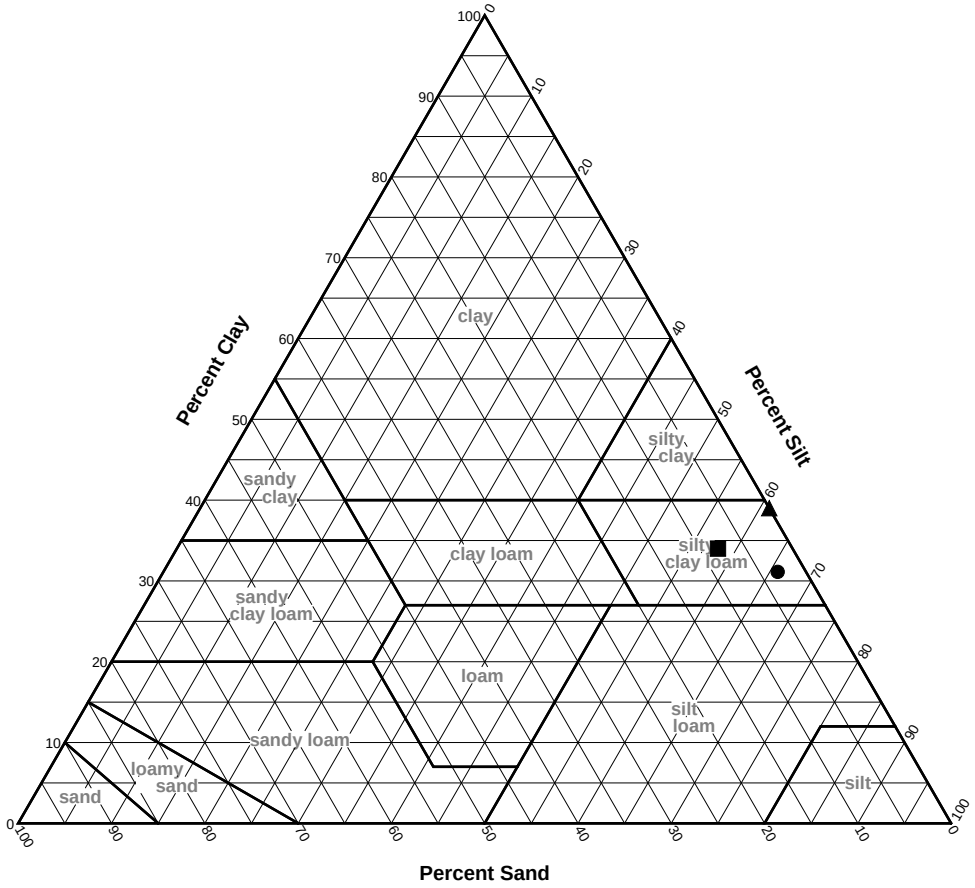
▲**Source of Sample:** BH-02 **Depth:** 25-26.5 **Sample Number:** 20242

Remarks:

PIONEER TECHNICAL SERVICES, INC.

Figure

USDA Soil Classification



SOIL DATA

	Source	Sample No.	Depth	Percentages From Material Passing a #10 Sieve			Classification
				Sand	Silt	Clay	
●	BH-01	20230	37-38.5	3	66	31	Silty clay loam
■	BH-01	20224	12-13.5	8	58	34	Silty clay loam
▲	BH-02	20242	25-26.5	0	61	39	Silty clay loam

PIONEER TECHNICAL SERVICES, INC.

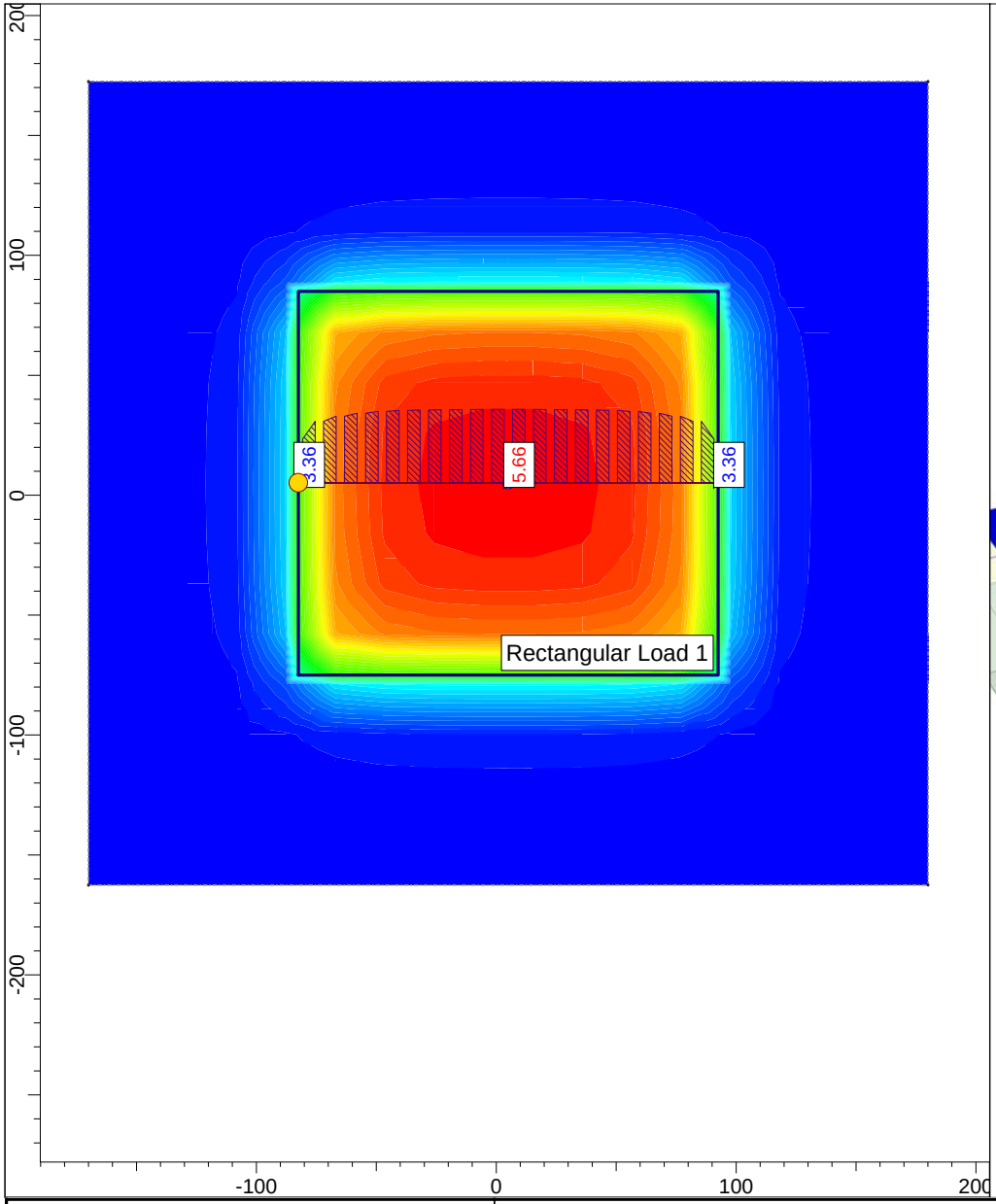
Client: Anderson-Montgomery

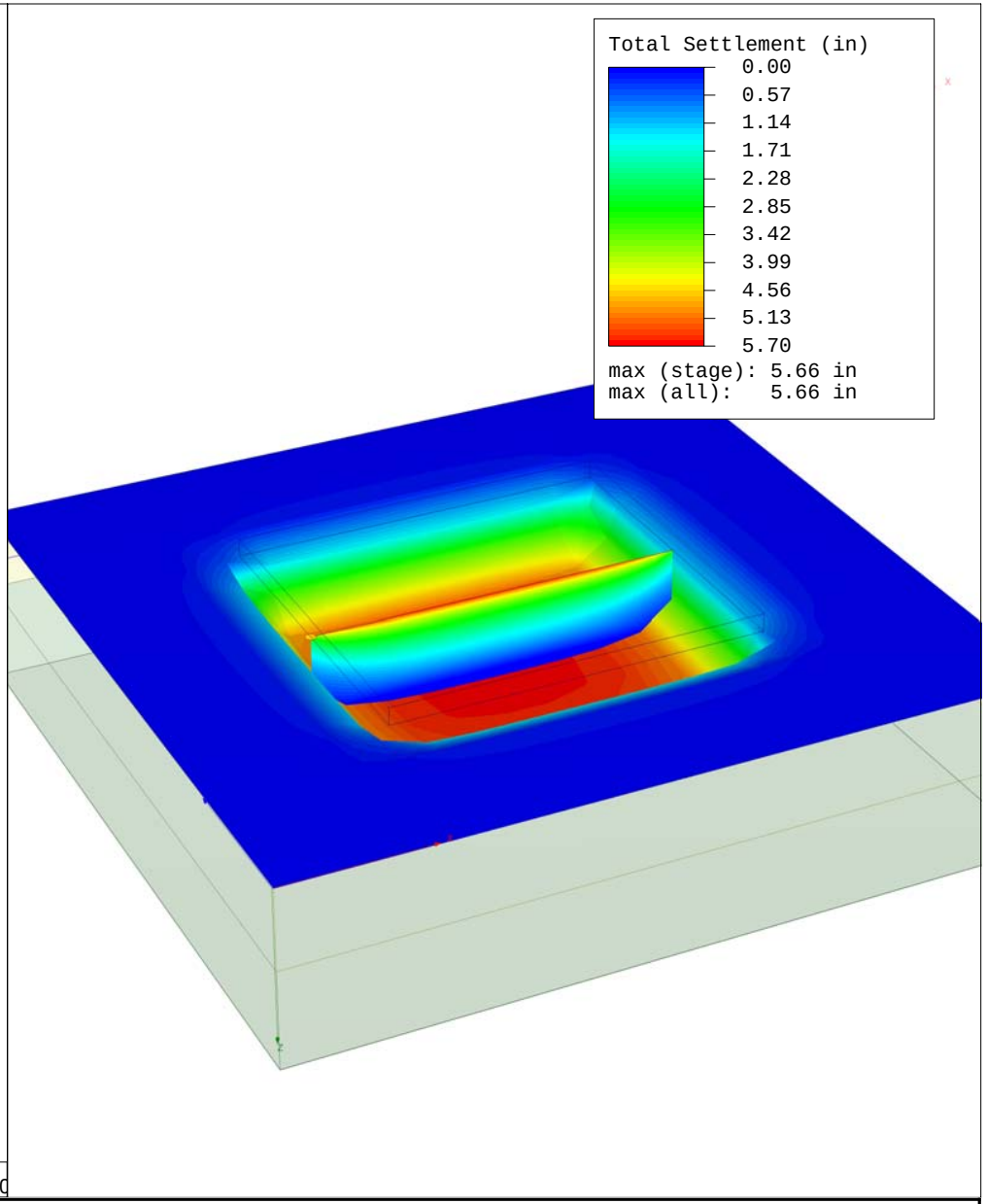
Project: Whitefish WWTP

Project No.:

Figure

Appendix D
Preliminary Settlement Calculations

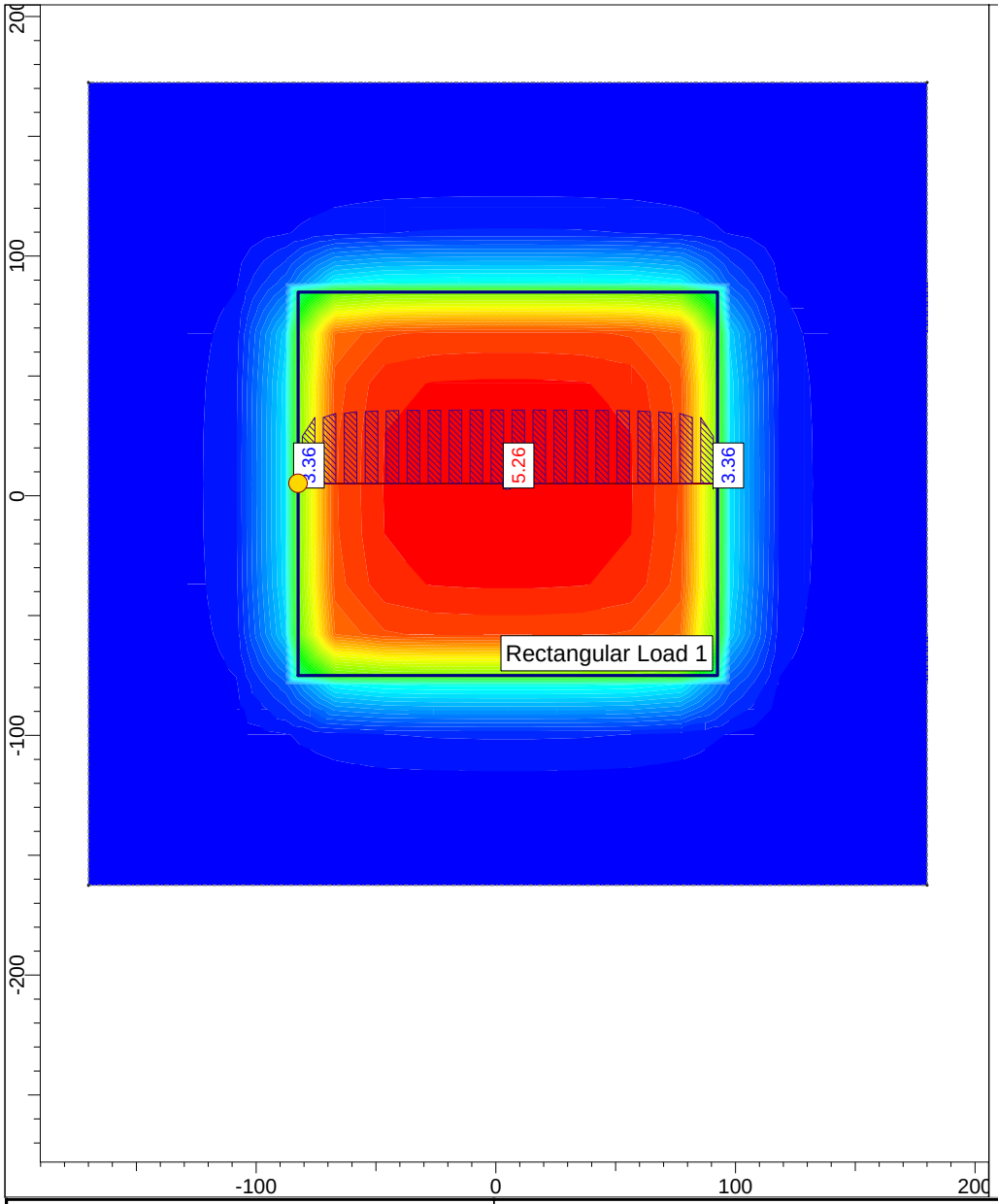


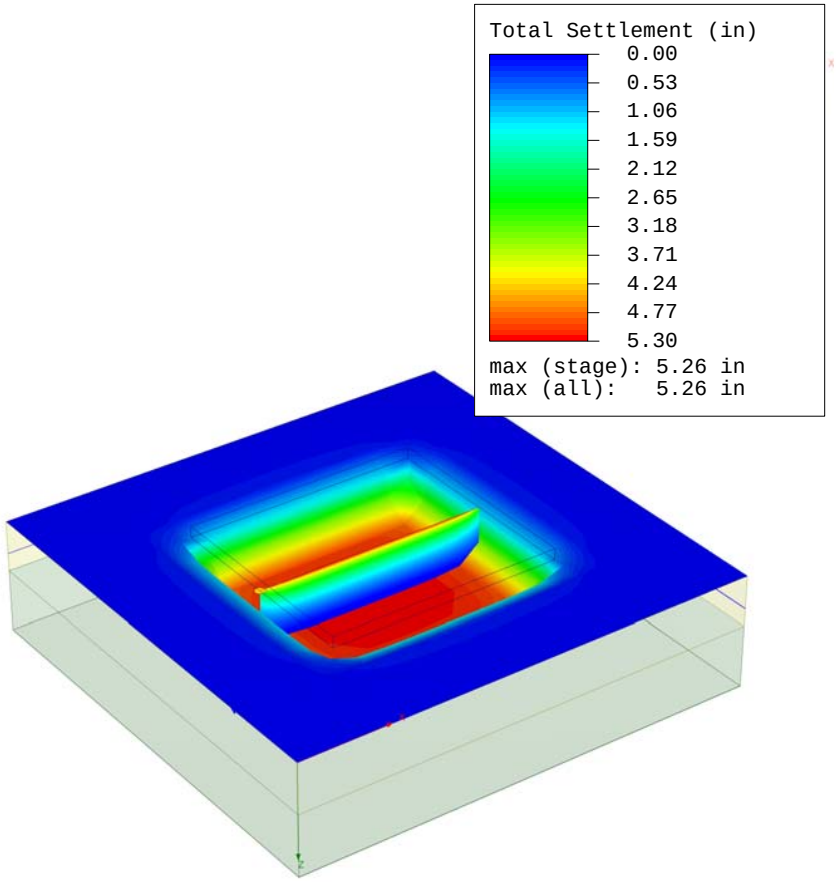


PIONEER TECHNICAL SERVICES, INC.

SETTLE3D 4.012

Project	Whitefish WWTP		
Analysis Description	Most Probable Sigma p		
Drawn By	MB	*Company*	Pioneer
Date	9/25/2017, 10:53:56 AM	*File Name*	WF WWTP consol_1.s3z

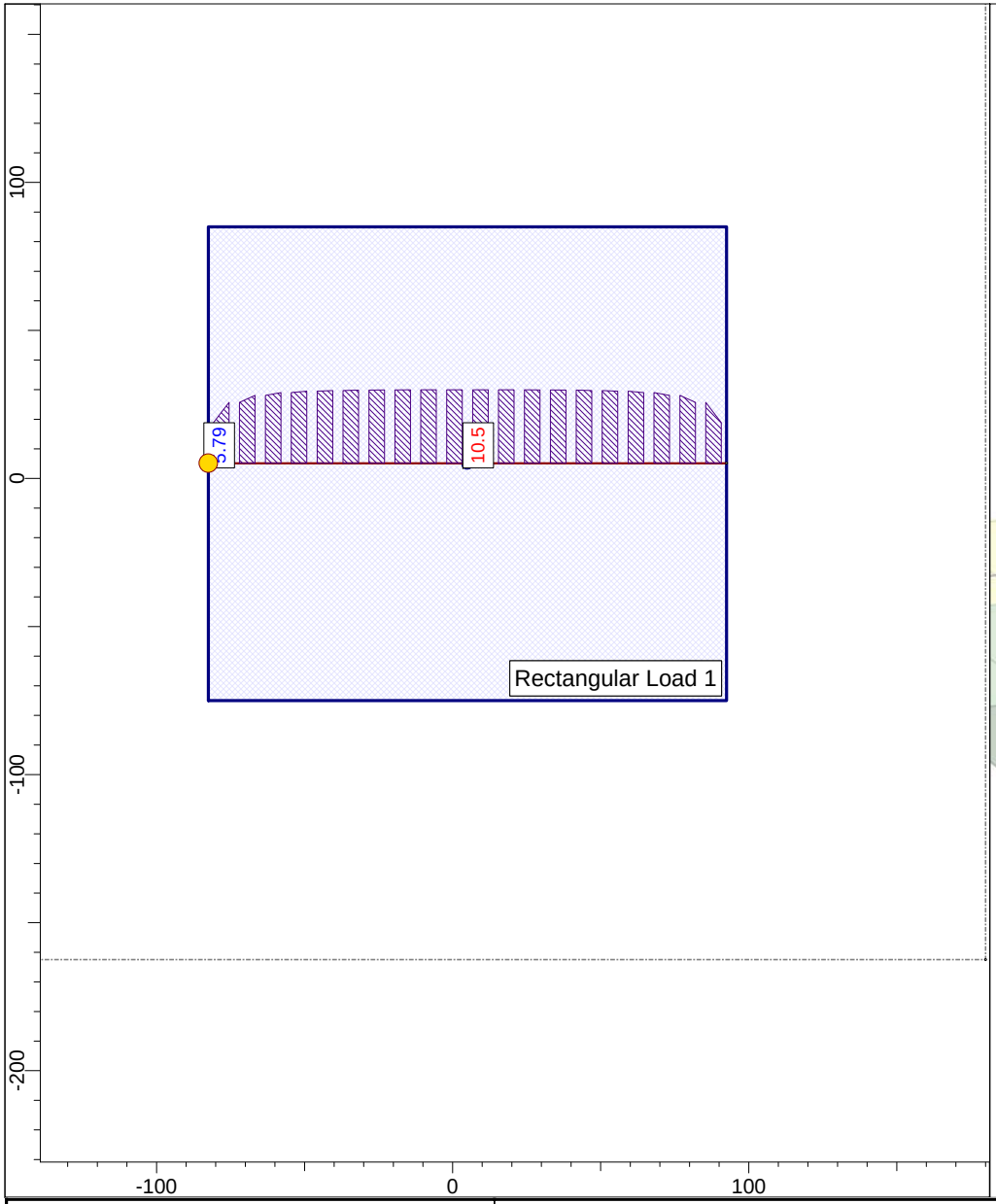


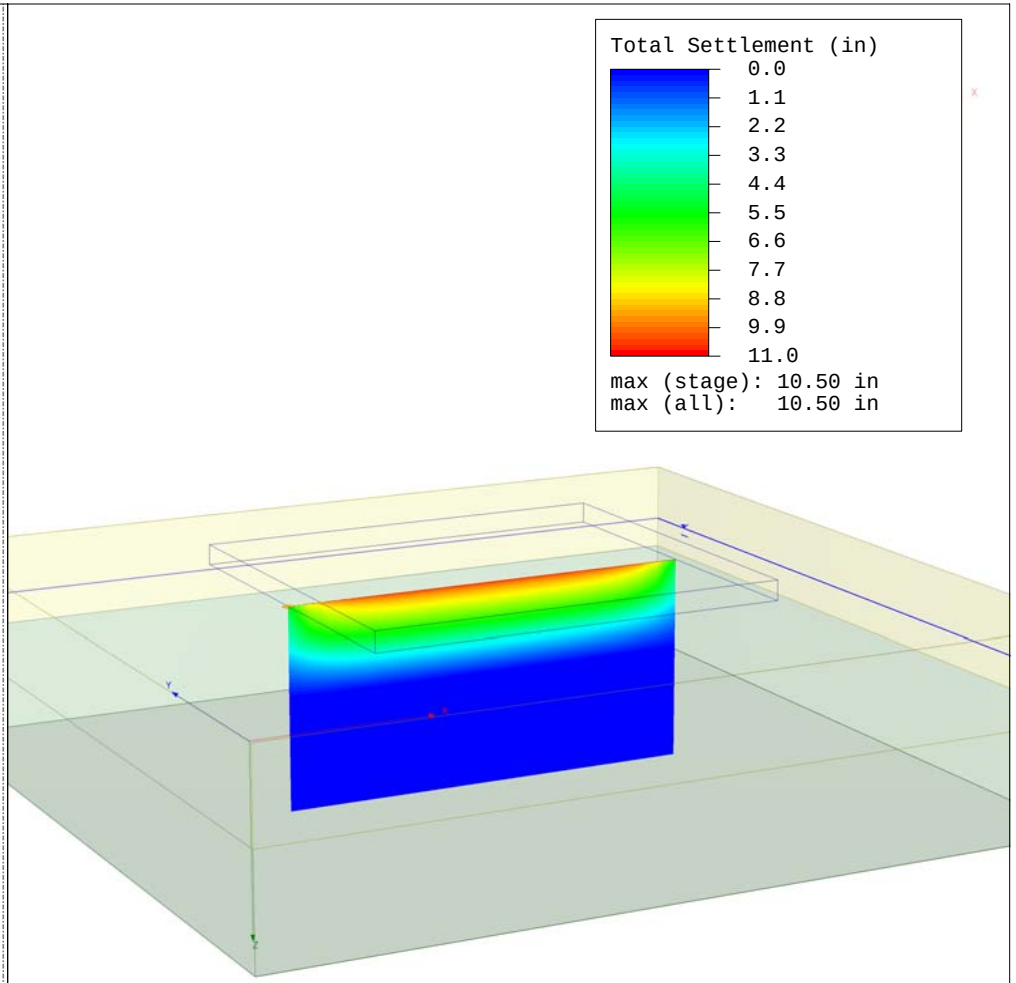


PIONEER TECHNICAL SERVICES, INC.

SETTLE3D 4.012

Project	Whitefish WWTP		
Analysis Description	Maximum Probable Sigma p		
Drawn By	MB	*Company*	Pioneer
Date	9/25/2017, 10:53:56 AM	*File Name*	WF WWTP consol_1.s3z

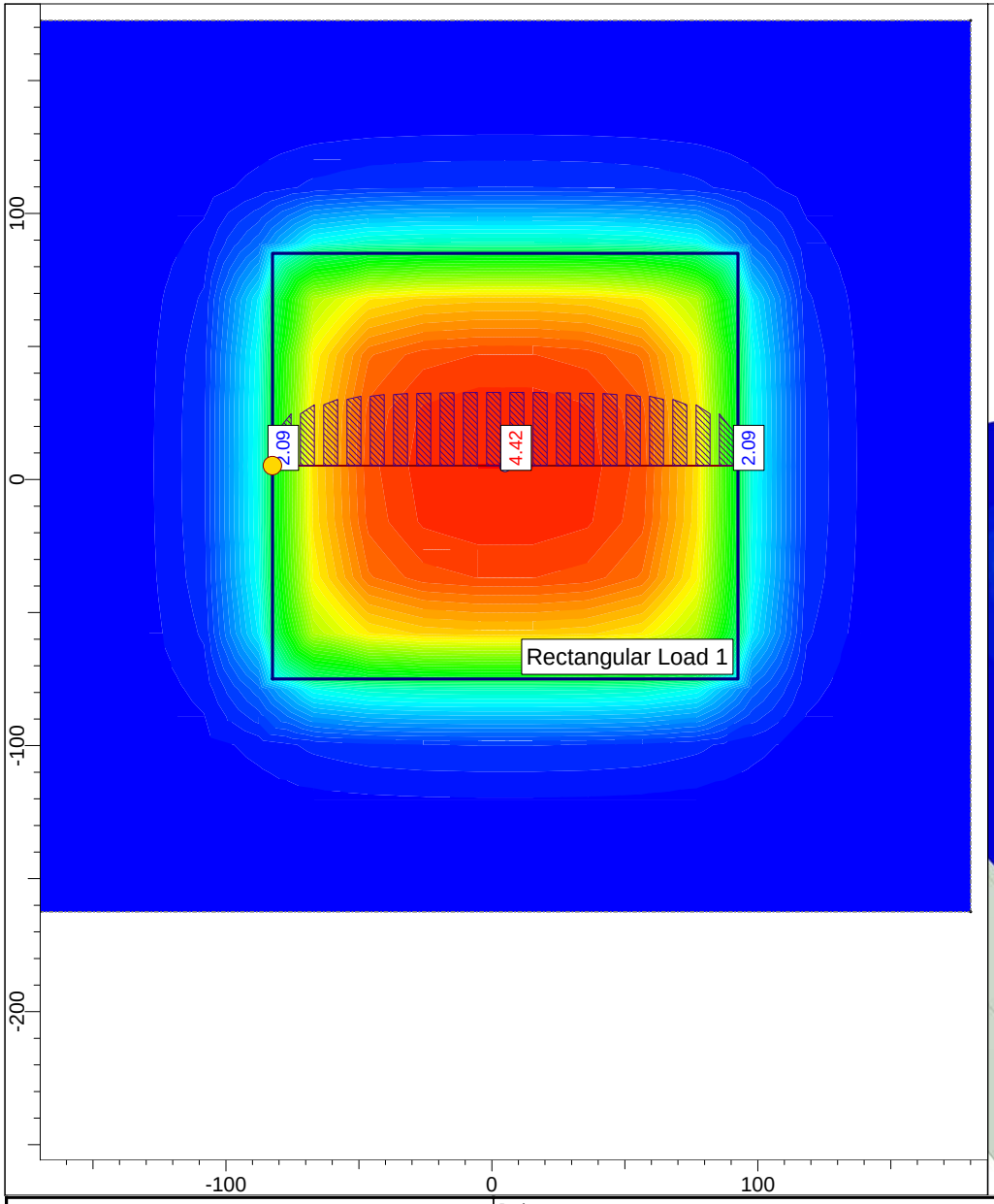


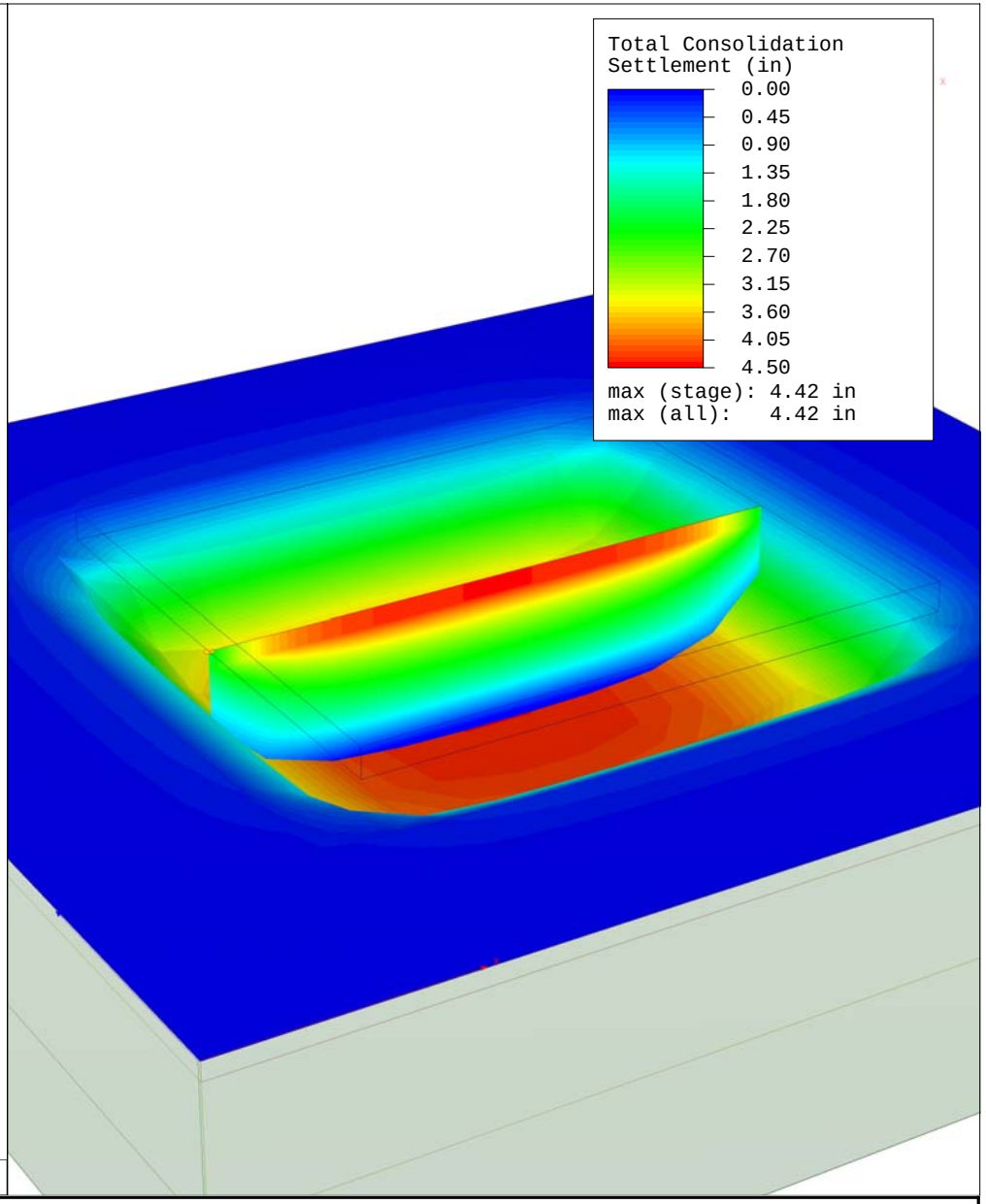


PIONEER TECHNICAL SERVICES, INC.

SETTLE3D 4.012

Project	Whitefish WWTP		
Analysis Description	Minimum Probable		
Drawn By	MB	Company	Pioneer
Date	9/25/2017, 10:53:56 AM	File Name	WF WWTP consol_1.s3z

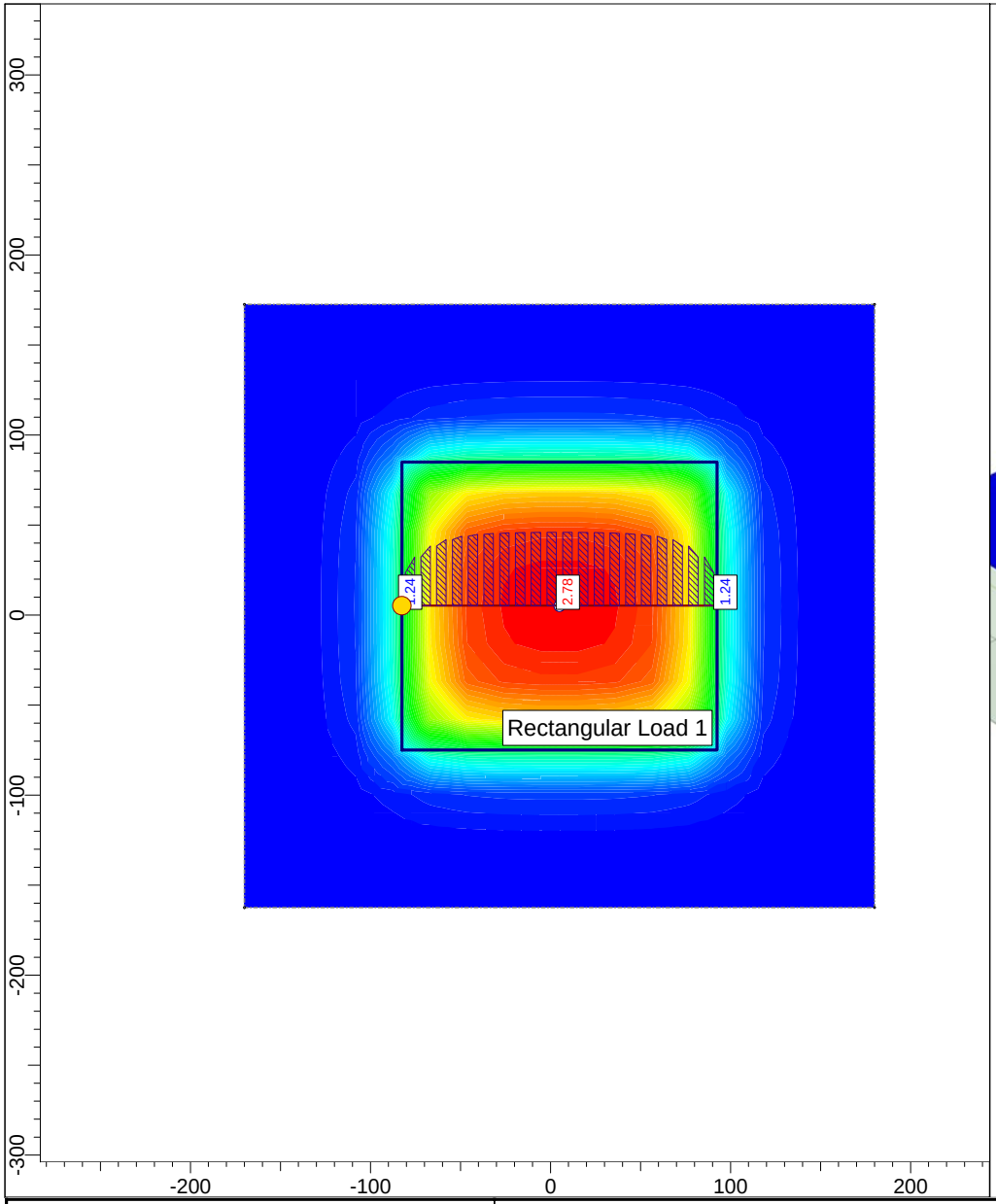


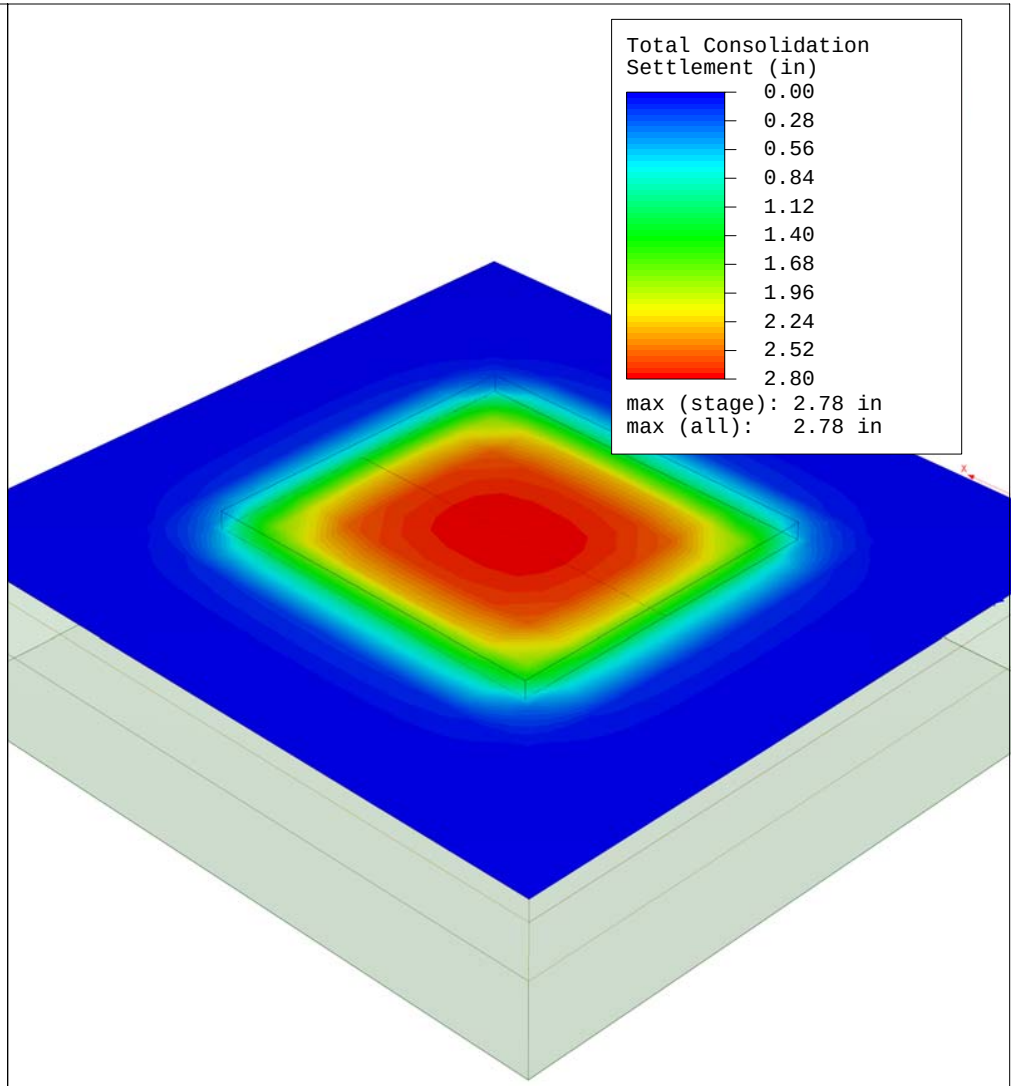


PIONEER TECHNICAL SERVICES, INC.

SETTLE3D 4.012

Project	Whitefish WWTP		
Analysis Description	Most Probable Sigma p: Structural fill pad constructed above bottom of pond (14 to 19' depth)		
Drawn By	MB	*Company*	Pioneer
Date	9/25/2017, 10:53:56 AM	*File Name*	WF WWTP consol_struc fill.s3z

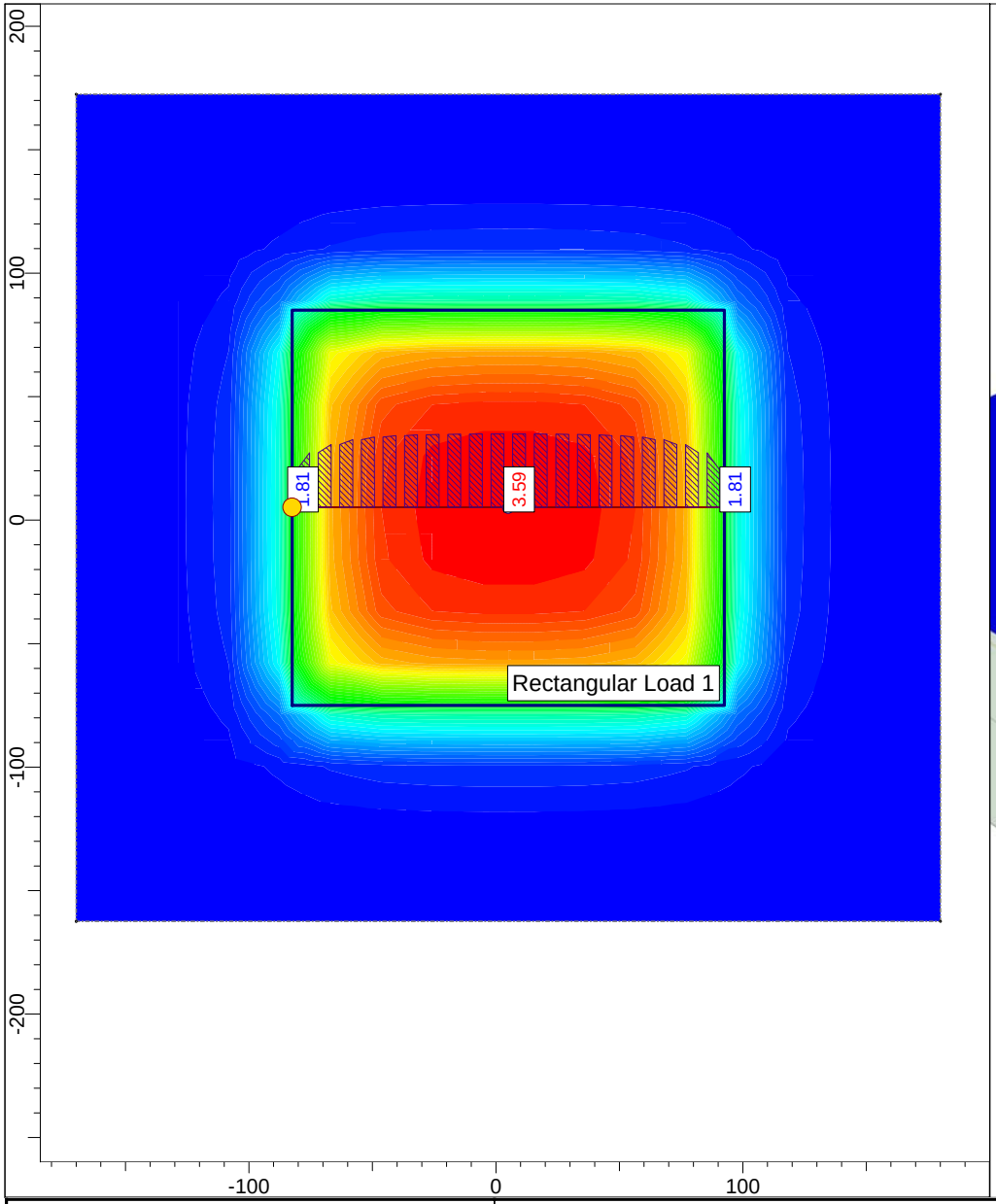


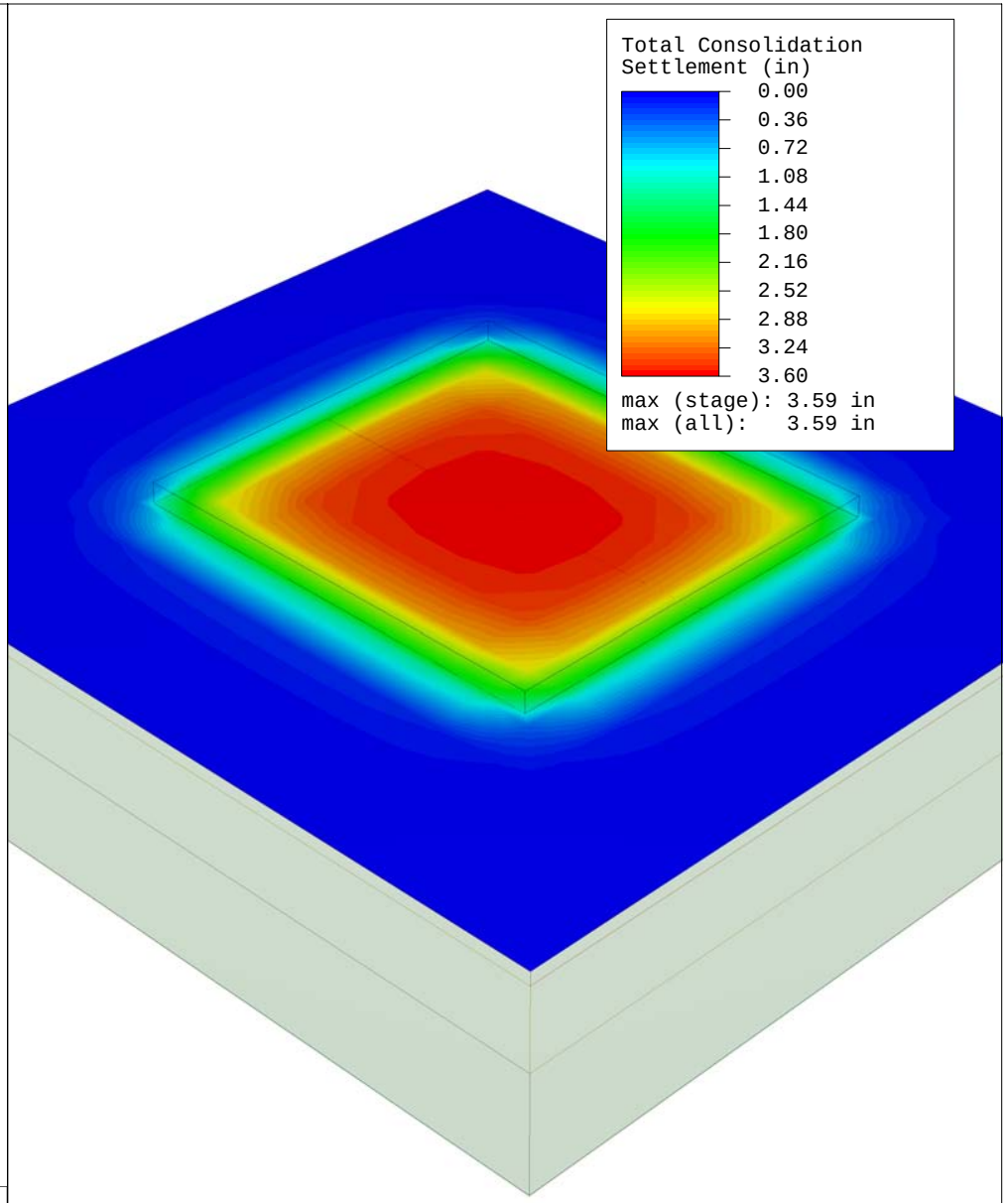


PIONEER TECHNICAL SERVICES, INC.

SETTLE3D 4.012

Project	Whitefish WWTP		
Analysis Description	Most Probable Sigma p; overexcavation, structural fill 10' below existing pond bottom (19 to 29' depth)		
Drawn By	MB	Company	Pioneer
Date	9/25/2017, 10:53:56 AM	File Name	WF WWTP consol_struc fill.s3z





PIONEER TECHNICAL SERVICES, INC.

SETTLE3D 4.012

Project	Whitefish WWTP		
Analysis Description	Most Probable Sigma p; overexcavation, structural fill 5' below existing pond bottom (19 to 24' depth)		
Drawn By	MB	Company	Pioneer
Date	9/25/2017, 10:53:56 AM	File Name	WF WWTP consol_struc fill.s3z

Appendix E
Seismic Data

USGS Design Maps Summary Report

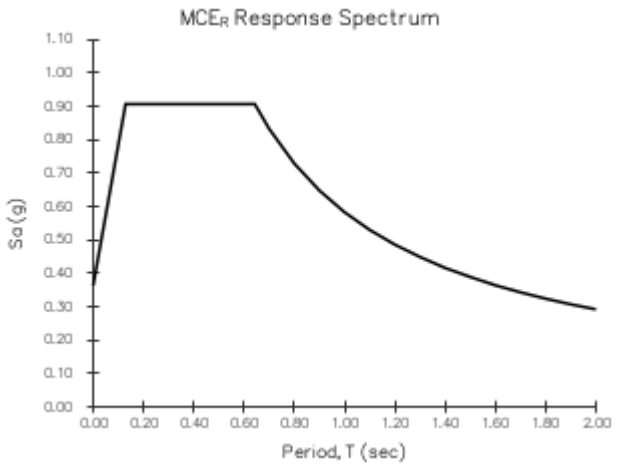
User–Specified Input

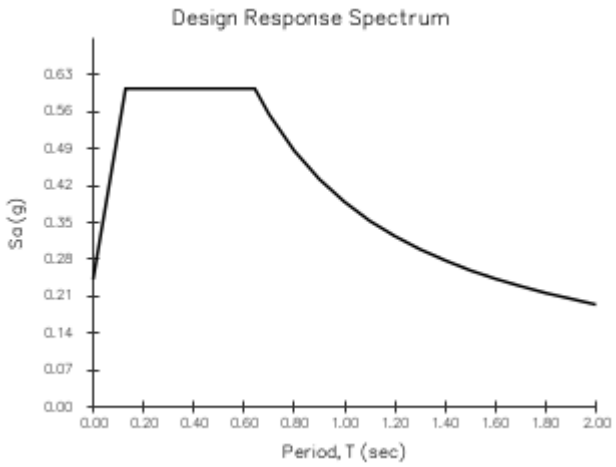
Report Title	Whitefish WWTP Wed January 3, 2018 23:15:58 UTC
Building Code Reference Document	2012/2015 International Building Code (which utilizes USGS hazard data available in 2008)
Site Coordinates	48.39155°N, 114.32536°W
Site Soil Classification	Site Class E – "Soft Clay Soil"
Risk Category	I/II/III

USGS–Provided Output

S_S =	0.627 g	S_{MS} =	0.907 g	S_{DS} =	0.604 g
S_1 =	0.179 g	S_{M1} =	0.583 g	S_{D1} =	0.389 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Conterminous U.S. 2014 (v4.0.x)

Spectral Period

Peak ground acceleration

Latitude

Decimal degrees

48.392

Time Horizon

Return period in years

475

Longitude

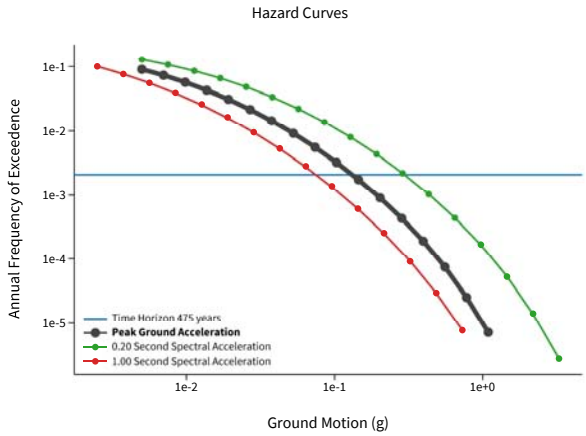
Decimal degrees, negative values for western long…

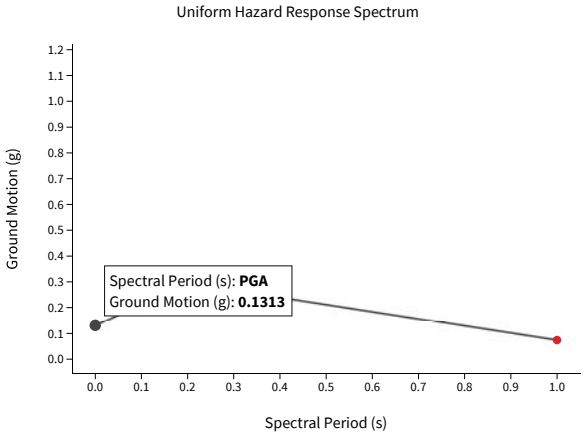
-114.326

Site Class

760 m/s (B/C boundary)

Hazard Curve

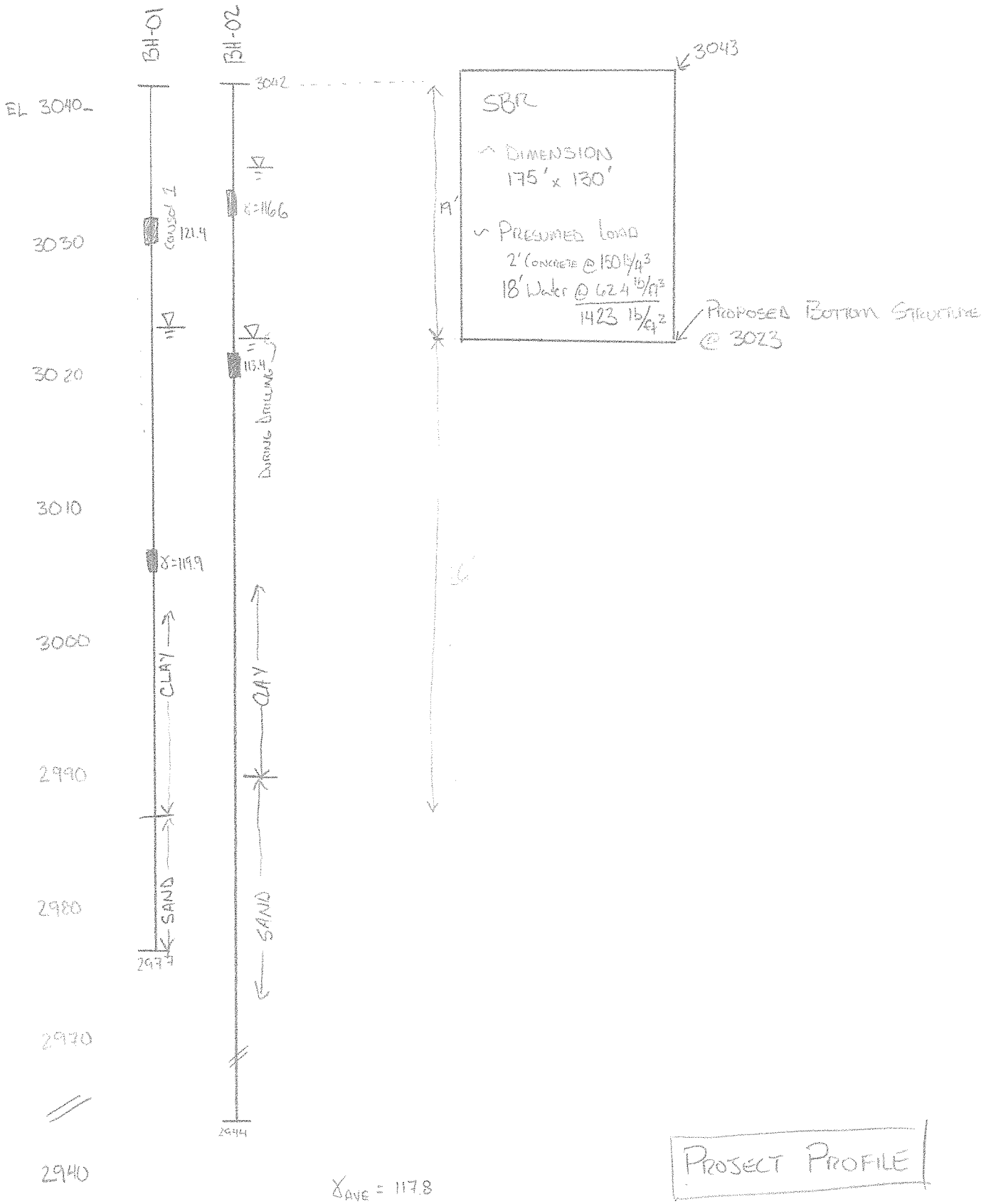




View Raw Data

PIONEER
TECHNICAL SERVICES, INC.
www.pioneer-technical.com

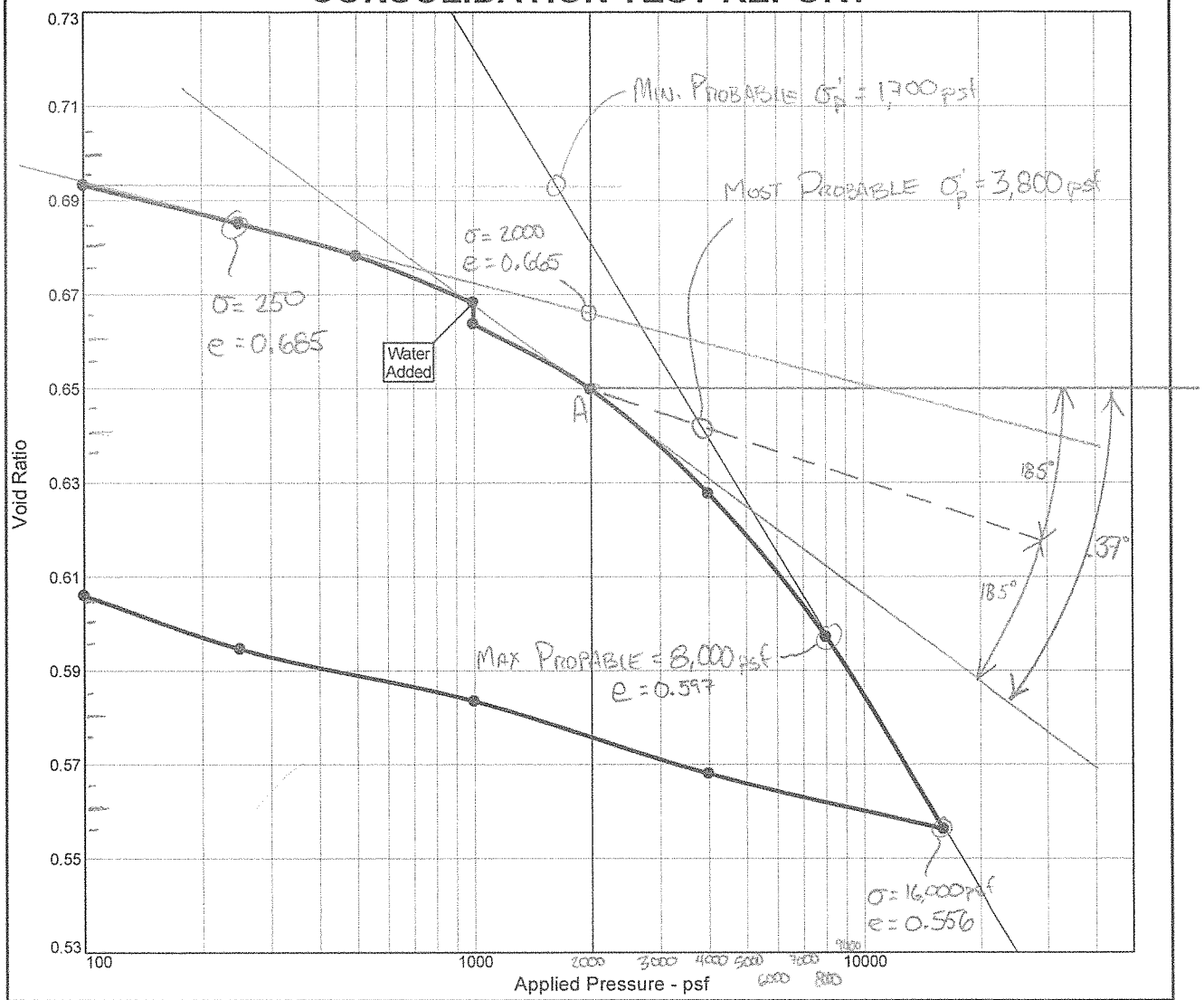
Project Name WHITEFISH Project No _____
Sheet No _____ of _____
Scale 1" = 10'
Calculated By MB Date _____
Checked By _____ Date _____



$\bar{X}_{AVE} = 117.8$

PROJECT PROFILE

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
86.4 %	22.3 %	99.3	30	15	2.7	CL		0.697

MATERIAL DESCRIPTION

γ_D = 121.4 pcf

Project No. Client:

Project: Whitefish WWTP

Source of Sample: BH-01 Depth: 10-12' Sample Number: 20252

Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

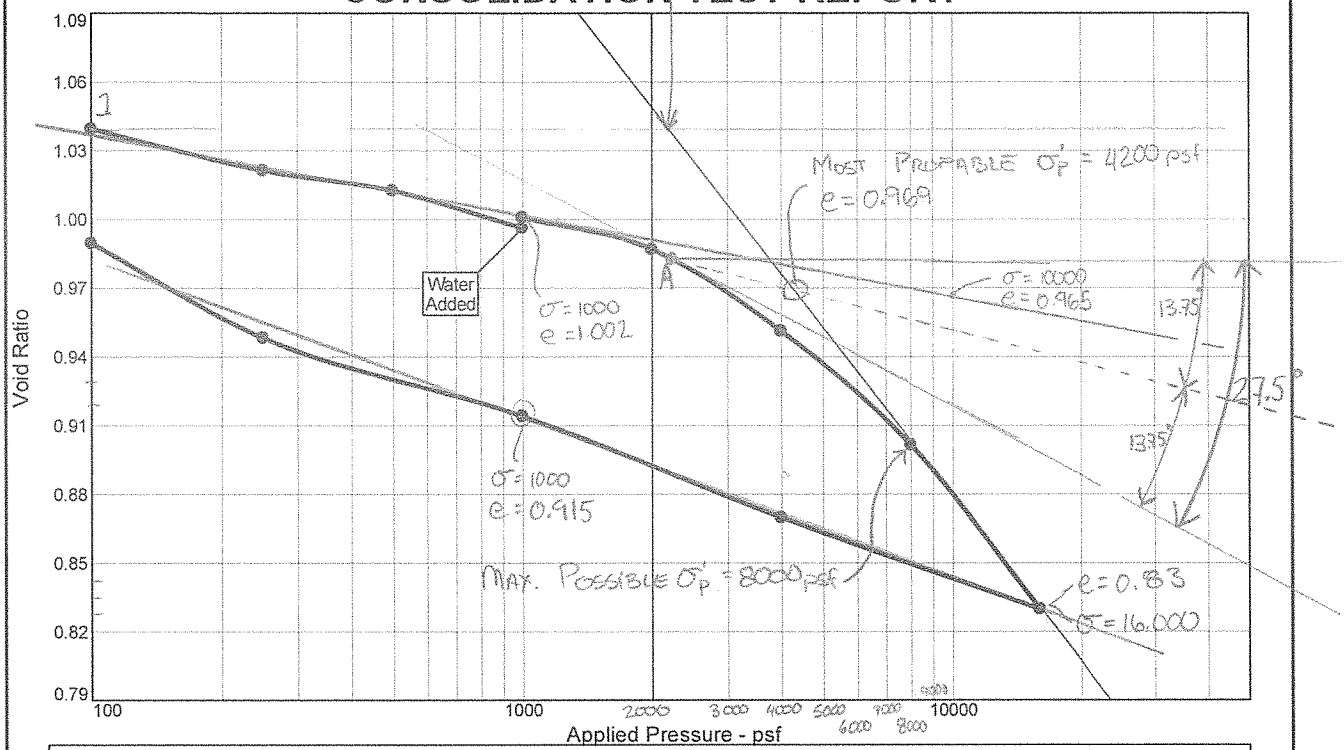
Figure

Tested By: NG

SPT n VALUE = 4 @ 12'

MIN. POSSIBLE σ_p' = 2,200 psf

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (psf)	C_v (ft.2/day)	C_α	No.	Load (psf)	C_v (ft.2/day)	C_α	No.	Load (psf)	C_v (ft.2/day)	C_α
6	2000	0.637	0.001								

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
97.0 %	37.5 %	82.5	40	18	2.7	CL	A-6(20)	1.043

MATERIAL DESCRIPTION

γ_m = 113.4 pcf

lean clay

Project No. **Client:**

Project: Whitefish WWTP

Source of Sample: BH-02 **Depth:** 18-20' **Sample Number:** 20255

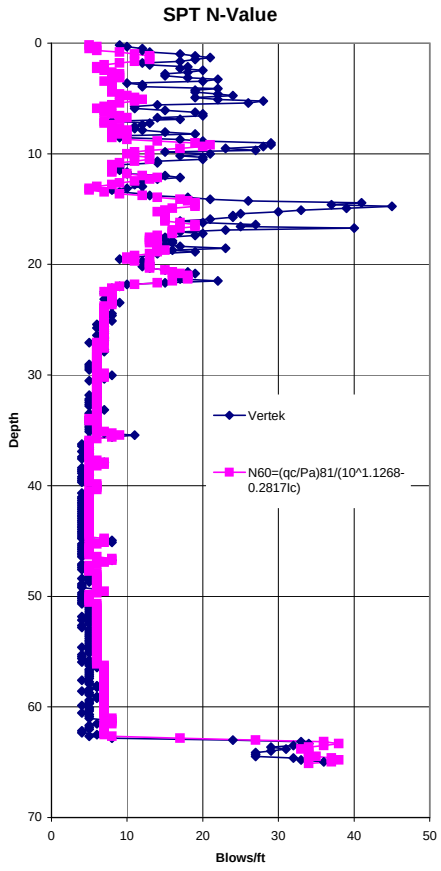
Remarks:

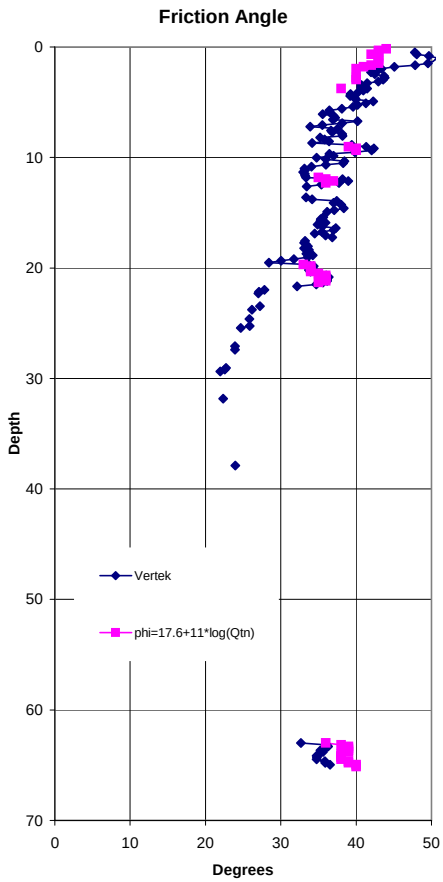
Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

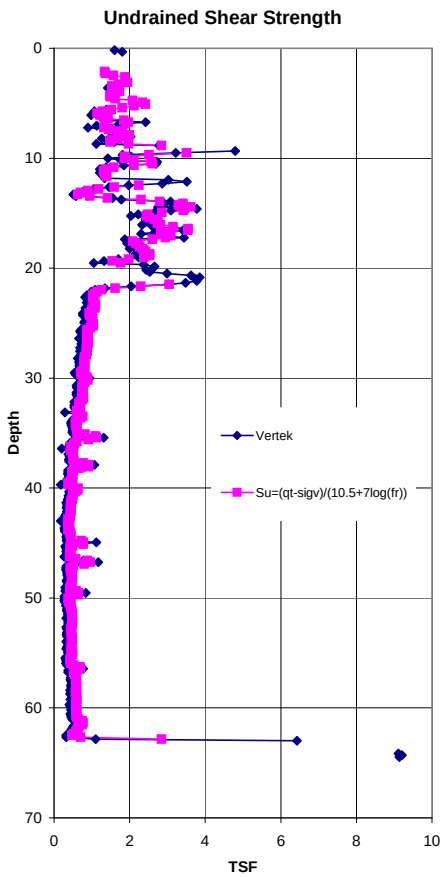
Figure

Tested By: NG

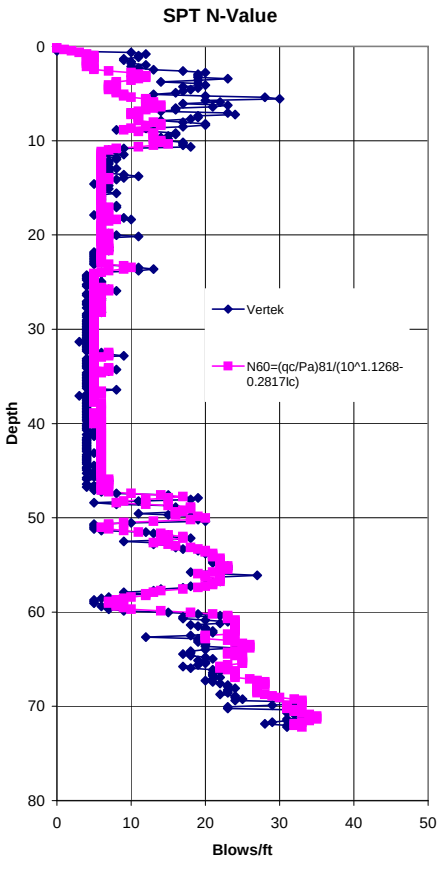
N value = 3 @ 20'

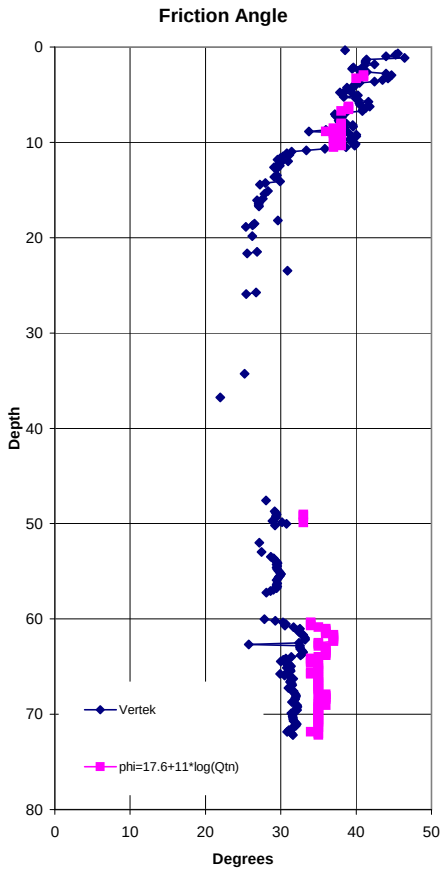


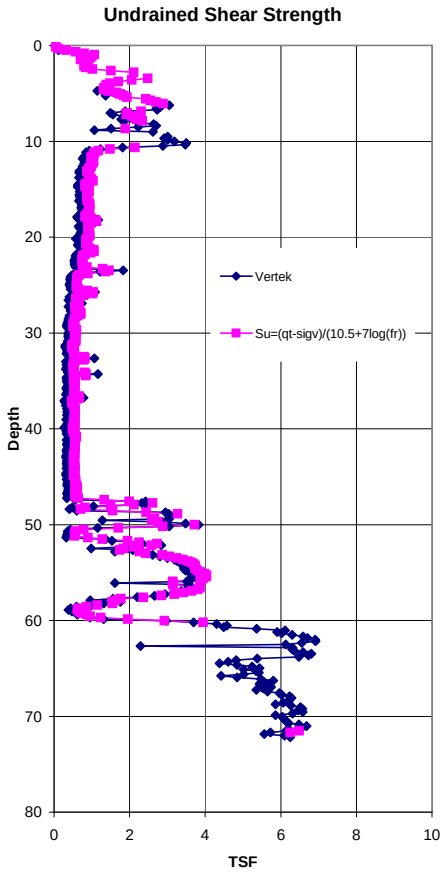




Requested Correlations from CPT Sounding S-1







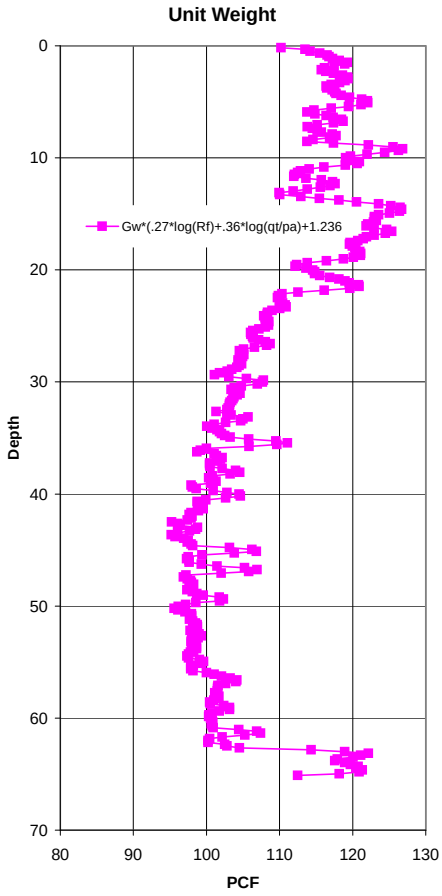
Requested Correlations from CPT Sounding S-2

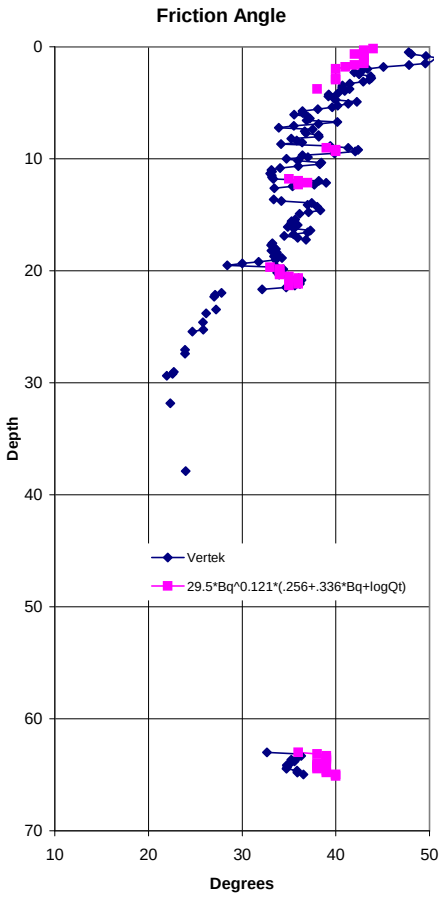
Project: Whitefish WWTP **BSS Job Number:** 19-07
Location: CPT S-1 **Date:** 4/1/2019

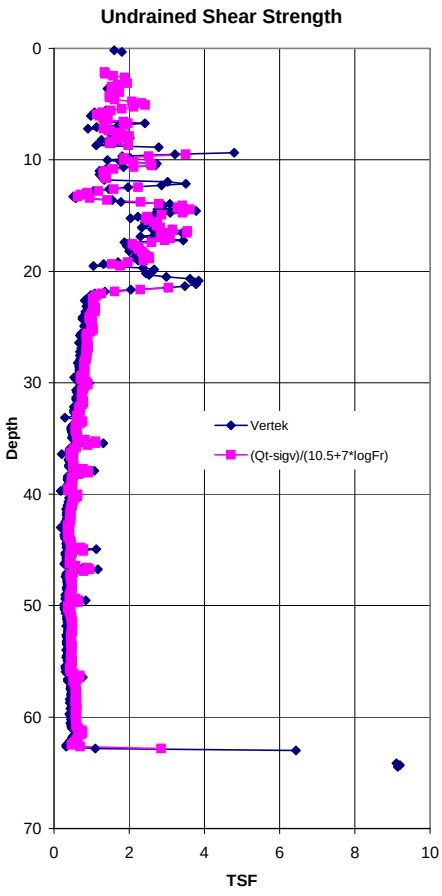
BIG SKY SUBSURFACE
Geotechnical Engineering Consulting

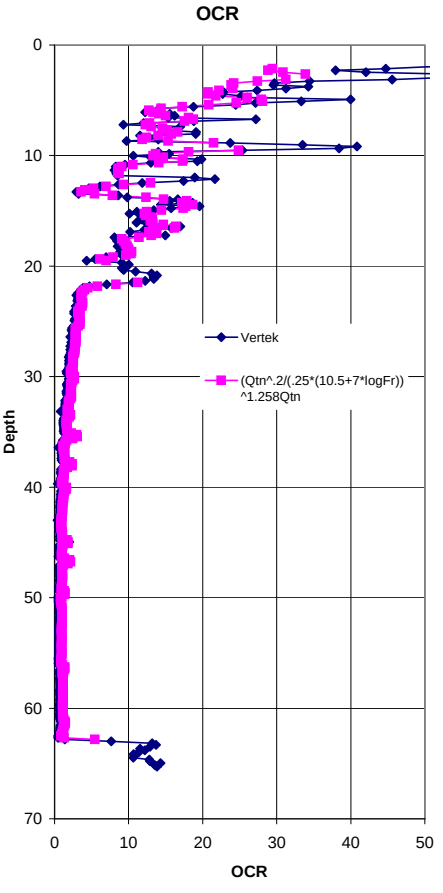
Requested Correlations

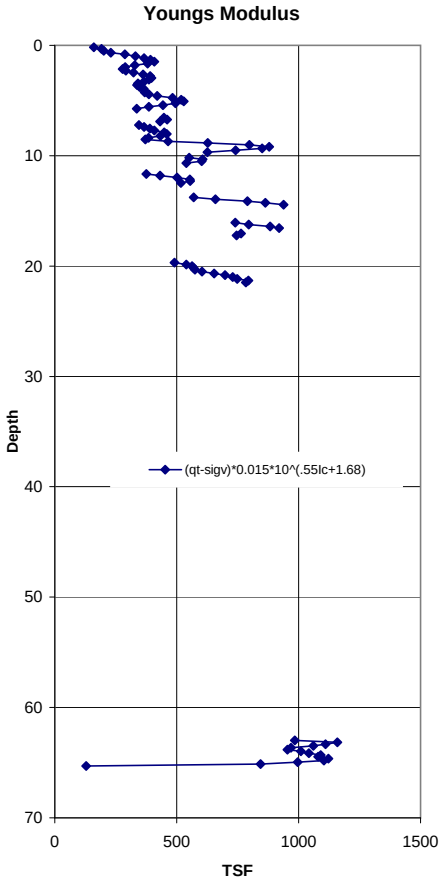
Figure C1

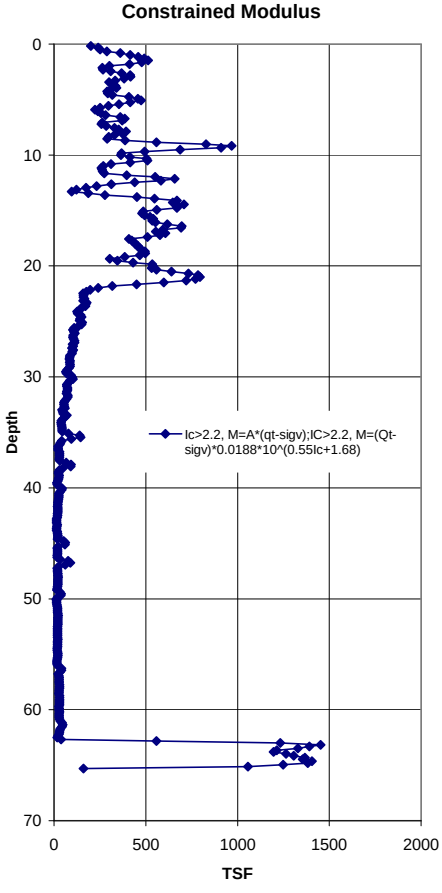










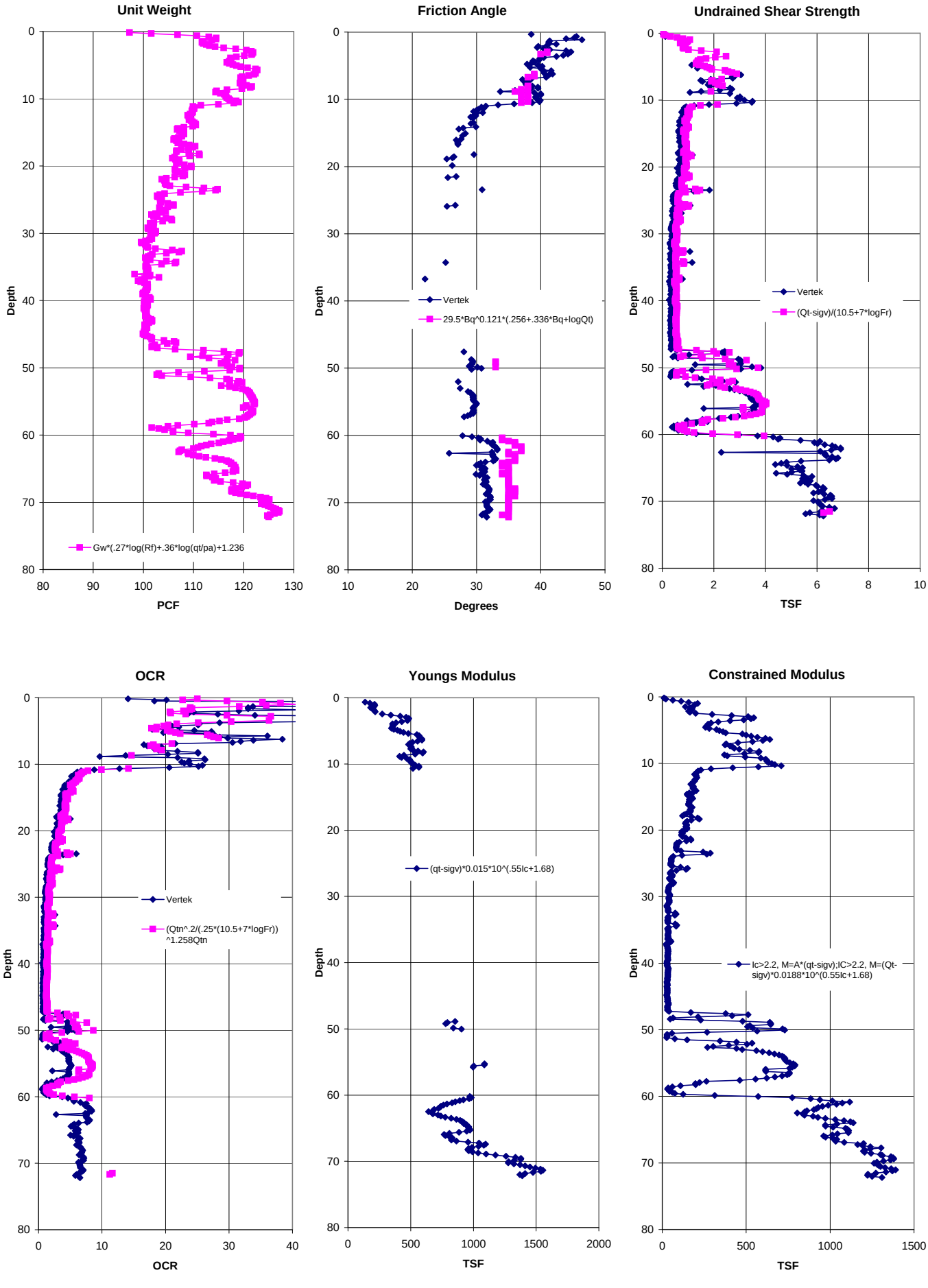


Requested Correlations

BIG SKY SUBSURFACE
Geotechnical Engineering Consulting

Project: Whitefish WWTP
BSS Job Number: 19-07
Location: CPT S-1
Date: 4/8/2019

Figure C3

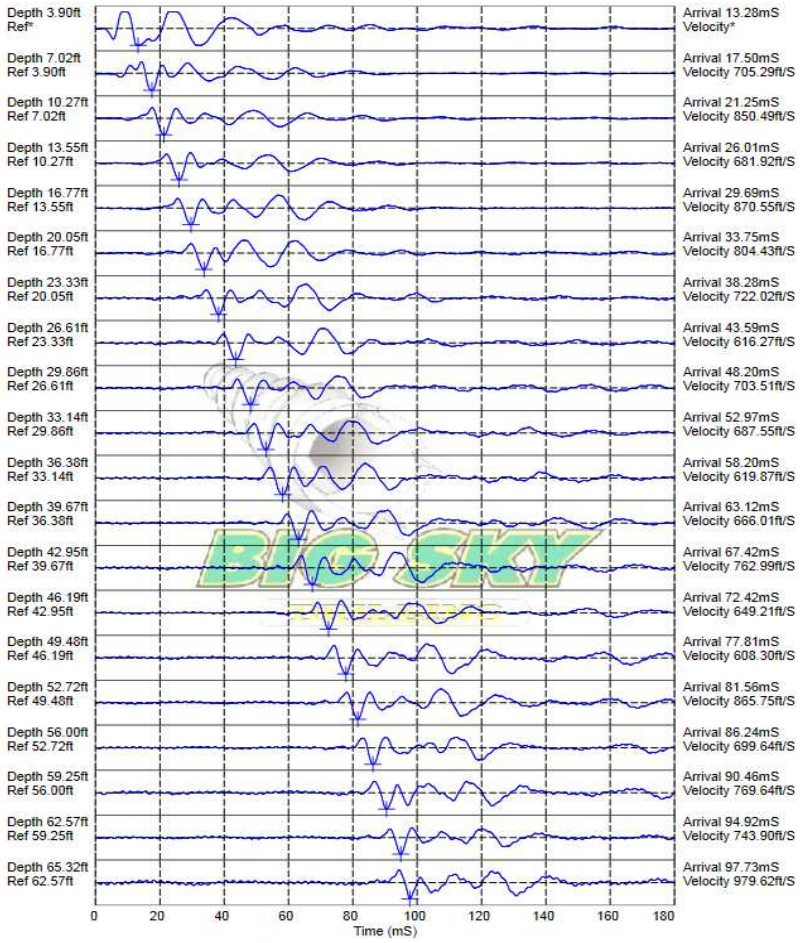


Requested Correlations

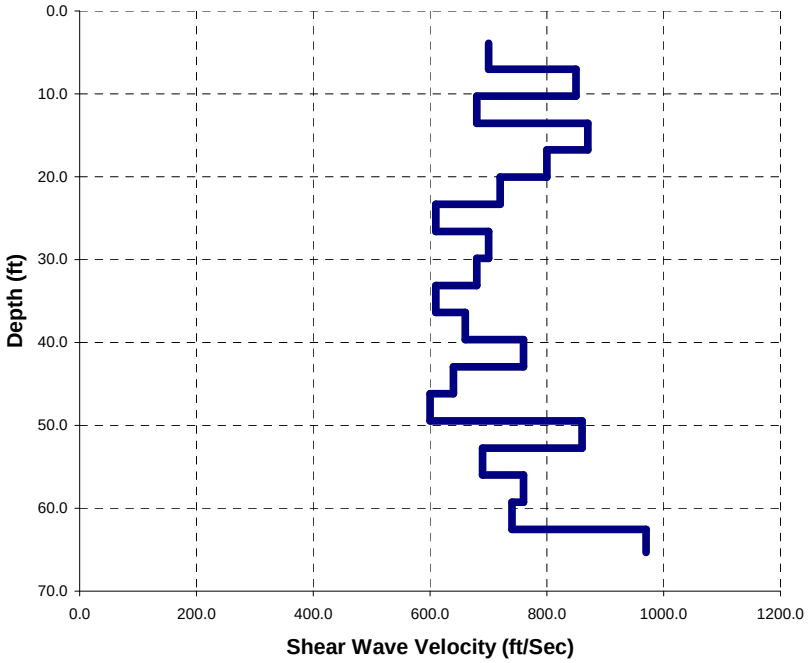
BIG SKY SUBSURFACE
Geotechnical Engineering Consulting

Project: Whitefish WWTP
BSS Job Number: 19-07
Location: CPT S-2
Date: 4/8/2019

Figure C4



Depth Range (ft)		Shear Wave Velocity	
start	stop	m/sec	ft/sec
3.9	7.0	215	700
7.0	10.3	259	850
10.3	13.5	208	680
13.5	16.8	265	870
16.8	20.0	245	800
20.0	23.3	220	720
23.3	26.6	188	610
26.6	29.9	214	700
29.9	33.1	210	680
33.1	36.4	189	610
36.4	39.7	203	660
39.7	42.9	233	760
42.9	46.2	198	640
46.2	49.5	185	600
49.5	52.7	264	860
52.7	56.0	213	690
56.0	59.3	235	760
59.3	62.6	227	740
62.6	65.3	299	970



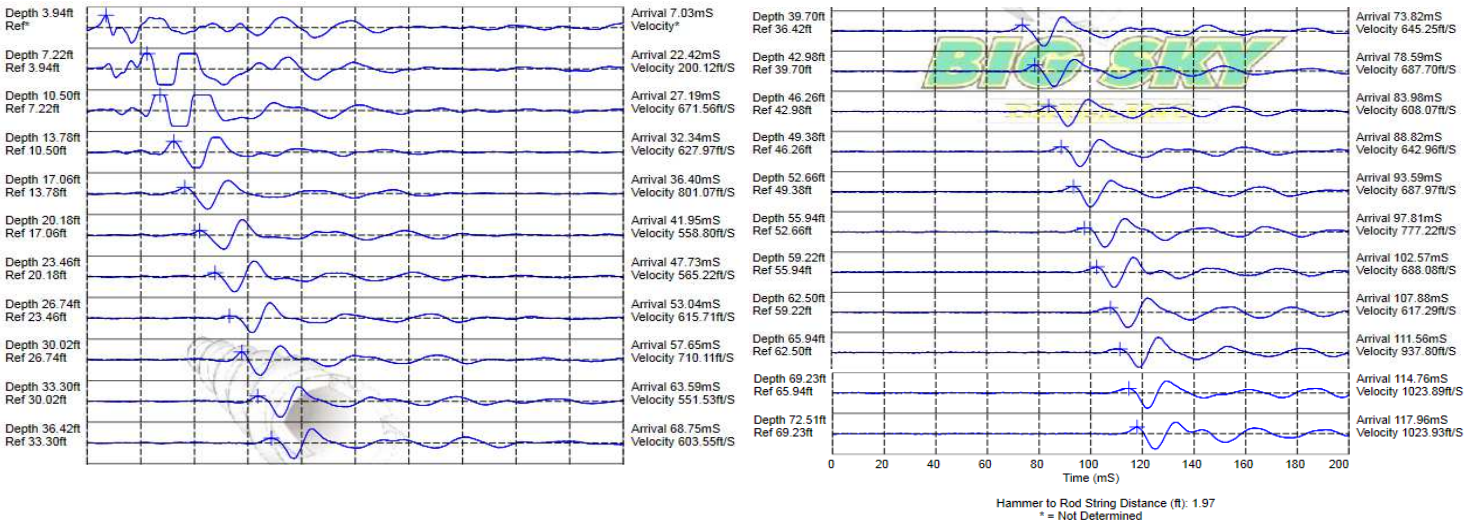
Project: Whitefish WWTP
Location: CPT S-1

BSS Job Number: 19-07
Date: 4/1/2019

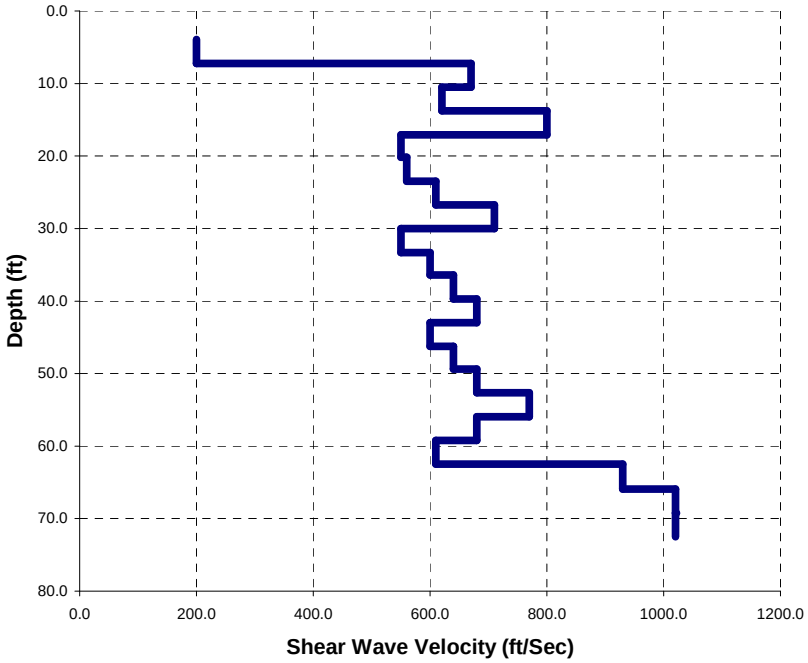
BIG SKY SUBSURFACE
Geotechnical Engineering Consulting

Seismic Shear Wave Velocity Test
(ASTM D7400)

Figure S1



Depth Range (ft)		Shear Wave Velocity	
start	stop	m/sec	ft/sec
3.9	7.2	61	200
7.2	10.5	205	670
10.5	13.8	191	620
13.8	17.1	244	800
17.1	20.2	170	550
20.2	23.5	172	560
23.5	26.7	188	610
26.7	30.0	216	710
30.0	33.3	168	550
33.3	36.4	184	600
36.4	39.7	197	640
39.7	43.0	210	680
43.0	46.3	185	600
46.3	49.4	196	640
49.4	52.7	210	680
52.7	55.9	237	770
55.9	59.2	210	680
59.2	62.5	188	610
62.5	65.9	286	930
65.9	69.2	312	1020
69.2	72.5	312	1020



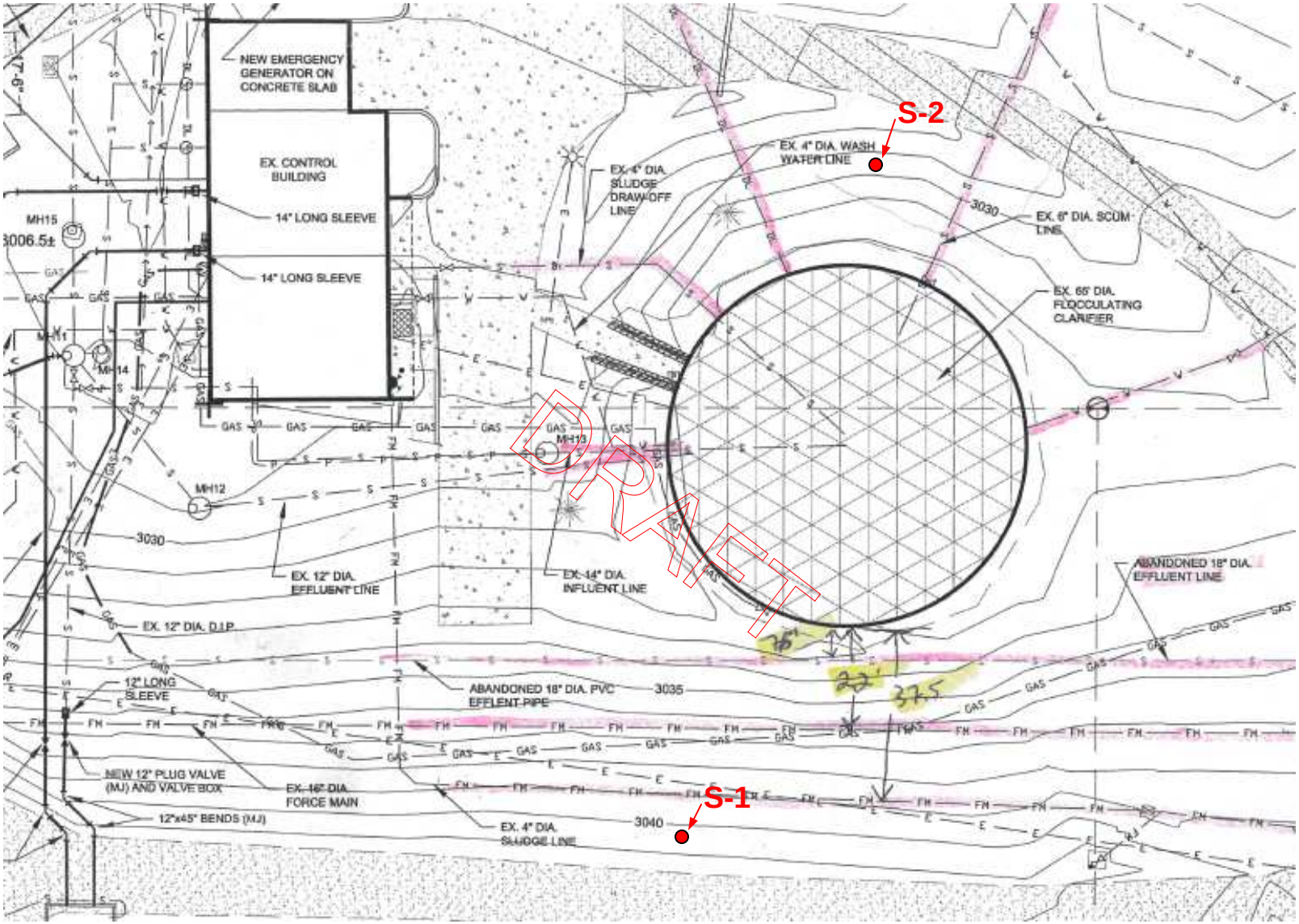
Project: Whitefish WWTP
Location: CPT S-2

BSS Job Number: 19-07
Date: 4/1/2019

BIG SKY SUBSURFACE
Geotechnical Engineering Consulting

Seismic Shear Wave Velocity Test
(ASTM D7400)

Figure S2



Approximate Sounding Locations

N

TDH Utility Drawing Base Image

BIG SKY SUBSURFACE

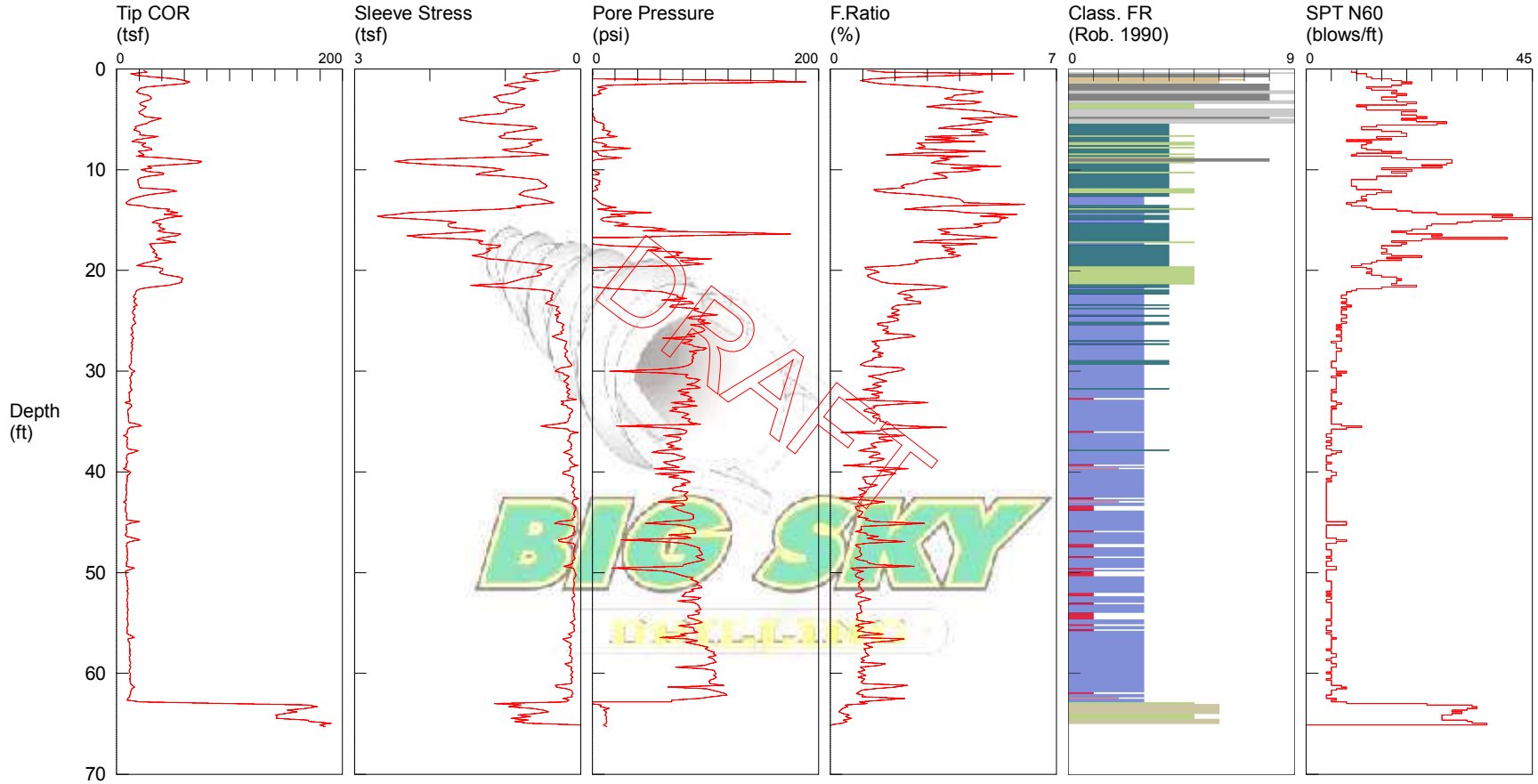
Site Plan
Project: Whitefish WWTP
Cone Penetrometer Soundings
Project Number: 19-07
Date: 4/2/19

SOUNDING

SOUNDING
CUSTOMER: Big Sky Subsurface
OPERATOR: JH
CONE ID: DDG1434

JOB NUMBER: Whitefish WWTP
HOLE NUMBER: S-1
TEST DATE: 3/30/2019 9:22:37 PM
COMMENT: Auto Enhance On
COMMENT: Filter On

COMMENT:
TOTAL DEPTH: 65.289 ft



1 Sensitive, fine grained
2 Organic soils - peats
3 Clays - clay to silty clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to sand
8 Very stiff sand to clayey sand **
9 Very stiff, fine grained **

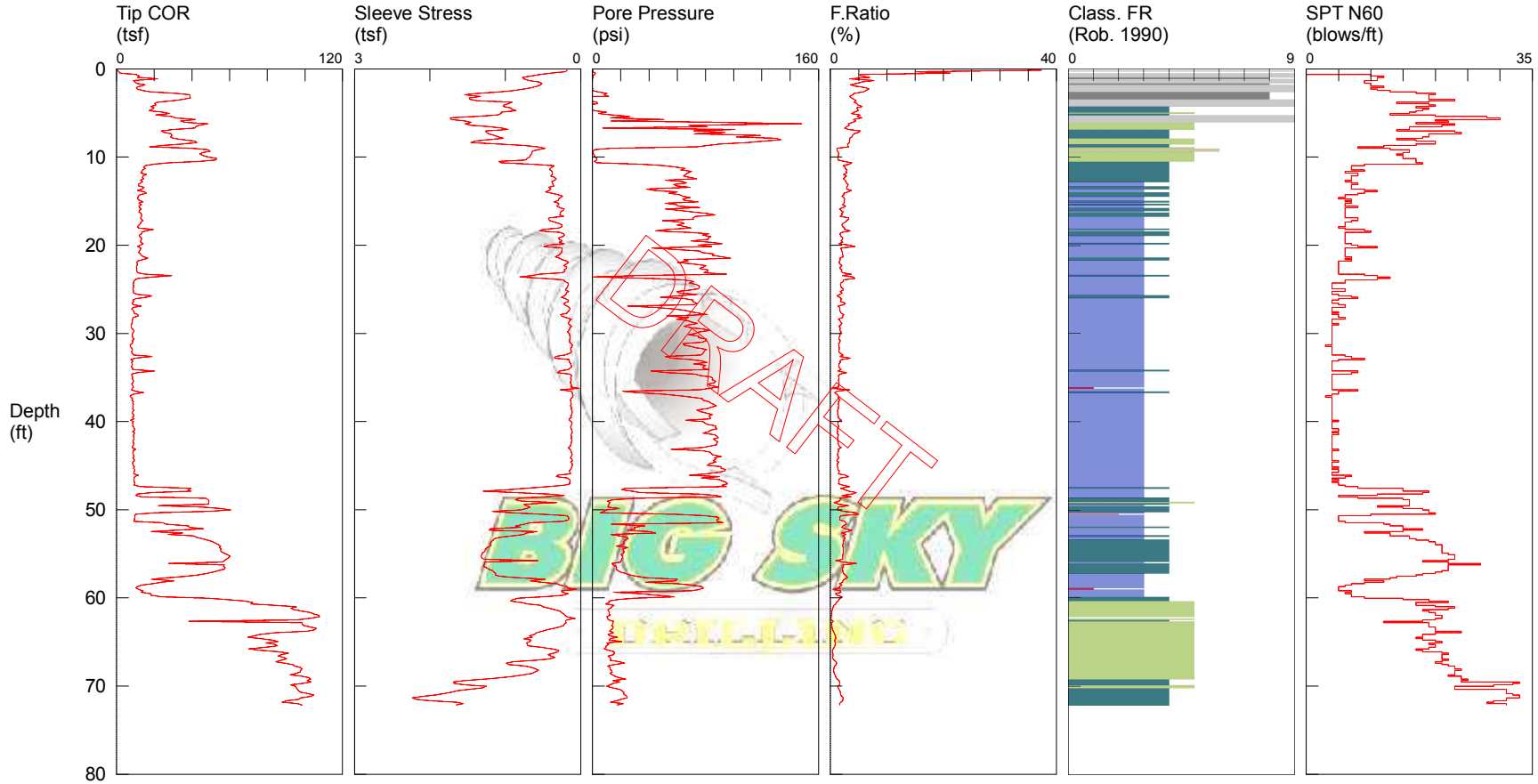
*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

SOUNDING

SOUNDING
CUSTOMER: Big Sky Subsurface
OPERATOR: JH
CONE ID: DDG1434

JOB NUMBER: Whitefish WWTP
HOLE NUMBER: S-2
TEST DATE: 3/31/2019 11:57:44 AM
COMMENT: Auto Enhance On
COMMENT: Filter On

COMMENT:
TOTAL DEPTH: 72.178 ft



1 Sensitive, fine grained
2 Organic soils - peats
3 Clays - clay to silty clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to sand
8 Very stiff sand to clayey sand **
9 Very stiff, fine grained **

*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

APPENDIX D

Sludge Sampling

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Montana Environmental Lab
Project: City of Whitefish WWTP
Lab ID: B19071199-001
Client Sample ID: MEL 7131, Cell #3 Sludge

Report Date: 07/23/19
Collection Date: 07/11/19 10:15
DateReceived: 07/12/19
Matrix: Sludge

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
MICROBIOLOGICAL							
Bacteria, Fecal Coliform, as Received	10000	CFU/g	H	1		A9222 Dmod	07/12/19 12:30 / ean
Bacteria, Fecal Coliform, Dry Basis	110000	CFU/g	H	1		A9222 Dmod	07/12/19 12:30 / ean
Estimated number of fecal coliform CFU/100mL							
PHYSICAL CHARACTERISTICS							
Moisture	90.9	wt%		0.20		A2540 G	07/18/19 16:03 / jlw
Solids, Total	9.08	wt%		0.01		A2540 G	07/18/19 16:03 / jlw
CHEMICAL CHARACTERISTICS							
Ammonia as N, KCL Extract	1710	mg/kg-dry	D	70		ASA33-7	07/23/19 11:53 / srm
Nitrate as N, KCL Extract	ND	mg/kg-dry		10		ASA33-8	07/23/19 11:54 / srm
Total Kjeldahl Nitrogen	8630	mg/kg-dry		100		ASA31-3	07/23/19 16:01 / srm
METALS, TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.1	5	SW6010B	07/22/19 12:23 / rlh
Cadmium	ND	mg/L		0.01	1	SW6010B	07/22/19 12:23 / rlh
Chromium	ND	mg/L		0.1	5	SW6010B	07/22/19 12:23 / rlh
Copper	0.02	mg/L		0.01		SW6010B	07/22/19 12:23 / rlh
Lead	ND	mg/L		0.1	5	SW6010B	07/22/19 12:23 / rlh
Mercury	ND	mg/L		0.002	0.2	SW7470A	07/19/19 13:34 / jag
Molybdenum	ND	mg/L		0.1		SW6010B	07/22/19 12:23 / rlh
Nickel	ND	mg/L		0.05		SW6010B	07/22/19 12:23 / rlh
Selenium	ND	mg/L		0.1	1	SW6010B	07/22/19 12:23 / rlh
Zinc	0.29	mg/L		0.01		SW6010B	07/22/19 12:23 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg-dry		3		SW6020	07/16/19 23:15 / car
Cadmium	ND	mg/kg-dry		0.5		SW6020	07/16/19 23:15 / car
Chromium	11	mg/kg-dry		1		SW6020	07/16/19 23:15 / car
Copper	243	mg/kg-dry		2		SW6020	07/16/19 23:15 / car
Lead	10	mg/kg-dry		2		SW6020	07/16/19 23:15 / car
Mercury	ND	mg/kg-dry		0.1		SW7471B	07/18/19 17:15 / jag
Molybdenum	1.4	mg/kg-dry		0.5		SW6020	07/17/19 20:00 / car
Nickel	9	mg/kg-dry		2		SW6020	07/16/19 23:15 / car
Phosphorus	2870	mg/kg-dry		10		SW6010B	07/16/19 21:03 / rlh
Selenium	ND	mg/kg-dry		6		SW6020	07/16/19 23:15 / car
Zinc	193	mg/kg-dry		3		SW6020	07/16/19 23:15 / car
WASTE ANALYSIS							
Paint Filter Liquids Test	27	g/100g				SW9095B	07/23/19 09:35 / jdw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

CELL # 3

EAST

1.0'	1.5'	1.0'
1.0'	0.5'	1.0'
0.0'	1.0'	1.0'
0.0'	0.5'	1.0'
1.0'	0.0'	1.0'
1.5'	2.0'	2'

NORTH

SOUTH

WEST