

South Rifle Lift Station



PROJECT MANUAL

**CITY OF RIFLE
202 RAILROAD AVENUE
RIFLE, COLORADO 81650**

2026

Pre-Bid Meeting: A Mandatory Pre-bid will be held May 11, 2026 at 10:00 am

Bid Due Date: July 1, 2026 at 2 pm

Anticipated Award Date: July 15th, 2026*

Anticipated Construction Start Date August 3, 2026

Anticipated Completion Date: December 2026

Final Day for Questions Friday, June 15, 2026 12 pm

*These dates are subject to change based on the award notification and execution of the Grant Agreement for the Energy/Mineral Impact Assistance Fund Grant Cycle 26-05.

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C3	SITE AND DEMOLITION PLAN
C4	SEWER P&P
C5	FORCE MAIN P&P
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E1	LEGEND
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E3	SITE PLAN
E4	BUILDING PLAN
I01	LEGEND
I02	P&IDS

Advertisement For Bids

Separate sealed BIDS for the construction of the **South Rifle Lift Station** will be received at the **Council Chambers, Rifle City Hall, 202 Railroad Avenue, Rifle, CO.** until 2:00pm, on July 1, 2026 at 2 pm, at which time they will be publicly opened and read aloud.

The Work will include all necessary labor, supervision, equipment, tools and materials for the construction of a new Wastewater lift station located at the existing South Lift Station site. Work includes the construction of a 100,000 gallon buried concrete wetwell, installation of a new packaged lift station and enclosure, buried pipe modifications, and electrical upgrades at the site.

A Bid Bond in the amount of 5% of bid price is required, and a Performance and a Payment Bond, each in the amount of 100% of bid, will be required. Bid Award will be the July 15th, 2026* Council Meeting. Time of Commencement of the Work is anticipated to be no later than May 20, 2026 *, with completion of Concrete Structures and Backfill by December 2026

A PREFERENCE FOR LOCAL CONTRACTORS WILL BE APPLIED BY THE OWNER WHEN SELECTING A CONTRACTOR per City of Rifle Code ARTICLE III Sec. 4-3-210.

A Mandatory Pre-bid will be held May 11, 2026 at 10:00 am, please issue all questions via email to Iris Trevisano.

Contact Iris Trevisano, itrevisano@rifleco.org , 970-665-6412 for questions or issues with downloading the documentation.

The City of Rifle values full inclusion and access for all of our facilities, programs, activities and services. We are pleased to provide meaningful accommodations to comply with the Americans with Disabilities Act (ADA) and reasonably provide translation, interpretation, modifications, accommodations, alternative formats, auxiliary aids, and services.

To request special assistance for Solicitations only, call Procurement and Grant Reporting Manager Iris Trevisano at 970-665-6412 or email Itrevisano@rifleco.org . Please allow 48 hours for your requests to be met.

This Advertisement for Bid is subject to all applicable provisions of the City of Rifle Municipal Code, including Article III- Purchasing regarding procurement procedures. In case of any inconsistency between this advertisement and the City Code, the provisions of the City Code shall take precedence.

*These dates are subject to change based on the award notification and execution of the Grant Agreement for the Energy/Mineral Impact Assistance Fund Grant Cycle 26-05.

Instructions to Bidders

1.0 Defined Terms

Terms used in these Instructions to Bidders, which are defined in the General Conditions of the City of Rifle Public Works Manual, have the meaning assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to Owner, as distinct from a sub-bidder, who submits a Bid to a Bidder. The term "Successful Bidder" means the lowest, qualified, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Advertisement for Bids, Instructions to Bidders, the Bid Form, and the Contract Documents (including all Addenda issued prior to receipt of Bids).

2.0 Copies of Bidding Documents

2.1 Complete sets of Bidding Documents must 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.

This Advertisement for Bids is subject to all applicable provisions of the City of Rifle Municipal Code, including Article III – Purchasing, which governs procurement procedures. In the event of any inconsistency between this advertisement and the City Code, the provisions of the City Code shall prevail.

The City of Rifle Public Works Manual, Part I-General Conditions, Part II-Construction Materials and Methods and Part III Minimum Design Standards, shall be followed unless otherwise specified herein. In case of conflict, follow the Supplementary General Conditions section 25, Precedence of Contract Documents. Copies of the Public Works Manual are available on Rifle's web site www.rifleco.org.

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

3.0 Qualifications of Bidders

3.1 The Owner may make such investigations as he deems necessary to determine the ability of the Bidder to perform the work, and to demonstrate qualifications to perform the Work. Each Bidder must be prepared to submit within five days of Owner's request written evidence of the types set forth in the Supplementary Conditions, such as financial data, previous experience and evidence of authority to conduct business in the jurisdiction where the Project is located. Each Bid must contain evidence of Bidder's qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the contract. The Owner reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein.

4.0 Examination of Contract Documents and Site

4.1 It is the responsibility of each Bidder before submitting a Bid, to (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the work, (c) consider federal, state and local laws and regulations that may affect cost, progress, performance or furnishing of the work, (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify Engineer of all conflicts, errors or discrepancies in the Contract Documents.

4.2 Information and data reflected in the Contract documents with respect to Underground Facilities at or contiguous to the site are based upon information and data furnished to Owner and Engineer by owners of such underground facilities or other, and Owner does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.

4.3 Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests, and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the work and which Bidder deems necessary to determine its Bid for performing and furnishing the work in accordance with the time, price and other terms and conditions of the Contract Documents.

4.4 On request, in advance, Owner will provide each Bidder access to the site to conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall fill and patch all holes, clean up, and restore the site to its former condition upon completion of such exploration.

4.5 The lands upon which the work is to be performed, rights-of-way, and easements for access thereto and other lands designated for use by Contractor in performing the work, are identified in the Contract Documents. All additional lands, and access thereto, required for temporary construction facilities or storage of materials and equipment, are to be provided by Contractor.

4.6 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions of performance and furnishing of the work.

5.0 Interpretations and Addenda

5.1 All questions about the meaning or intent of the Contract Documents are to be directed to Engineer. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than five (5) days prior to the date of opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

5.2 Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner or Engineer.

6.0 Conditions of Work

6.1 Each Bidder must inform himself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of his obligation to furnish all material and labor necessary to carry out the provisions of his Contract. Insofar as possible, the Contractor, in carrying out his work, must employ such methods or means as will not cause any interruption of or interference with the work of any other Contractor or danger to the public.

7.0 Substitute or "Or-Equal" Items

7.1 The Contract, if awarded, will be on the basis of materials and equipment described in the drawings or specified in the specifications, without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the drawings or specified in the Specifications that substitute or "or-equal" items of materials or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the effective date of the Agreement. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in the General Conditions and may be supplemented by the Supplementary Conditions.

8.0 Subcontracts

8.1 The Bidder is specifically advised that any person or other party to whom it is proposed to award

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subcontract under this Contract must be acceptable to the Owner. The bidder shall submit, with their bid, a completed list of subcontractors they propose to use on this contract.

9.0 Bid Form

9.1 The Bid Form is included with the Bidding Documents; additional copies may be obtained from City Hall of Rifle, 202 Railroad Avenue, Rifle, Colorado.

9.2 All blanks on the Bid Form must be completed in ink, by typewriter, or electronically and printed. NOTE: The spreadsheet is offered for your convenience only. The contractor is responsible for use and confirmation of any formulae or calculations therein. The submittal may be on the pdf. All tracking of project progress will be through that spreadsheet.

9.3 Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.

9.4 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

9.5 All names must be typed or printed below the signature.

9.6 The Bid shall contain an acknowledgment of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).

9.7 The address, email, and telephone number for communications regarding the Bid must be shown.

10.0 Submission of Bids

10.1 Bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be enclosed in an opaque sealed envelope, marked with the project title (and, if applicable, the designated portion of the project for which the Bid is submitted) and name and address of the Bidder and accompanied by the required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it. Any submission received after the advertised Bid Opening shall be returned unopened to the sender.

11.0 Modification and Withdrawal of Bids

11.1 Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

11.2 If, within twenty-four (24) hours after Bids are opened, any Bidder files a duly signed, written notice with Owner and Engineer and promptly thereafter demonstrates to the reasonable satisfaction of Owner and Engineer that there was a material and substantial mistake in the presentation of its Bid, that Bidder may withdraw its Bid.

12.0 Bids to Remain Subject to Acceptance

12.1 All Bids will remain subject to acceptance for sixty (60) days after the day of the Bid opening, but Owner may, in its sole discretion, release any Bid prior to that date.

13.0 Award of Contract

13.1 Owner reserves the right to reject any and all Bids, to give any and all informalities, and to negotiate a Contract

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terms with the Successful Bidder, and the right to disregard all nonconforming, non-responsible, unbalanced or conditional Bids. Also, Owner reserves the right to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the project to make an award to that Bidder, whether because the bid is not responsible or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner.

13.2 In evaluation of Bids, Owner will consider the qualifications of the Bidders, 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.

13.3 Owner may consider the qualifications and experience of subcontractors, suppliers and other persons and organizations proposed for those portions of the work as to which the identity or subcontractors, suppliers, and other persons and organizations may be submitted as provided in the Supplementary Conditions. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the work when such data is required to be submitted prior to the Notice of Award.

13.4 Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed subcontractors, suppliers and other persons and organizations to perform and furnish the work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

13.5 If the Contract is to be awarded, it will be awarded to the lowest Bidder whose evaluation by Owner indicates to Owner that the award will be in the best interests of the Project.

13.6 Section 2.26 of the General Conditions of the City of Rifle's Public Works Manual and section 16.00 of the Supplementary Conditions set forth Owner's requirements as to performance and other Bonds. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by the required Contract Security.

13.7 If the Contract is to be awarded, Owner will give the successful Bidder a Notice of Award within sixty (60) days after the date of the Bid opening.

14.0 Laws and Regulations

14.1 The Bidders' attention is directed to the fact that all applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

14.2 This Advertisement for Bid is subject to all applicable provisions of the City of Rifle Municipal Code, including Article III- Purchasing regarding procurement procedures. In case of any inconsistency between this advertisement and the City Code, the provisions of the City Code shall take precedence.

15.0 Complete Prices

15.1 All lump sum, alternate, and unit prices must include all required General Conditions line items necessary to complete the work, including, but not limited to the following (as required): all permits, insurance, and taxes (except as specified in Article 3.0 of the Supplementary General Conditions); supervision; layout and survey as needed; protection of all surrounding materials; lifting/hoisting; equipment and personnel; off-site management and administrative assistance; trash disposal to a separate dumpster; miscellaneous equipment; mobilization; as-built drawings; fuel, watchmen, flagmen, and site security; scheduling; small tools; drawings and printing expenses and mailing costs.

15.2 On bid items to be paid as lump sum that may extend beyond a single pay estimate, a schedule of values shall

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be submitted to OWNER a minimum of 10 days prior to commencement of work. Adequate detail shall be given to allow a value to be placed on work completed during any given pay estimate.

16.0 Permits and Fees

16.1 Bids shall include all sales tax (except as specified in Article 3.0 of the Supplementary General Conditions) and all other applicable taxes and fees related directly to the construction of this project. Fees for permits and inspections directly related to this construction will be paid by the BIDDER; however, no tap fees or access charges for this or subsequent work will be the responsibility of the BIDDER. City has Tax Exemption, a copy of which will be provided to the Contractor. Contractor and all subcontractors shall hold a current license to perform work in Rifle, Garfield County, and the State of Colorado.

17.0 Authorities

17.1 Technical Specifications included herein supplement the Standard Specifications and take precedence. Work shall be completed as per these specifications and accepted by the Owner or proper agencies having jurisdiction before final payment is requested of the Owner.

18.0 Subsurface Investigations

18.1 Geotechnical reports, if available, are included in the appendix of the Project Manual. Contractor use of such reports shall be in accordance with section 18.00 "Soils Investigation", of the Supplemental General Conditions.

19.0 Completion of Work

19.1 Work shall be completed as per the City of Rifle Public Works Manual (and as modified by these specifications) and accepted by the Owner or proper agencies having jurisdiction before final payment is requested of the Owner.

****Contractor shall provide a daily estimate of progress to the Public Works Director or City representative to verify quantities and that we shall stay within the contracted price. The City shall not pay for work above the contract price.**

20.0 Bid Bond

20.1 Bid security shall be made payable to the Owner in the amount of 5% of the bidder's maximum bid price in the form of a certified check or a bid bond, using the form herein, issued by a surety meeting the requirements of the Supplementary General Conditions. The bid security of the successful bidder will be retained until such bidder has executed the agreement and furnished the required contract security whereupon it will be returned; if the successful bidder fails to execute and deliver the agreement and furnish the required contract security within ten (10) days of the Notice of Award, the Owner may annul Notice of award and the bid security of that bidder will be forfeited. Owner will return bid bonds or checks of unsuccessful bidder within or by 60 days after the bid submittal date.

21.0 Payment Bond

21.1 Payment Bond form is found in Agreement Documents section of this package.

22.0 Performance Bond

22.1 Performance Bond form is found in Agreement Documents section of this package.

23.0 Work By Illegal Aliens Prohibited

23.1 Work By Illegal Aliens Prohibited. Pursuant to Section 8-17.50191, C.R.S., *et. Seq.*,

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Contractor warrants, represents, acknowledges, and agrees that:

1. Contractor does not knowingly employ or contract with an illegal alien.
2. Contractor shall not knowingly employ or contract with an illegal alien to perform works or enter into a contract with a subcontractor that fails to certify to Contractor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this Agreement.
3. Contractor has participated in or attempted to participate in the basic pilot employment verification program created in Public Law 208, 104th Congress, as amended, and expanded in Public Law 156, 108th Congress, as amended, administered by the Department of Homeland Security (hereinafter, "Basic Pilot Program") in order to verify that Contractor does not employ illegal aliens. If Contractor is not accepted into the Basic Pilot Program prior to entering into this Agreement, Contractor shall forthwith apply to participate in the Basic Pilot Program and shall submit to the City written verification of such application within five (5) days of the date of this Agreement. Contractor shall continue to apply to participate in the Basic Pilot Program, and shall verify such application to the City in writing, every three (3) months until Contractor is accepted or this Agreement is completed, whichever occurs first. This Paragraph 3 shall be null and void if the Basic Pilot Program is discontinued.
4. Contractor shall not use the Basic Pilot Program procedures to undertake pre-employment screening of job applicants while this Agreement is being performed.
5. If Contractor obtains actual knowledge that a subcontractor performing work under this Agreement knowingly employs or contracts with an illegal alien, Contractor shall be required to:
 - (a) notify the subcontractor and the City within three (3) days that Contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and
 - (b) terminate the subcontract with the subcontractor if within three (3) days of receiving the notice required pursuant to this subparagraph the subcontractor does not stop employing or contracting with the illegal alien; except that Contractor shall not terminate the contract with the subcontractor if during such three (3) days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.
6. Contractor shall comply with any reasonable request be the Colorado Department of Labor and Employment ("Department") made in the course of an investigation that the Department is undertaking pursuant to the authority established in subsection 8-17.5-102(5), C.R.S.
7. Contractor violates this Addendum; the City may terminate this Agreement for breach of contract. If this Agreement is so terminated, Contractor shall be liable for actual and consequential damages to the City arising out of said violation.

25.0 Scopes of Bids

24.0 Local Contractor Preference

24.1 A PREFERENCE FOR LOCAL CONTRACTORS WILL BE APPLIED BY THE OWNER WHEN SELECTING A CONTRACTOR per City of Rifle Code ARTICLE III Sec. 4-3-210. (b)

The following local preferences shall be considered in source selection for all City contracts:
Notwithstanding other provisions of this Article, in the awarding of contracts for goods or services, the City Council and Procurement Officer shall provide the following primary and secondary percentage preferences for local goods and services provided by local vendors when quality, delivery time and services are judged by the Procurement Officer to be essentially equal:

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Contract>Amount	Primary Preference City of Rifle Goods/Vendors	Secondary Preference Garfield County Goods/Vendors
Less than \$1,000	10% discount	5% discount
\$1,001 to \$5,000	8% discount	4% discount
\$5,001 to \$25,000	6% discount	3% discount
\$25,001 to \$100,000	5% discount	2.5% discount
\$100,000 to \$200,000	4% discount	2% discount
\$200,001 to \$500,000	3% discount	1.5% discount
\$500,000 or greater	2% discount	1% discount

25. Accessibility Requirements

25.1 All work performed as a result of this solicitation must comply with all applicable provisions of §§24-85-101, C.R.S., et seq., and the Accessibility Standards for Individuals with a Disability, as established by the Office Of Information Technology pursuant to §24-85-103 (2.5), C.R.S. and 3) all State of Colorado technology standards related to technology accessibility and with Level AA of the most current version of the Web Content Accessibility Guidelines (WCAG), incorporated in the State of Colorado technology standards.

END OF INSTRUCTIONS TO BIDDERS

Required Bid Documents

Bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be enclosed in an opaque sealed envelope, marked with the project title (and, if applicable, the designated portion of the project for which the Bid is submitted) and name and address of the Bidder and accompanied by the required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it. Any submission received after the advertised Bid Opening shall be returned unopened to the sender. Required Bid Documents are in the Bid Submittal Checklist Below

- _____ **Bid Form**
- _____ **List of Materials Suppliers/ Subcontractors**
- _____ **Contractor’s License**
- _____ **Bid Schedule**
- _____ **Bid Bond**

BID FORM - Page 1

DATE: _____

BIDDER:

Name of Bidder _____

Address of Bidder _____

Phone Number _____

Email Address _____

Contact Name _____

HEREBY PROPOSES and agrees, if this Bid is accepted, to enter into Agreement with the Owner to perform all work, including the assumption of all obligations, duties, and responsibilities necessary to the successful completion of the contract and the furnishing of all materials and equipment required to be incorporated in and form a permanent part of the Work; tools, equipment, supplies, transportation, facilities, labor, superintendence, and services required to perform the Work; and bonds, insurance, submittals; and all fees as indicated or specified in the Contract Documents to be performed or furnished by BIDDER for the amount identified and detailed in the BID SCHEDULE and further totaled below ("Bid Proposal Amount"):

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CITY OF RIFLE
BID FORM - Page2

DOCUMENTS AND ADDENDA:

The BIDDER submits that he has carefully examined the site of the proposed work and the existing conditions, as well as the drawings and specifications. Also, he has thoroughly reviewed the proposal form, Instructions to Bidders, General Conditions, Supplementary Conditions, General Requirements, and the Specifications and Drawings, and acknowledges that the following addenda covering revisions to the drawings and/or specifications, and the cost, if any, of such revisions has been included in the Total Bid Price.

Addendum No. _____ Dated _____

Addendum No. _____ Dated _____

Addendum No. _____ Dated _____

CHANGES TO THE WORK:

BIDDER agrees to perform all the WORK for the Total Base Bid price identified in the "Bid Proposal Amount." If circumstances arise during construction of this project which dictate a change in quantity, then the pricing for that particular portion of the job will be adjusted up or down with the BIDDER'S Schedule of Values (as included in the Contract Documents) to the revised quantity required by the construction circumstances of these plans. Final payment will be based upon count or measurement of items in place upon completion of the project at the units of measure and unit prices, with the exception of lump sum items.

For changes not covered by a contract unit price, BIDDER proposes that all such changes ordered to the work which increases the Scope of Work shall be priced in advance of the work and such unit prices will be approved by the Owner prior to commencement of work.

PERFORMANCE AND LABOR & MATERIAL PAYMENT BONDS:

By signing and submitting this Bid Proposal, the BIDDER certifies that upon demand, Performance and Labor & Material Payment Bonds can be furnished in amounts sufficient to cover the total proposed cost of work.

TIME OF COMMENCEMENT, COMPLETION, AND DAMAGES:

The BIDDER agrees that, if awarded the Contract, the Work will be substantially complete, ready for occupancy by Owner, according to the schedule submitted by BIDDER of within the indicated construction durations specified within the Contract Documents except for delays caused by Acts of God, neglect of the Owner or the

CITY OF RIFLE

BID FORM - Page 3

Representative of the Owner or other causes beyond the BIDDER'S control, and allows for no time due to labor disputes or strikes. Weather (unless severe) is not considered as an excuse for delay of the work.

Time is expressly declared to be of the essence in completion of the Work covered by the Contract Documents. Where additional time is allowed under the Agreement for the Completion of the work, the new time limits shall be of the essence of the Agreement.

GENERAL AGREEMENTS:

The BIDDER agrees to the following:

The BIDDER has had an opportunity to examine the Site of the work and has examined the Contract Documents therefore.

The BIDDER has carefully prepared the bid proposal upon the basis thereof and has carefully examined and checked the Bid Proposal and the materials, equipment and labor required thereunder, the cost thereof, and figures therefore, and hereby states that the amount or amounts set forth in the Bid Proposal is, or are, correct and that no mistake or error has occurred in the Bid Proposal or in the BIDDER's computations upon which the Bid Proposal is based and the BIDDER agrees that no claim for reformation, modification, rescission or correction of the Bid Proposal will be made after the scheduled closing time for the receipt of Bid Proposals.

The BIDDER understands that the Owner reserves the right to reject any or all Bids for any or no reason and to waive any informality in the bidding.

The BIDDER understands that this Bid shall not be withdrawn for a period of 60 calendar days after the scheduled closing time for receiving bids.

The BIDDER understands that unless a bid item is included on the "Bid Schedule", no separate payment shall be made for items required to complete the work in accordance with the contract. If included on the bid schedule, then work under the item will be paid at the unit or units given and shall include all necessary work complete and in place.

In preparing the Bid Proposal, the BIDDER has verified and is reasonably assured of the availability of all labor, materials, and products in this document.

The BIDDER has carefully reviewed the Bid Documents in their entirety and has agreed to meet these requirements.

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BID FORM - Page 4

DOCUMENT EXECUTION:

DATED This _____ day of _____, 2026

(Name of Firm)

(Street Address)

(City, State, Zip)

(Signature)

(Printed Signature)

(Title)

Please check as appropriate:

_____ An individual

_____ A Partnership Between: _____

_____ A Corporation organized under the laws of the State of _____

END OF BID FORM

LIST OF PREFERRED MATERIALS SUPPLIERS / SUBCONTRACTORS

Provide the name of the materials supplier or subcontractor included in your base bid price. Any changes in the providers listed below can be made only with the approval of the Owner. Any amount of work greater than 10% of the amount bid shall be considered as a subcontractor/Materials Supplier.

Name of Subcontractor Provided	Work Item Performed or Value	% of /Materials Supplier
Gorman Rupp _____	Lif Station Package Supplier_____	
CAT/Wagner_____	Generator Supplier_____	
Browns Hill Engineering_____	Electrical and Controls_____	
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

CITY OF RIFLE

PRE-SELECTED EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pre-Selected Equipment Specification
- B. Section does not include equipment for which substitutions will not be accepted.

1.2 RELATED SECTIONS

- A. Section 26 25 00 – Diesel Generator
- B. Section 46 07 53 – Gorman Rupp Packaged Lift Station

1.3 EQUIPMENT INFORMATION

- A. The units listed below are pre-selected by the City. No substitutions will accepted.

Project Specification	Model and Manufacturer	Quantity
Section 26 25 00	CAT Wagner Diesel Generator 80 KW Model C4 4GCABR	1
Section 46 07 53	Gorman Rupp Lift Station Package T6A35-B/WW	1

- B. Should the Contractor wish to or need to submit an acceptable substitution, the subsequent specifications should be used. Redesign costs will be the responsibility of the Contractor.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

BID SCHEDULE

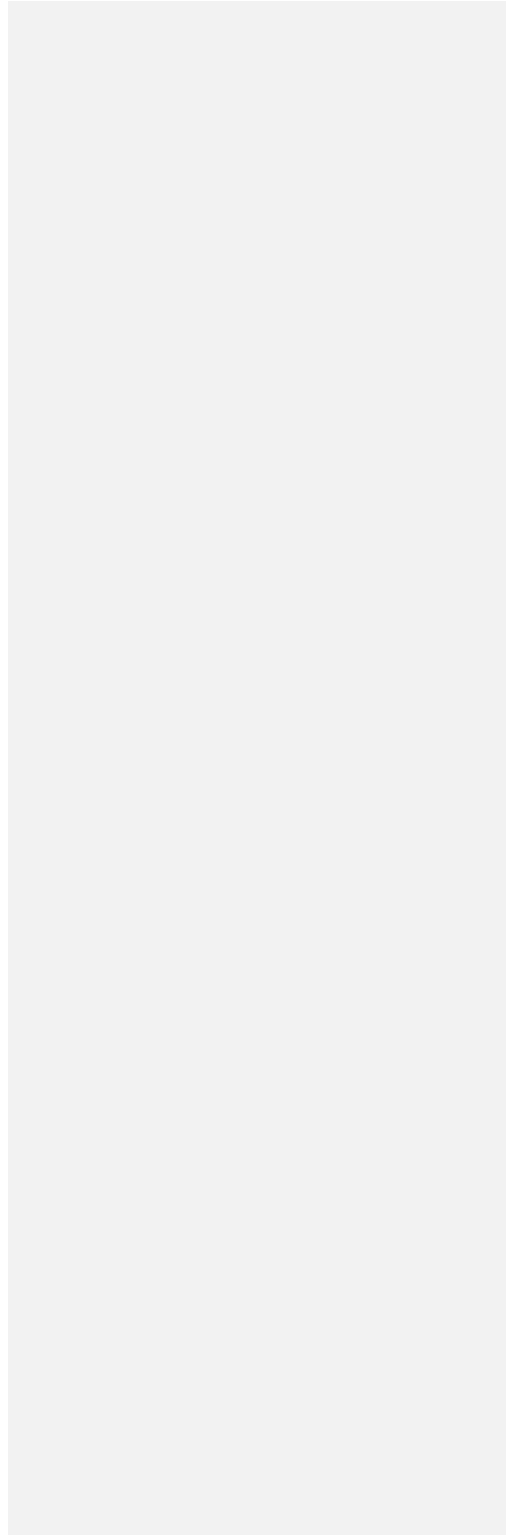
(See attached)

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BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____

as Principal, and _____

held and firmly bound unto _____

in the penal sum of _____

for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed this _____ day of _____, 2026. The condition of the above obligation is such that whereas the Principal has submitted to the **CITY OF RIFLE, COLORADO**, a certain BID, attached hereto and hereby made a part hereof to enter into a contract in writing, for the South Rifle Lift Station

NOW, THEREFORE,

[a] If said Bid shall be rejected, or

[b] If said Bid shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (properly completed in accordance with said Bid) and shall furnish a Bond for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its Bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

(L.S.)
Principal

Surety

By: _____

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as Amended) and be authorized to transact business in the state where the project is located.

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CONTRACTOR'S LICENSING STATEMENT FORM

The undersigned is licensed in accordance with the laws of Colorado providing for the registration of Contractors:
License Number _____; Class _____.

Name of Contractor's Firm _____

Business Address and Telephone Number _____

Name of Individual Owner (print) _____

Signature of Owner _____

OR

Signature, Title, and Address of members signing on behalf of the partnership:

Name _____ Title _____

Address _____

Name _____ Title _____

Address _____

Name _____ Title _____

Address _____

OR

Corporation organized under the laws of the State of _____

Signature of President of Corporation

Signature of Secretary of Corporation

(Place Seal Here)

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AGREEMENT

THIS AGREEMENT, made this ____ day of _____, 2026, by and between, CITY OF RIFLE hereinafter called "OWNER", and _____ doing business as a Corporation, hereinafter called "CONTRACTOR".

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned:

1. The CONTRACTOR will commence and complete the construction of: _____
South Rifle Lift Station
2. The CONTRACTOR will furnish all of the material, supplies, tools, equipment, labor and other service necessary for the construction and completion of the WORK described herein.
3. The CONTRACTOR will commence the work required by the CONTRACT DOCUMENTS within **14** calendar days after the date of the NOTICE TO PROCEED and will complete the same by **as indicated in the contract documents**, unless the period for completion is extended otherwise by the CONTRACT DOCUMENTS.
4. The Contractor agrees to perform all of the Work described in the CONTRACT DOCUMENTS and comply with the terms therein for the sum of (\$ _____) dollars or as shown in the BID SCHEDULE.
5. The term "CONTRACT DOCUMENTS" means and includes the following:
 - A. ADVERTISEMENT FOR BID
 - B. INSTRUCTIONS TO BIDDERS
 - C. BID
 - D. BID BOND
 - E. AGREEMENT
 - F. GENERAL CONDITIONS (CITY OF RIFLE PUBLIC WORKS MANUAL)
 - G. SUPPLEMENTARY GENERAL CONDITIONS
 - H. PAYMENT BOND
 - I. PERFORMANCE BOND
 - J. NOTICE OF AWARD
 - K. NOTICE TO PROCEED
 - L. LIST OF DRAWING SHEETS

SHEET NUMBER	SHEET TITLE
C0	COVER
C1	NOTES & LECEND
C2	PROPOSED SITE PLAN
C3	SITE AND DEMOLITION PLAN
C4	SEWER P&P
C5	FORCE MAIN P&P
C6	BASIN PIPING
C7	TANK VOLUME DIAL RAM
C8	DETAILS
C9	DETAILS
C10	DETAILS
S1	STRUCTURAL ABBREVIATIONS
S2	STRUCTURAL GENERAL AND MATERIAL NOTES
S3	WET WELL ROOF AND BASE SLAB PLANS
S4	WET WELL SECTIONS
S5	STRUCTURAL STANDARD DETAILS
S6	WET WELL SECTION AND DETAILS

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E1	LEGEND
E2	ONE- LINE DIAGRAMS
E3	SITE PLAN
E4	BUILDING PLAN
10 1	LEGEND
I02	P&IDS

- M. TYPICAL SPECIFICATIONS noted in the City Public Works Manual and CDOT Specifications.
- N. TECHNICAL SPECIFICATIONS
- O. ADDENDA: No. _____, dated _____ 2026.
- ADDENDA: No. _____, dated _____ 2026.
- ADDENDA: No. _____, dated _____ 2026.
- ADDENDA: No. _____, dated _____ 2026.

**CITY OF RIFLE
AGREEMENT**

6. The OWNER will pay to the CONTRACTOR in the manner and at such times as set forth in the GENERAL CONDITIONS such amounts as required by the CONTRACT DOCUMENTS.
7. This AGREEMENT shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this AGREEMENT in triplicate, each of which shall be deemed an original on the date first above written.

CITY OF RIFLE

OWNER: _____

BY: _____

NAME: _____

TITLE: _____

(SEAL)

ATTEST (OWNER): _____

(Please Type)

NAME: _____

TITLE: _____

CONTRACTOR: _____

BY: _____

NAME: _____

ADDRESS: _____

(SEAL)

ATTEST (CONTRACTOR): _____

(Please type)

NAME _____

TITLE: _____

Contingency Allowances

Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

FORCE ACCOUNT ITEMS

DESCRIPTION

This special provision contains the Department's estimate for force account items included in the Contract. The estimated amounts marked with an asterisk will be added to the total bid to determine the amount of the performance and payment bonds. Force Account work shall be performed as directed by the Engineer.

BASIS OF PAYMENT

Payment will be made in accordance with PWM Section 2.30. Payment will constitute full compensation for all work necessary to complete the item.

Force account work valued at \$5,000 or less, that must be performed by a licensed journeyman in order to comply with federal, state, or local codes, may be paid for after receipt of an itemized statement endorsed by the Contractor.

<u>Force Account Item</u>	<u>Quantity</u>	<u>Estimated Amount</u>
F/A Minor Contract Revisions	F.A.	TBD

Force Account Descriptions

F/A Minor Contract Revisions – This work consists of minor work authorized and approved by the Engineer, which is not included in the contract drawings or specifications, and is necessary to accomplish the scope of work of this contract.

Construction Schedule

Task	Start	End	Cal. Days
Bidding	4/20/2026	7/15/2026	86
Contract Execution	7/15/2026	7/29/2026	14
Subcontractor Buyout/Shop Drawings/Submittals	7/29/2026	8/26/2026	28
Mass Excavation	8/26/2026	9/9/2026	14
Concrete Slab	9/9/2026	9/16/2026	7
Concrete Wall	9/16/2026	9/30/2026	14
Concrete Deck	9/30/2026	10/14/2026	14

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Commented [MM1]: I think you all sent over a new one but didn't want to replace just in case anything had been changed with DOLA input

Cure, Backfill	10/14/2026	11/4/2026	21
Piping/sitework	10/17/2026	11/14/2026	28
Equipment, valves, electrical, generator Installation	11/14/2026	12/12/2026	28
Surface Restoration/Hydro mulch	12/12/2026	12/19/2026	7

Certificate of Insurance

Certificates of Insurance from the contractor and subcontractor’s insurance carriers shall name the City of Rifle as an additional insured party. Submission of Certificates of Insurance shall be provided prior to commencing any work.

Performance Bond Form

KNOW ALL MEN BY THESE PRESENTS that

Name of Contractor

Address of Contractor

a Corporation, Partnership or Individual

Hereinafter called Principal, and Name of Surety

Address of Surety

Hereinafter called Surety, are held and firmly bound unto

Name of Owner

Address of Owner

Hereinafter called OWNER, in the penal sum of Dollars (\$) in lawful money of the United States for the payment of which sum well and truly to be made, we bind ourselves, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the OWNER, dated the day of , a copy of which is hereto attached and made a part hereof for the construction of:

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms conditions and agreements of said contract during the original term thereof, and any extensions thereof, which may be granted by the OWNER, with 22-05-29 at notice to the SURETY and during the 04/2026

guaranty period, and if he shall satisfy all claims and demands incurred under such contract, and shall full indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

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Performance Bond

PROVIDED, FURTHER, THAT THE SAID surety for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the terms of the contract or to the WORK to be performed hereunder or the SPECIFICATIONS accompanying the same shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____
(number of copies)

counterparts, each one of which shall be deemed an original, this ____ day of _____, _____.

Principal (signature)

By: _____
Type/print

Address

ATTEST:

(Principal) Secretary

Address

(SEAL)

Witness as to Principal

Address

SURETY: _____

By: _____
Attorney-in Fact

Address

ATTEST:

Witness as to Surety

Address

NOTE: Date of BOND must not be prior to date of Contract. If CONTRACTOR is partnership, all partners should execute BOND.
IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the WORK is located.

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Payment Bond Form

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS that

(Name of Contractor)

(Address of Contractor)

a _____, hereinafter called Principal,
(Corporation, Partnership, Individual)

and _____
(Name of Surety)

(Address of Surety)

Hereinafter called Surety, are held and firmly bound unto _____

(Name of Owner)

(Address of Owner)

hereinafter called "OWNER" in the penal sum of _____dollars,
(\$_____) in lawful money of the United States, for the payment of which sum well and truly to be made,
we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract
with the OWNER, dated the _____ day of _____, _____, a copy of which is hereto attached and
made a part hereof for the construction of:

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms,
SUBCONTRACTORS, and corporations furnishing materials for or performing labor in the prosecution of
the WORK provided for in such contract, and any authorized extension or modification thereof, including all
amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs or machinery, equipment and
tools, consumed or used in connection with the construction of such WORK, and all insurance premiums
on said WORK, and for all labor performed in such WORK, whether by SUBCONTRACTOR or otherwise,
then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety for value received hereby stipulates and agrees that no
change, extension of time, alteration or addition to the terms of the contract or to the WORK to be performed
there under or the SPECIFICATIONS accompanying the same shall in any way affect its obligation on this
BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the
terms of the contract or to the WORK or to the SPECIFICATIONS.

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PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____
(number)

counterparts, each one of which shall be deemed an original, this _____ day of _____,
_____.

Principal

ATTEST:

(Principal) Secretary By: _____ (s)

(Address)

Witness as to Principal:

(Address)

(Surety)

By: _____
(Attorney-In-Fact)

(Address)

ATTEST:

Witness as to Surety

(Address)

NOTE: Date of BOND must not be prior to date of Contract. If CONTRACTOR is partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the WORK is located.

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CITY OF RIFLE

Notice of Award

Dated

TO: _____
Bidder

OWNER'S PROJECT NO. _____

PROJECT: South Rifle Lift Station

CONTRACT FOR: FULL CONSTRUCTION SERVICES

You are notified that your Bid dated _____, 2026, for the above Contract has been considered. You are the apparent successful Bidder and have been awarded a contract for CONSTRUCTION SERVICES AS PER PLANS DATED
.

Contract Price of your Contract is _____ Dollars (_____).

Three copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award.

You must comply with the following conditions precedent within fifteen days of the date of this Notice of Award, that is by _____, 2026 _____.

1. You must deliver to the OWNER three fully executed counterparts of the Agreement, including all the Contract Documents, Performance and Payment Bonds. Each of the Contract Documents must bear your signature on the cover.
2. You must deliver with the executed Agreement the Contract Security (Bonds)
3. You must deliver with the executed Agreement, proof of insurance coverage as specified in the General Conditions (section 2.32) and Supplementary General Conditions (paragraph 2.00). Failure to comply with these conditions within the time specified will entitle OWNER to consider your bid abandoned, to annul this Notice of Award and to declare your Bid Security forfeited. Within ten days after you comply with those conditions, OWNER will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

City of Rifle
Owner

By: _____
Authorized Signature

Civil Engineer: _____
Title

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CITY OF RIFLE

Notice to Proceed

To: _____

Date: _____

Project: _____

You are hereby notified to commence WORK in accordance with the Agreement

dated _____, 2026, on or before _____, 2026.

By: _____
Owner

Title: _____

ACCEPTANCE OF NOTICE Receipt of the above NOTICE TO PROCEED is hereby acknowledged

By _____

this the _____ day of _____, 2026.

By: _____

Title: _____

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General Conditions

PWM Section 2.1. ADDITIONAL INSTRUCTIONS, MODIFICATIONS AND DETAIL DRAWINGS

The engineer may, during the duration of the contract agreement and in accordance with Sections 2-16, 2-17, and 2-18 of these General Conditions, furnish the contractor written instructions, modifications or detail drawings necessary to illustrate changes in the work.

The additional written instructions and detailed drawings thus supplied shall become a part of the contract documents, without invalidating the contract agreement, and the contractor shall perform the work as modified or altered.

PWM Section 2.2. EXECUTION, CORRELATION, INTENT, INTERPRETATION AND FURNISHING OF CONTRACT DOCUMENTS

The contract documents shall be executed in triplicate by the owner and contractor.

By executing the contract agreement the contractor represents that he has visited the sight of the work, familiarized himself with the locale, subsurface and site conditions under which the work is to be performed, and correlated his observations with the available information included with and required by the contract documents.

The contract documents are complementary and what is required by any one shall be as binding as if required by all. The intention of the documents is to include all labor, materials, equipment and incidentals necessary for the proper execution and completion of the work. It is not intended that work not covered under any heading, section, class or trade of the specifications shall be supplied unless it is required elsewhere in the contract documents or is reasonably inferable there from as being necessary to produce the intended results. Words, which have well known technical or trade meanings, are used herein in accordance with such recognized meanings. Well-known technical standards are used herein in accordance with the latest edition and revisions thereof.

Written interpretations necessary for the proper execution or progress of the work, in the form of drawings or other wise, will be issued with reasonable promptness by the engineer and in accordance with any approved schedule, upon written request from the contractor. Such interpretations shall be consistent with and reasonably inferable from the contract documents and may be effected by field order.

Unless otherwise provided in the contract documents, the contractor will be furnished, free of charge, three (3) copies of drawings and specifications necessary for the execution of the work. All drawings and specifications thus furnished shall not be reused on any other project.

PWM Section 2.3. SCHEDULES, REPORTS AND RECORDS

The contractor shall submit to the owner such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the owner may request concerning work performed or to be performed.

Prior to the first partial payment estimate the contractor shall submit to the engineer schedules indicating:

A. Partial payments that he anticipates he will earn during the course of the work.

B. The order in which he proposes to carry on the work, including dates at which he will start the various parts of the work, estimated date of completion of each part; and as applicable:

1. The dates at which special detailed drawings will be required from the engineer.
2. The date that the contractor will submit shop drawings to the engineer.
3. Respective dates that manufacturing will begin, the testing and the installation of materials, supplies and equipment.

Schedules submitted by the contractor shall reflect:

C. The timely and orderly completion of:

1. Specific portions of the work as called for in the Special Conditions.
2. The work in accordance with allowed contract time.

D. The inability to perform work on Saturdays, Sundays, holidays or between the hours of 7:00 p.m. and 7:00 a.m. on any working day, without written permission from the engineer.

E. The safety, adequacy and efficiency of his plant equipment, tools, labor and methods of performing the work.

F. The availability of materials, equipment and incidentals to be incorporated in the work.

G. Maintenance and control of traffic.

PWM Section 2.4. DRAWINGS, SPECIFICATIONS, CONFLICTS AND DISCREPANCIES

The intent of the drawings and specifications is that the contractor shall furnish all labor, materials, tools, equipment, incidentals and transportation necessary for the proper execution of the work in accordance with the contract documents to complete the project in an acceptable manner, ready for use, occupancy or operation by the owner.

In case of conflict between the drawings and specifications, the specifications shall govern. Figured dimensions on drawings shall govern over scale dimensions, detailed drawings shall govern over General Drawings and Special Conditions shall govern over Standard Specifications. Any discrepancies between the drawings and specifications and site conditions; or any inconsistencies, errors, omissions or ambiguities in the drawings or specifications; or any errors or omissions in the layout as given by survey points and instructions shall be immediately reported to the engineer, in writing, who shall promptly verify and correct such inconsistencies or ambiguities in writing. Work performed by the contractor after such discovery, until authorized or corrected by the engineer, shall be done at the contractor's risk.

PWM Section 2.5. SHOP DRAWINGS AND MATERIAL SAMPLES

The contractor shall provide shop drawings, in triplicate, as may be necessary for the prosecution of the work (i.e. vault piping, electrical systems, reinforcing, non-detailed items, etc.) as required by the contract documents. The engineer shall promptly review all shop drawings. The engineer's approval of any shop drawing shall not release the contractor from responsibility for deviations from the contract documents. The approval of any shop drawing, which substantially deviates, from the requirement of the contract documents shall be evidenced by a Change Order.

When submitted for the engineer's review, shop drawings shall bear the contractor's certification that he has reviewed, calculated non-detailed dimensions, checked and approved the shop drawings and that they are in conformance with the requirements of the contract documents.

Portions of the work requiring a shop drawing or material sample submission shall not begin until the shop drawing or submission has been approved by the engineer. A copy of each approved shop drawing and each approved material sample shall be kept in good order by the contractor at the site and shall be available to the engineer.

PWM Section 2.6. MATERIALS, SERVICES, AND FACILITIES

It is understood that, except as otherwise specifically stated in the contract documents, the contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete and deliver the work within the specified time.

Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the work. Stored materials and equipment to be incorporated in the work shall be located so as to facilitate prompt inspection.

Manufactured articles, materials and equipment shall be fabricated, furnished, applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer or in accordance with the latest revision to or edition of well known technical standards (i.e. ASTM, AWWA, Colorado Department of Transportation, etc.) referred to in the Specifications or Special Conditions.

Materials, supplies and equipment shall be in accordance with samples submitted by the contractor and approved by the engineer.

Materials, supplies or equipment to be incorporated into the work shall not be purchased by the contractor or the subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

PWM Section 2.7. INSPECTION AND TESTING

All materials and equipment used in the construction of the project shall be subject to adequate inspection and testing in accordance with generally accepted standards and as required by the contract documents.

The owner shall provide technical personnel, acting under the supervision of the engineer, for the inspection and testing of the work in progress to ascertain that the completed work complies in all respects with the requirements of the contract documents.

If the contract documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any work to specifically be inspected, tested, or approved by someone other than the

contractor, the contractor will give the engineer timely notice of readiness. The contractor will then furnish the engineer the required certificates of inspection, testing or approval.

Neither observations by the engineer nor inspections, tests or approvals by any person shall relieve the contractor from his obligations to perform the work in accordance with the requirements of the contract documents.

The engineer and his representative will at all times have access to the work whenever it is in preparation or in progress. In addition, authorized representatives and agents of any participating federal or state agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The contractor will provide proper facilities for such access and observation of the work and also for any inspection thereof.

If any work is covered contrary to instructions or without approval or consent from the engineer, it must if required by the engineer, be uncovered for his examination and properly restored at the contractor's expense.

If any work has been covered which the engineer has not specifically requested to observe prior to its being covered, or if the engineer considers it necessary or advisable that covered work be inspected or tested by others, the contractor, at the engineer's request, will uncover, expose or otherwise make available for observation, inspection or testing as the engineer may require, that portion of the work in question, furnishing all necessary labor, materials, tools and equipment. If it is found that such work is defective, the contractor will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such work is not found to be defective, the contractor will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate Change Order shall be issued.

Any work done or materials used without inspection by an authorized Department representative may be ordered uncovered, removed, or restored at the Contractor's expense.

PWM Section 2.8. SUBSTITUTIONS

Whenever a material, article or piece of equipment is identified on the drawings or specifications by reference to brand name or catalog number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The contractor may request, in writing, the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the contract documents by reference to brand name or catalog number, and if, in the opinion of the engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the engineer may approve its substitution and use by the contractor. Any cost differential shall be deductible from the contract price and the contract documents shall be appropriately modified by Change Order. The contractor warrants that if substitutes are approved, no major changes in the function or general design of the project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the contractor without a change in the contract price or contract time.

PWM Section 2.9. PATENTS

The contractor shall pay all applicable royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and save the owner harmless from loss on account thereof, except that the owner shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified by the owner; notwithstanding anything above to the contrary, if the contractor has reason to believe that the design, process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information, in writing, to the engineer.

PWM Section 2.11. LICENSES, PERMITS, AND REGULATIONS

All contractors and subcontractors performing work on the project shall have a current City of Rifle Municipal or Building Contractor's License, whichever is applicable to their trade. Permits and licenses of a temporary nature necessary for the prosecution of the work shall be secured and paid for by the contractor. Permits, licenses, and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the owner, unless otherwise specified. The contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the contractor observes that the Contract Documents are at variance therewith, he shall promptly notify the engineer in writing, and any necessary changes shall be adjusted as provided in the Contract Documents for changes in the work.

PWM Section 2.12. PROTECTION OF WORK, EMPLOYEES, PUBLIC AND PROPERTY

The contractor will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. He will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees on the Work and the public who may be affected thereby, all the work and all the materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including pedestrian and vehicular traffic, trees, shrubs, lawns, fences, walks, pavements, roadways, structures and utilities, shown or not shown on the plans which are not designated for removal, relocation or replacement in the course of construction.

The contractor will comply with all applicable laws, ordinances, rules, regulations and order of any private or public body having jurisdiction. He will notify owners and users of adjacent utilities when prosecution of the work may affect them. He shall keep adjacent highways, streets and private access open to traffic and free of dirt and litter resulting from handling operations. He shall take reasonable precautions to protect private property adjacent to the project from such nuisances as dust, dirt, rock and excessive noise. The contractor shall remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the contractor, any subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except such as may be due to errors in the Contract Documents, or caused by agents or employees of the owner.

PWM Section 2.13. EMERGENCIES

In emergencies affecting the safety of life or the work or property at the site or adjacent thereto, the contractor, without special instruction or authorization from the engineer or owner, shall act to prevent threatened damage, injury or loss.

He will give the engineer prompt written notice of any significant changes in the Work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be issued covering the changes and deviations involved, except when the emergency is attributed to acts of the contractor in performing the Work.

PWM Section 2.14. LAWS, ORDINANCES, RULES, REGULATIONS, AND ORDERS

The contractor shall keep himself fully informed of, and shall comply with all applicable laws, ordinances, rules, regulations and orders of the city, county, state, federal or public bodies having jurisdiction affecting the work. He shall provide, erect and maintain all necessary, police, watchmen, flagmen, firemen, shoring, signing, traffic devices, barricades and sanitary facilities, as required by the conditions and progress of the work, and all other necessary safeguards for safety and protection, as set forth by the United States Department of Labor, Occupational Safety and Health Administration.

The contractor must conform to the rules and regulations of the Industrial Commission of Colorado. Prior to starting excavation the contractor shall obtain from the Commission and file with the engineer a copy of his "Notice of Intent to Excavate."

The contractor shall comply with the requirements of CRS § 8-17-101 (1985 Supp.) by employing not less than 80 percent Colorado residents in the several classifications of skilled and common labor employed on the project.

The contractor shall be an equal opportunity employer and adhere specifically to all the City of Rifle resolutions and ordinances pertaining thereto.

The contractor shall protect and indemnify the owner and its agents against any claim or liability arising from or based on the violations of such ordinances, regulations, or laws, caused by the negligent actions of the contractor, his agents or employees.

PWM Section 2.15. SUPERVISION AND DISCIPLINE BY CONTRACTOR

The contractor will supervise and direct the work. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The contractor will employ and maintain on the work a qualified supervisor or superintendent who shall have been designated in writing by the contractor as the contractor's representative at the site. The supervisor shall have full authority to act on behalf of the contractor and all communications given to the supervisor shall be as binding as if given to the contractor. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the work. The contractor shall at all times enforce strict discipline and good order among his employees and shall avoid employing on the project anyone unskilled in the work assigned.

PWM Section 2.16. CHANGES IN THE WORK

At any time during the progress of the work, the owner, through its city manager, may order alterations or changes in the plans, specifications, character or quantity of work, without invalidating the contract agreement. When the total arithmetic dollar value of all such changes, both additive and deductive, does not exceed 25 percent of the contract price, bid unit or lump sum prices, where applicable, shall be used. Should the dollar value of the changes exceed 25 percent of the contract price, the value of the changes over 25 percent shall be based on negotiated unit or lump sum prices, where applicable.

The engineer, also, may at any time, by issuing a Field Order, make changes in the details of the work, the contractor shall proceed with the performance of any changes in the work so ordered by the engineer unless the contractor believes that such Field Order entitles him to a change in contract price or time, or both, in which event he shall give the engineer written notice thereof within fifteen days after the receipt of the ordered change, and the contractor shall not execute such changes pending the receipt of an executed Change Order or further instruction from the owner.

PWM Section 2.17. CHANGES IN CONTRACT PRICE

The contract price may be changed only by a Change Order. The value of any work covered by a Change Order or of any claim for increase or decrease in the contract price shall be determined by one or more of the following methods in the order of precedence listed below.

- A. Contract Unit Prices. If a change is ordered in an item of work covered by a contract unit or lump sum price, then an adjustment in the contract price will be made based upon the increase or decrease in quantity of the contract unit or lump sum price.
- B. Agreed Prices. Adjustments in contract price for changes ordered that are not covered by contract unit or lump sum price or exceed the limitation in Section 2.16, will be determined by agreement between contractor and owner. If unable to reach agreement, the owner may direct the contractor to proceed on the basis of extra work in accordance with Paragraph C.
- C. Extra Work. When the price for extra work cannot be agreed upon, the owner will pay for the extra work based on the accumulation of costs as provided herein below.
 1. Daily Reports by Contractor. At the close of each working day, the contractor shall submit a daily report to the engineer, together with applicable delivery tickets, listing all labor, materials, and equipment for that day, and for other services and expenditures when authorized. An attempt shall be made to reconcile the report daily, and it shall be signed by the engineer and the contractor. In the event of disagreement, pertinent notes shall be entered by each party to explain points which cannot be resolved immediately. Each party shall retain a signed copy of the report. Reports by subcontractors or others shall be submitted through the contractor.
 - a. Labor. The report shall show the names of workers, classifications, and hours worked.
 - b. Material. The report shall describe and list quantities of materials used.
 - c. Equipment. The report shall show type of equipment, size and hours of operation, including loading and transport, if applicable.
 - d. Other Services and Expenditures. Other services and expenditures shall be described in such detail as the engineer may require.
 2. Basis for Establishing Costs.
 - a. Labor. The costs of labor will be the actual cost for wages for each craft or type of workers at the time the extra work is done, plus employer payments of payroll taxes and insurance, health and welfare, pension, vacation, and other direct costs resulting from federal, state or local laws, as well as assessments or benefits required by lawful collective bargaining agreements. The use of a labor classification which would increase the extra work cost will not be permitted unless the contractor establishes the necessity for such additional costs. Labor costs for equipment operators and helpers shall be reported only when such costs are not included in the invoice for equipment rental.
 - b. Materials. The cost of materials, or equipment to be incorporated in the work, shall be at invoice or lowest current price at which such materials are locally available and delivered to the job site in the quantities involved, plus freight and delivery. The owner reserves the right to approve materials and sources of supply, or to supply materials to the contractor if necessary for the progress of the extra work. No markup shall be applied to any material provided by the owner.
 - c. Tool and Equipment Rental. No payment will be made for the use of tools which have a replacement value of \$400 or less. Regardless of ownership, the rates to be used in determining equipment rental costs shall not exceed rates approved or authorized by the Colorado Department of Transportation at the time the extra work is performed. (Dataquest-Rental Rate Blue Book)

The rental rates paid shall include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance and all incidentals.

Necessary loading and transportation costs for equipment used in performing the extra work shall be included.

If equipment is used intermittently and, when not in use, could be returned to its rental source at less expense to the owner than holding it at the work site, it shall be returned, unless the contractor elects to keep it at the work site at no expense to the owner.

The reported rental time for equipment already at the job site shall be the duration of its use on the extra work, commencing at the time it is first put into actual operation on the extra work.

d. Other Items. The owner may authorize other items, which may be required on the extra work. Such items include labor, services, material and equipment which are different in their nature from those required for the work and which are of a type not ordinarily available from the contractor or any of the subcontractors.

Invoices covering all such items in detail shall be submitted with the request for payment.

e. Invoices. Vendors' invoices for material, equipment rental, and other expenditures, shall be submitted with the request for payment. If the request for payment is not substantiated by invoices or other documentation, the engineer may establish the cost of the item involved at the lowest price which was current at the time of the report.

3. Markup.

a. Work by Contractor. The following percentage shall be added to the contractor's costs and shall constitute the markup for all overhead and profits:

Labor (1.32 x certified payroll) 15

Materials 15

Equipment Rental 15

Other Items and Expenditures 15

To the sum of the costs and markups provided for in this subsection, one percent shall be added as compensation for bond and liability insurance.

b. Work by Subcontractor. When all or any part of the extra work is performed by a subcontractor, the markup established herein shall be applied to the subcontractor's actual cost of such work, to which a markup of five percent on the subcontracted portion of the extra work may be added by the contractor.

4. Any other cause which, in the opinion of the engineer, entitles the contractor to additional time, including but not restricted to acts of the public enemy, acts of any government in either its sovereign or any applicable contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and unforeseeable severe abnormal weather.

PWM Section 2.18. CHANGES IN CONTRACT TIME

The contract time may be changed only by a Change Order. The contractor shall notify the engineer promptly and in writing of any occurrence or conditions which, in the contractor's opinion, entitle him to an extension or reduction in contract time. Such notice shall be submitted in ample time to permit full investigation and evaluation of the contractor's claim. Failure to provide such notice shall constitute a waiver by the contractor of any claim. The engineer shall acknowledge the contractor's notice within seven days of its receipt.

Changes in contract time for the completion of the work shall be stipulated by Change Order:

A. When changes in the work occur.

B. When work is suspended by the owner.

C. For unforeseeable causes beyond the control and without the fault or negligence of the contractor, his subcontractor or supplier and which were not the result of their fault or negligence.

D. When delays in the progress of the work caused by:

1. Any act or neglect of the owner, his employees or agents.

2. Other contractors employed by the owner.

3. Any delay in furnishing of drawings, information or return of shop drawings by the engineer.

4. Any other cause which, in the opinion of the engineer, entitles the contractor to additional time, including but not restricted to acts of the public enemy, acts of any government in either its

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sovereign or any applicable contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and unforeseeable severe abnormal weather.

PWM Section 2.19. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

The date of beginning and the time for completion of the work are essential conditions of the contract documents and the work embraced shall be commenced on the date specified in the Notice to Proceed.

The contractor will proceed with the work at such rate of progress to insure full completion within the contract time. It is expressly understood and agreed, by and between the contractor and the owner, that the contract time for the completion of the work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the work.

A daily charge will be made against the contractor for each working day, including free time, that any work shall remain uncompleted after elapse of contract time. This daily charge, determined by the original contract amount for the project from the table herein below, will be deducted from any money due the contractor. This deduction will not be considered a penalty but as liquidated damages.

The schedule of liquidated damages set forth below is an amount, agreed to by the contractor and the City of Rifle, as reasonably representing additional construction engineering costs incurred by the City if the contractor fails to complete performance within the contract time.

The schedule of liquidated damages will be:

Original Contract Amount Daily Charge

From To and

More than Including

\$ 0 \$ 25,000 \$ 270

25,000 50,000 465

50,000 100,000 540

100,000 500,000 950

500,000 1,000,000 1,250

1,000,000 2,000,000 1,400

2,000,000 4,000,000 1,750

4,000,000 8,000,000 1,970

8,000,000 10,000,000 2,050

Over \$10,000,000 - daily charge will increase by \$100 increments for each \$2,000,000 over \$10,000,000.

Permitting the contractor to continue and finish the work or any part thereof after elapse of contract time will not operate as a waiver on the part of the City of any of its rights under the contract.

Any deduction assessed as liquidated damages under this section shall not relieve the contractor from liability for any damages or costs resulting from delays to other contractors on the project or other projects caused by a failure of the assessed contractor to complete the work according to contract times.

The contractor shall not be charged with liquidated damages or any excess cost when the delay in completion of the work is due to the following and the contractor has promptly given written notice of such delay to the owner or engineer.

A. To any preference, priority or allocation order duly issued by the owner.

B. To unforeseeable causes beyond the control and without the fault or negligence of the contractor, including but not restricted to, acts of God, or of the public enemy, acts of the owner, acts of another contractor in the performance of a contract with the owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and unforeseeable severe abnormal weather.

The owner shall have the right to deduct the amount of liquidated damages from any monies due or to become due to the contractor, or to sue for and recover compensation for damages for non-performance of the work, from the contractor and his surety, as stipulated in the contract documents.

PWM Section 2.20. CORRECTION OF WORK

The contractor shall promptly remove from the premises all material and work condemned by the engineer for failing to comply with the contract documents, whether incorporated in the construction or not, and the contractor shall promptly replace and re-execute the work in accordance with the contract documents and without expense to the owner and shall bear the expense of making good all work and material of other contractors destroyed or damaged by such removal or replacement.

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All removal and replacement Work shall be done at the contractor's expense. If the contractor does not take action to remove such condemned work and materials within ten days after receipt of written notice, the owner may remove such work and store the materials at the expense of the contractor.

PWM Section 2.21. SUBSURFACE CONDITIONS

The contractor shall promptly, and before such conditions are disturbed, except in the event of an emergency, which jeopardizes the safety of the project and/or persons thereon, notify the owner in writing of:

- A. Subsurface or latent physical conditions at the site differing materially from those indicated in the contract documents.
- B. Previously unknown physical or other conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract documents.

The engineer shall promptly investigate the conditions, and if he finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the work, an equitable adjustment shall be made and the contract documents shall be modified by a Change Order. Any claim of the contractor for adjustment hereunder shall not be all wed unless he has given the required written notice; provided that the engineer may, if he determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

PWM Section 2.22. SUSPENSION, DELAY OR INTERRUPTION OF WORK

The owner may, at any time and without cause, suspend the work or any portion thereof for a period of not more than ninety calendar days or such further time as agreed upon by the contractor, by written notice to the contractor and the engineer which notice shall fix the date on which work shall be resumed. The contractor will resume that work on the date so fixed. The contractor will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to any suspension.

If the performance of all or any portion of the work is suspended, delayed or interrupted as a result of a failure of the owner or engineer to act within the time specified in the contract documents, or if no time is specified, within a reasonable time, an adjustment in the contract price or an extension of the contract time, or both, shall be made by Change Order to compensate the contractor for the costs and delays necessarily caused by the failure of the owner or engineer.

PWM Section 2.23. OWNER'S RIGHT TO TERMINATE OR ABANDON WORK

If the contractor is adjudged bankrupt or insolvent, or if he makes a general assignment for the benefit of his creditors, or if a trustee or receiver is appointed for the contractor or for any of his property, or if he files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or applicable laws, or if he repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if he repeatedly fails to make prompt payments to subcontractors or for labor, materials or equipment or if he disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction of the work or if he disregards the authority of the engineer, or if he otherwise violates any provision of the contract documents, then the owner may, without prejudice to any other right or remedy and after giving the contractor and his surety a minimum of ten days from delivery of a written notice, terminate the services of the contractor and take possession of the project and of all materials, equipment, tools, construction equipment and machinery thereon owned by the contractor, and finish the work by whatever method he may deem expedient. In such case the contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price exceeds the direct and indirect costs of completing the project, including compensation for additional professional services, such excess shall be paid to the contractor. If such costs exceed such unpaid balance, the contractor will pay the difference to the owner. Such costs incurred by the owner will be determined by the engineer and incorporated in a Change Order.

Where the contractor's services have been so terminated by the owner, said termination shall not affect any right of the owner against the contractor then existing or which may thereafter accrue. Any retention or payment of monies by the owner due the contractor will not release the contractor from compliance with the contract documents.

After ten calendar days from delivery of a written notice to the contractor, the owner may, without cause and without prejudice to any other right or remedy, elect to abandon the project and terminate the contract. In such case, the contractor shall promptly remove all of his equipment, temporary facilities and supplies from the

premise, clean up the project and contiguous properties. Otherwise, the owner shall perform such housekeeping at the expense of the contractor. However, the contractor shall be paid for all work executed and any expense sustained plus reasonable profits as a result of such action by the owner.

PWM Section 2.24. CONTRACTOR'S RIGHT TO TERMINATE OR STOP WORK

If, through no act or fault of the contractor, the work is suspended for a period of more than ninety calendar days by the owner or under an order of court or other public authority, or the engineer fails to act on any request for payment within thirty calendar days after it is submitted, or the owner fails to pay the contractor substantially the sum approved by the engineer within thirty calendar days of its approval and presentation, then the contractor may, after ten calendar days from delivery of a written notice to the owner and the engineer, terminate the contract and recover from the owner payment for all work executed and all expenses sustained. In addition and in lieu of terminating the contract, if the engineer has failed to act on a request for payment or if the owner has failed to make any payment as aforesaid, the contractor may upon ten calendar days notice to the owner and the engineer stop the work until he has been paid all amounts then due, in which event and upon resumption of the work, Change Orders shall be issued for adjusting the contract price or extending the contract time, or both, to compensate for the costs and delays attributable to the stoppage of the work.

PWM Section 2.25. SUBCONTRACTING

The contractor may utilize the services of subcontractors on those parts of the work which, under normal contracting practices, are performed by specialty subcontractors.

The contractor shall not award work to subcontractor(s), in excess of fifty percent of the total contract price, without prior written approval of the owner.

The contractor shall be fully responsible to the owner for the acts and omissions of his subcontractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

The contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the contractor by the terms of the contract documents insofar as applicable to the work of subcontractors and to give the contractor the same power as regards terminating any subcontract that the owner may exercise over the contractor under any provision of the contract documents.

Nothing contained in this contract shall create any contractual relation between any subcontractor and the owner.

PWM Section 2.26. CONTRACT SECURITY

The contractor shall, within seven calendar days after the receipt of the Notice of Award, furnish the owner with a Performance and Payment Bond in the penal sum of the total contract price, conditioned upon the performance by the contractor of all Change Orders, undertakings, covenants, terms, conditions and agreements of the contract documents, and upon the prompt payment by the contractor to all persons supplying labor, equipment and materials in the prosecution of the work provided by the contract documents. Such bond shall be executed by the contractor and a corporate bonding company licensed to transact such business in the State of Colorado and listed in the most recent revision of "Surety Companies Acceptable on Federal Bonds" as published in the U.S. Treasury Department Circular No. 570. The expense of the bond shall be borne by the contractor. If at any time a surety on any such Bond is declared a bankrupt or loses its right to do business in the State of Colorado, or is disapproved by the owner, the contractor shall, within ten calendar days after notice from the owner to do so, substitute an acceptable bond (or bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the owner. The premiums on such bond shall be paid by the contractor. No further partial payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable bond to the owner.

PWM Section 2.27. PARTIAL COMPLETION AND OCCUPANCY

At any time during the performance of the work that a portion of the permanent construction has been satisfactorily completed, in accordance with the contract documents, which is not required for the operation of the contractor but is needed or required by the owner, the engineer shall issue to the contractor a written notice of partial completion, and thereupon or at any time thereafter, the owner may take over, occupy, operate and use that portion of the construction therein described.

The notification of partial completion shall in no way be construed to constitute an extension in contract time for the completion of all the work or as a waiver of the right of the owner to require the fulfillment of all the terms of the contract documents. If such prior use should cause an increase in the cost of, or in the time required

for, performance of the Work, as determined by the engineer, an equitable adjustment to the contractor shall be made and the contract documents modified by a Change Order.

PWM Section 2.28. MEASUREMENT OF QUANTITIES FOR PAYMENT

Measurement for pay items in the contract shall be as defined in the Measurement and Payment Section of the City of Rifle Standard Specifications for Design and Construction or as modified in the Special Conditions. The methods of measurement and computation to be used in determination of quantities; of work performed, of materials to be furnished and/or installed; will be those methods generally recognized as conforming to good engineering practice.

Sundry items, which are incident to or required in the construction of the work, but are not included as items in the Bid Schedule, shall be considered an integral part of the work to be performed. All labor, materials, etc., required for such items shall be furnished and installed, and the costs shall be included in the applicable contract unit price or lump sum amount bid.

PWM Section 2.29. SCOPE OF PAYMENT

Payment to the contractor will be made only for the actual quantities of contract items constructed and installed in accordance with the plans and specifications.

Payment made at the contract unit price or lump sum amount bid shall be full compensation for furnishing all labor, materials, equipment, appurtenances, taxes, insurance, permits and incidentals necessary to complete the work as shown on the plans and as required by the Specifications. Each item, fixture, piece of equipment, etc., shall be complete in place, operational and accepted.

No additional payment, over the amount bid, will be made for related work to any item unless specifically called for in the contract. Neither will payment be made for materials wasted, rejected or placed outside of plan limit lines.

PWM Section 2.30. PARTIAL PAYMENT AND CERTIFIED TAX REPORTS

The engineer, on or about the twenty-fifth day of the month in which work on the project is performed, shall prepare for contractor's approval, a partial payment estimate of the work performed and materials placed in accordance with the contract documents.

Not more than eighty (80) percent of the cost of materials and equipment delivered and suitably stored at or near the project site, but not incorporated in the work may be included in an estimate; provided however, the contractor furnishes invoices and supportive data establishing title in the name of the owner, to the engineer.

The amount to be retained from partial payments will be ten percent of the value of completed work, exclusive of mobilization and payment for materials on hand. When the retainment on contracts exceeding \$80,000 in value has reached five percent of the amount of the contract, no further retainment will be made. Amount of retainment will be held until such time as final payment is made with the following provision: When ninety-seven and one-half percent of the work has been completed, the engineer may, at his discretion and The amount to be retained from partial payments will be ten percent of the value of completed work, exclusive of mobilization and payment for materials on hand. When fifty percent of the work required by contracts exceeding \$150,000. has been performed, no further retainment will be made if in the opinion of the City, satisfactory progress is being made on the work. Amount of retainment will be held until such time as final payment is made with the following provision: When ninety-seven and one-half percent of the work has been completed, the engineer may, at his discretion and with the consent of the Surety, reduce the retained amount to twice the value of the work remaining to be done. Any amount retained under this provision shall be subject to the requirements of Colorado Revised Statute § 24-91-103.

Earnings so retained on contracts exceeding \$150,000. in value may be withdrawn by the contractor provided the contractor provides the City with an irrevocable letter of credit in a form and from a financial institution acceptable to the owner. Any amounts so retained by the owner under this provision shall be subject to Colorado Revised Statute. § 24-91-105.

The contractor upon receipt of each partial payment estimate shall either indicate his approval by signing and returning a copy to the engineer, or return the estimate unsigned and indicate in writing his reason for refusing payment.

The owner, within fifteen- (15) days of presentation to the engineer of an approved partial payment estimate, shall pay the contractor the amount due thereon.

Upon receipt from the contractor of an approved designated semifinal estimate, as prepared by the engineer:

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- A. The contractor shall, in writing, request the engineer to make a semifinal inspection in preparation for final acceptance of the work by the owner.
- B. The contractor shall prepare and furnish the engineer certified city and county sales and use tax reports covering the equipment and materials incorporated in the work.

The engineer, upon receipt of written request for semifinal inspection, shall promptly make said inspection of the work and issue to the contractor a written notice advising him of any deficiencies, corrective measures or clean up that he must complete prior to preparation of the final payment request.

All work covered by partial payment made shall thereupon become the sole property of the owner, but this provision shall not be construed as relieving the contractor of the sole responsibility for the care and protection of the work upon which payments have been made or the restoration of any damaged work, or as a waiver of the right of the owner to require the fulfillment of all terms of the contract documents.

PWM Section 2.31. FINAL PAYMENT REQUEST, ACCEPTANCE AND RELEASE

Upon completion of the work, cleanup of the project site, the engineer's receipt from the contractor in triplicate of certified tax receipts, the engineer, within ten calendar days thereafter shall:

- A. Prepare a final payment request, for contractor's approval, showing the total value of the work completed in accordance with the contract documents and as modified by any Change Orders, less the value of:
 - 1. Partial payments previously made by the owner to the contractor.
 - 2. Retention of any claims, on file with the owner, against the contractor
 - 3. Estimated costs of completing any incomplete or unsatisfactory items of the work.
 - 4. Payments advanced by the owner, to subcontractors, material and equipment suppliers or others which are known by the contractor to have been made but not previously accounted for.
 - 5. Liquidated damages not previously paid to the owner by the contractor.
- B. Advise the owner and contractor by written notice that:
 - 1. The work has been inspected and accepted by him under the conditions of the contract documents.
 - 2. The work, effective the date of the notice, is placed under warranty, at the contractor's expense, for a period of two years.

- 3. The entire balance shown on the final payment request, as prepared by the engineer, is due and payable within thirty calendar days from date of approval thereof by the contractor.

Upon approving the final payment request, as prepared by the engineer, the contractor by such act, indemnifies and saves the owner and his agents harmless from all claims growing out of the lawful demands of subcontractors, laborers, workmen, mechanics, material men and furnishers of machinery and parts thereof, equipment, tools, and all supplies incurred in the furtherance of the performance of the work. The contractor shall, at the owner's request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged or waived. If the contractor fails to do so, the owner may, after having notified the contractor, either pay unpaid bills or withhold from the contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged, in accordance with the terms of the contract documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the owner to either the contractor, his surety, or any third party. In paying any unpaid bills of the contractor, any payment so made by the owner shall be considered as a payment made under the contract documents by the owner to the contractor and the owner shall not be liable to the contractor for any such payments made in good faith.

The acceptance by the contractor of final payment shall be and shall operate as a release to the owner of all claims and all liability to the contractor other than claims in stated amounts as may be specifically excepted by the contractor for all things done or furnished in connection with this work and for every act and neglect of the owner and others relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the contractor or his sureties from the warranty period or any other obligations under the contract documents or the Performance and Payment Bond.

In the event the owner fails to make final payment as herein provided, there shall be added daily interest at the rate of six percent per annum, commencing on the first day after said payment is due and continuing until the payment is delivered or mailed to the contractor.

PWM Section 2.32. INSURANCE

The contractor shall at its own expense keep in full force and effect during the term of this contract insurance as follows:

The contractor shall secure and maintain statutory workmen's compensation.

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The contractor agrees to secure, at his own cost, a policy or policies of insurance sufficient to insure against the liability assumed by the contractor pursuant to the provisions of paragraph 2.36 of these General Conditions. The contractor's insurer must be rated "B+" or better, according to Best's Key Rating Guide and must be admitted to do business in the State of Colorado. The contractor shall provide the owner with a certificate of insurance from a properly qualified representative of the insurer, that any policy purchased pursuant to this contract complies with the conditions required by this contract. The certificate of insurance must show current name and address of the insured(s) named in the policy. The contractor shall not commence any work under this contract, and shall not allow any subcontractor or any officer, employee, or agent of the contractor or any subcontractor to commence any work under this contract, until any such certification has been received and approved by the owner.

The contractor shall not be relieved of any liability assumed pursuant to the foregoing paragraph by reason if its failure to secure insurance as required by this contract or by reason of its failure to secure insurance in sufficient amounts, of sufficient durations, or of sufficient types to cover such liability. The required policy shall meet the following conditions:

A. The policy limits shall be as follows:

1. The limit for an injury to one person in any single occurrence shall be no less than \$1,000,000, and the limit for an injury to two or more persons in any single occurrence shall be no less than \$2,000,000. Costs of defense shall not be included within such limits or, if they are so included, the minimum limits shall be \$1,000,000 combined single limits.
2. The general aggregate limit shall be unlimited or at least \$2,000,000.

B. The policy shall include the owner as an additional insured. The parties hereto understand and agree that the owner is relying on and does not waive or intend to waive by this contract, any provision hereof, including the provisions of this paragraph, the monetary limitations (presently \$1,000,000 per person and \$2,000,000 per occurrence) or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, ☐ C.R.S. 24-10-101, et seq., as from time to time amended, or otherwise available to the owner.

C. The insurer shall give the owner notification of any cancellation or termination by refusal to renew the policy or any change in coverage of the policy in the manner provided by law. If no such notification is provided by law, the insurer shall give the owner at least thirty (30) days prior written notification of any cancellation or termination by refusal to renew the policy or of any change in coverage of the policy, unless cancellation or termination is for non-payment of premium, in which case, the industry standard of ten (10) days prior written notification shall apply.

D. The contractor shall be solely responsible for any deductible losses under the policy.

E. If the policy is a claims made policy, the policy shall provide the contractor the right to purchase, upon cancellation or termination by refusal to renew the policy, an extended reporting period of not less than two years. The contractor agrees to purchase such an extended reporting period should the policy be cancelled or terminated.

F. If the policy is a claims made policy, the policy shall give the owner the right to purchase the extended reporting period described in paragraph E above if the contractor fails to purchase such an extended reporting period as required by this contract. The owner's exercise of such right shall not relieve the contractor of any liability for its failure to purchase such an extended reporting period as required by this contract.

G. If the policy is a claims made policy, the retroactive date of any renewal of such policy shall be no later than the date this contract is signed by the parties hereto.

H. If the contractor purchases a subsequent claims made policy in place of any prior policy, the retroactive date of such subsequent policy shall be no later than the date the contract is signed by the parties hereto.

The contractor shall secure and maintain, at his own expense, if applicable or called for in the Special Conditions, the following insurance coverage:

Fire, extended coverage and vandalism insurance on the project to the full insurable value thereof for the benefit of the owner, the contractor and subcontractors.

"All Risk" type builder's risk insurance for work to be performed. Unless otherwise authorized by the owner, the amount shall not be less than the contract price totaled in the Bid Proposal. The policy shall cover not less than the losses due to fire, explosion, hail, lightning, vandalism, malicious mischief, wind, collapse, riot, aircraft and smoke during the contract time and until the work is accepted by the owner. The policy shall name as the insured the contractor, the owner and their designated agents.

Special Comprehensive General Bodily Injury and Property Damage for the period of time that work being performed is encroaching on or property owned or controlled by individuals, partnerships or

corporations such as irrigation companies and railroads, state or federal agencies, and to limits set forth in their permit. The policy shall be issued to the permittee and name as the insured the contractor, the owner and their designated agents.

The contractor must comply with the owner's requirements for filing certificates of insurance, as determined by the Risk Management Division. A certificate of insurance acceptable to the Risk Management Division must be provided at the time the contract is executed by the parties hereto unless both parties arrange otherwise.

The contractor is responsible for submitting certificate(s) of insurance, subject to the insurance requirements described above, for all subcontractors. All certificates of insurance are subject to periodic verification and approval by the owner.

PWM Section 2.33. SEPARATE CONTRACTS

The owner reserves the right to let other contracts in connection with this project, or contiguous thereto. The contractor shall afford other contractors, utility companies or owner's forces reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs. If the proper execution or results of any part of the contractor's work depends upon the work of any other contractor, the contractor shall inspect and promptly report to the engineer any defects in such work that render it unsuitable for such proper execution and results.

If the performance of additional work by other contractors, utility companies or the owner is not noted in the contract documents prior to the execution of the contract, written notice thereof shall be given to the contractor by the engineer, prior to starting any such additional work. If the contractor believes that the performance of such additional work by the owner or others entitles him to a change in contract price or time, or both, he may, by written notice to the engineer, request a Change Order as provided under Changes in the Work.

PWM Section 2.34. HOUSEKEEPING AND CLEANUP

At all times during the progress of the work the contractor, at his expense, shall maintain the site, storage yard, adjacent properties, both public and private, policed and free of litter or trash. All material and equipment to be incorporated in the work shall be stored in a neat appearing manner and protected from damage or the elements until accepted in accordance with the contract documents.

Prior to final payment, the contractor, at his expense, shall remove from the project site and from contiguous private and public property, all temporary structures, equipment, rubbish and waste materials resulting from his operations. He shall clean up, police around and over all facilities that the owner will acquire maintenance thereof.

Disposal areas for waste material, from the contractor's operation, shall be those areas that comply in every way with local ordinances and are approved by the engineer.

PWM Section 2.35. ASSIGNMENT

Neither the contractor nor the owner shall sell, transfer, sublet as a whole, or otherwise dispose of the contract or any portion thereof without the written consent of the other and its surety; nor shall the contractor assign any monies due or to become due to him thereunder, except to a bank or financial institution acceptable to the owner.

PWM Section 2.36. INDEMNIFICATION

The contractor agrees to indemnify and hold harmless the owner, its officers, employees, insurers, and self-insurance pool, from and against all liability, claims and demands on account of personal injuries, including without limitation worker compensation claims and death claims, or property loss or damage, or any other loss of any kind whatsoever, which arises out of or are in any manner connected with this contract, whether or not such injury, loss, or damage is caused by, or is claimed to be caused by, the act, omission, negligence or other fault of the contractor, any employees of the contractor, or any other person or entity; or by accident; or by any other cause. Nothing herein is intended to constitute a covenant, promise, or agreement to indemnify and hold harmless the owner from any liability or damages directly caused by or attributable to the owner's own negligence. The contractor agrees to investigate, handle, respond to, provide defense for, and defend against, any liability, claims, or demands arising from, connected with, or related to the contract at the sole expense of the contractor regardless of whether the liability, claim, or demand is related to the owner's own negligence and the contractor further agrees to bear all other costs and expenses, related thereto, including court costs and attorney fees, whether or not the claim or claims alleged are groundless, false, or fraudulent. Nothing herein is intended to be, or may be construed as, a waiver or the immunities, protections, or limitations on damages

provided to The City of Rifle by the Colorado Governmental Immunity Act, C.R.S. § 24-10-101 through 24-10-120, as it may from time to time be amended.

PWM Section 2.37. ENGINEER'S STATUS AND DECISIONS

The engineer shall act as the owner's representative during the construction period. He shall decide questions which arise in the execution of the work. He shall perform technical inspections in the field, in laboratories, at factories, at sources of supply and wherever he feels the necessity to determine the quality and acceptability of material and equipment furnished and work performed. He shall reject all material, equipment and work which fails to conform to the specifications. He shall stop the performance of the work whenever such stoppage may be necessary to insure the proper execution of the contract documents. He shall determine the quantity of work to be paid for and prepare all partial payments, estimates and the final payment request for submittal to the owner after obtaining the contractor's approval thereof.

The engineer will not be responsible for the construction means, controls, techniques, sequences, procedures or construction safety.

The engineer shall, within a reasonable time after presentation, make decisions by written notice on all claims of the owner or the contractor on all matters relating to the execution and progress of the work or the interpretation of the contract documents.

PWM Section 2.38. LAND, RIGHTS-OF-WAY, EASEMENTS AND ENCROACHMENTS

Prior to issuance of Notice to Proceed, the owner shall obtain all land and rights-of-way necessary for carrying out and for the completion of the work to be performed pursuant to the contract documents, unless otherwise stated in the Special Conditions or mutually agreed to.

The owner shall indicate on the drawings or provide to the contractor information which delineates and describes the lands owned, rights-of-way and easements acquired, and encroachments over lands upon which the work is to be performed.

Delays in furnishing land for the work by the owner may be deemed proper cause for a change in the contract price, contract time, or both.

The contractor shall provide, at his own expense and without liability to the owner, any additional land and access thereto that the contractor may desire for temporary construction facilities, or for storage of materials and equipment.

PWM Section 2.39. GUARANTY AND WARRANTY

The contractor shall guarantee all material and equipment incorporated in, and warrant all workmanship on, the project for a period of two years from the date of written notice of acceptance of the project or portions thereof. The contractor shall within forty-eight hours after notification from the owner, subsequently verified by written notice, make all needed repairs and corrections which develop or result from defective workmanship, materials or equipment.

In the event the contractor should fail to make such repairs, adjustments, or performs other necessary work required to correct any deficiencies, the owner may do so and charge the contractor the cost thereby incurred. The Performance and Payment Bond shall remain in full force and effect through the guarantee and warranty period.

PWM Section 2.40. TAXES

The contractor will pay all applicable sales, use and other similar taxes required by the laws of the State of Colorado. When taxes are due, the developers, other responsible parties, and/or their subcontractors, prior to requesting final warranty on their project shall furnish the engineer, in triplicate on the City form, certified receipts of sales, use and other similar taxes, required by law, paid on all materials and equipment incorporated in or used in the performance of the work.

Notwithstanding the above, the contractor shall obtain from the Colorado Department of Revenue a Certification of Exemption indicating, where applicable, that the contractor's purchase of construction or building materials is for use in the building, erection, alteration or repair of public works owned and used by the City of Rifle, in its governmental capacity. The contractor shall file with the engineer a certified copy of the Certification of Exemption, prior to commencing Work.

Where a project is exempt from such tax, the amount of such tax shall not be included in any bid proposal submitted to the City.

PWM Section 2.41. DESIGNING AND PERFORMING WORK WITHOUT A CONTRACT AGREEMENT

All property owners, individuals, partnerships or corporations which engage in the subdividing or improving of land, or in the design or construction of the Work, ultimately to be maintained, operated, occupied or owned by the City of Rifle, other than those directly contracting with the City, shall adhere to this Public Works Manual, Design and Construction of Public Improvements to which these General Conditions are a part.

No portion of the work shall be performed until the engineer has approved the drawings pertaining there to, and then only by a contractor that is licensed and bonded to the City of Rifle.

Those who are responsible for, or cause the work to be performed, and those who actually perform the work, will be considered, for purposes of these General Conditions and Standard Specifications, as having executed a contract agreement, as contractor, with the City of Rifle as owner, even though no agreement exists. As such, they shall comply with all the technical and performance provisions of these Specifications, be subject to inspection and the directives of the engineer.

PWM Section 2.42. CLOSEOUT

To close out a project or development, several items need to be taken into account by the Contractor, Engineer and by the Owner. Several of these items may have been initiated prior to or during the work.

The Contractor of the work shall notify the Engineer and the Owner in writing that he has reached "Substantial Completion" and include a list of work yet to be completed or corrected. If requested by the Engineer, closeout of areas or portions of work may be allowed by the Owner.

The Engineer, along with the Owner's representative, shall inspect the work to determine if it is substantially complete. If it is substantially complete, a "Certificate of Substantial Completion" will be issued by the Engineer along with a "Punch List" of items to be completed or corrected, to the Contractor and the Owner.

The Contractor shall complete and/or correct the items listed on the punch list, or any other item that becomes known, and again notifies the Engineer and Owner in writing that the work is ready for final inspection. At this time, the Contractor may submit his application for final payment to the Engineer.

The Engineer along with the Owner's representative will make a final inspection. If the work is found acceptable and complete to the satisfaction of the Owner, a meeting will be scheduled to finalize all other items due. Should the Contractor fail to complete and/or correct all punch list items required by the Owner, the Contractor shall pay for additional "Final Inspections" by the Engineer at the Engineer's current rates. If the Contractor has any question with regard to any items found on the punch list, he shall request clarification from the Engineer prior to final inspection.

Prior to release of final payment, a meeting (referred to in the previous paragraph) shall be held to collect from the Contractor and/or the Engineer, for the Owner, the following items:

1. Outside Inspection Certificates, as applicable,
2. Materials Certificates of Compliance,
3. Equipment and Material guarantees,
4. Contractors two-year (or longer, if required) guarantee or warranty using Owner forms,
5. Operation & Maintenance Manuals and Parts list, as applicable,
6. Receipts for Materials delivered to the Owner,
7. Miscellaneous Keys, Tools, etc.
8. Final Application for Payment,
9. Consent of Surety to Final Payment,
10. Contractor's Affidavit of Release of Liens,
11. Project Record Drawings (As-Built),
12. Quitclaim deed from developer conveying any interest it has in the public improvements to the Owner using Owner format,
13. Bill of Sale conveying all public improvements to the Owner free and clear of liens and encumbrances using Owner format,
1. Final Payment Amount,
2. Contractor acknowledgement of Date of Warranty, and
3. All other documentation.

And the Owner will provide to the Engineer:

1. Public Works Director Certification that the work has been constructed in conformance with the plans and specifications.
2. A letter informing the financier to release the Letter of Credit.

Inspection certificates shall be submitted (Number 1, in the list above) from any State or Other governing body having jurisdiction, such as State electrical certification that the work is in strict conformance with applicable codes.

The Contractor shall remedy any defects due to faulty materials or workmanship and pay for damage to other work resulting there from, for a period of one year (or longer, if required) in accordance with Section 2.39 herein. A written warranty based on the provisions of Section 2.39 shall be provided to the Owner, dated as agreed with the Owner, properly signed and notarized and addressed to the Owner.

All keys to doors, panels or switches, special tools required for equipment and spare parts or supplies, as applicable, shall be accounted for and turned over to the Owner.

The Owner, will initiate action to advertise in the local newspaper regarding final payment to the Contractor and determining the date for payment.

Project Record Drawings (As-Built) shall consist of one blackline copy of the completed project work with changes clearly marked and clouded and a CD-ROM. The CD-ROM disk shall include the marked-up sheets in individual PDF format files and the electronic line work in the latest AutoCAD drawing format. The electronic line work should be supplied such that all improvements are located on the Rifle grid i.e. UTM Z13 in metric (meter) scale. All drawings (electronic and hardcopy) should be clearly and neatly marked "RECORD DRAWING" in ½" block letters in the lower right quadrant of the sheet.

Item 14, above, shall be broken down into 1) cost of water system per individual street (including pipe, fittings, valves, services, hydrants, etc.), 2) sewer system (including pipe, services, manholes, etc.) per individual street, 3) storm drain and culvert system per individual street (including pipe, inlets, boxes, flared ends, manholes, etc.) and 4) individual street costs (including signals, signs, striping, asphalt, road base, curb, gutter sidewalk, grading, etc.).

PWM Section 2.43. RIGHTS AND REMEDIES

The duties and obligations imposed by the Contract Documents and the rights and remedies available there under shall be in addition to and not as a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law, including but not limited to tort remedies. The Contractor agrees that the economic loss rule as set forth in the Town of Alma v. Azco Construction, Inc., 10 p.3d 1256 (Colo. 2000) shall not serve as a limitation on the Owner's right to pursue tort remedies in addition to other remedies it may have against the Contractor. Such rights and remedies shall survive the acceptance of the Work or any termination of the Contract Documents. Contractor further specifically waives all provisions of Chapter 8 of Article 20 of Title 13, Colorado Revised Statutes, regarding defects in the Work under the Contract. In the event any portion of this provision is deemed un-enforceable by a court of competent jurisdiction, the remaining portions of this provision shall survive.

PWM Section 2.5. SURVEYS

1. GENERAL

- 1.1. Scope. Work to be performed under this section shall include all labor, equipment, materials, tools, and incidentals necessary to cover the following:

- 1.1.1. Layout of work.
- 1.1.2. Field measurements of work quantities.
- 1.1.3. Determination of as-built locations, lines, and grades at completion of the work for preparation of as-built drawings.

- 1.2. Description. The Engineer will provide horizontal and vertical survey control data for control points in the field necessary for the Contractor to proceed with construction staking for the work. The Contractor shall be responsible for protecting all field control set(s). Replacement by the Engineer of Engineer-established control points which have been damaged or destroyed by the Contractor will be charged at the Engineer's current rate.

- 1.2.1. The Contractor shall furnish all necessary detail surveys including all lines, grades, and appropriate surveys.
- 1.2.2. The Engineer reserves the right to perform any desired checking and/or correction of the Contractor's

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surveys but this shall not relieve the Contractor of responsibility for the adequate performance of the work.

- 1.3. The work shall be done under the supervision of a Professional Engineer or Professional Land Surveyor who is experienced and competent in road and bridge construction surveying and is registered in the State of Colorado.

2. MATERIALS (Not Applicable)

3. METHOD AND PROCEDURES

- 3.1. Contractor Surveying. The Contractor shall perform all construction surveying and staking that is necessary for construction of the project. Construction surveying and staking shall be based on survey control established by the Engineer.
- 3.2. Staking. Acceptable staking placement intervals for the various construction survey control operations are described in the CDOT Survey Manual. Stationing shall be established in the field on centerline or an approved offset.
- 3.3. Accuracy and Tolerances. Accuracy of surveys and survey tolerances shall be as specified in the CDOT Survey Manual.
- 3.4. Responsibility and Inspection. Supervision and coordination of construction surveying is the Contractor's responsibility. The Contractor shall check the work to verify the accuracy and include documentation of this check in the Survey Records. All Contractor surveying inaccuracies, errors, or omissions shall be corrected at the Contractor's expense. Engineer's inspection or the Contractor's corrections shall not entitle the Contractor to additional payment or contract time extension.
- 3.5. Reset Controls and Stakes. Control points, bench marks, and other significant stakes that are damaged, destroyed, or made inaccessible by the progress of construction shall be replaced, transferred, or re-established at the Contractor's expense.
- 3.6. Changes. All changes in lines and grades required by field conditions and all discrepancies in grades, alignment, location, or dimensions detected by the Contractor shall be immediately submitted to the Engineer in writing. No changes in given data or plans will be allowed unless approved by the Engineer in writing. All changes shall be documented in the survey records.
- 3.7. Survey Records. Survey records shall be completed as the work is done. Field survey notes for construction surveying and checking by the Contractor shall be recorded in survey records in conformance with the format given in the CDOT Survey Manual. If an electronic format is used, it shall contain the same information and format as required in the Survey Manual for written documentation. All survey records generated shall be the property of the County and shall be available to the Engineer for inspection or reproduction at all times. All survey records shall be transmitted to the Engineer for inclusion into the project records before final project acceptance. All survey records shall be stamped with the seal of, and signed by, the responsible P.E. or P.L.S.

4. FIELD QUALITY CONTROL (Not Applicable)

5. MEASUREMENT AND PAYMENT

5.1. Measurement

- 5.1.1. Measurement for payment for layout of work and surveys will be by the lump sum basis.

5.2. Payment

- 5.2.1. Payment for layout of work and surveys will be made at the lump sum price quoted therefore in the Bid Schedule. The unit price quoted shall include full compensation for furnishing labor, materials, equipment, tools, accessories, and incidentals and for performing all work, including but not limited to, layout of work, field measurement of quantities, as-built drawings.

1.00 GENERAL

2.00 INSURANCE

2.01 Unless otherwise provided in these Supplementary General Conditions, Contractor shall purchase and maintain property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in these Supplementary General Conditions or required by Law). This insurance shall include the interests of Owner, Contractor and Subcontractor in the Work, shall insure against the perils of fire and extended coverage, shall include "all risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in these Supplementary General Conditions, and shall include damages, losses and expenses arising out of, or resulting from, insured loss or incurred in the repair or replacement of any insured property (including fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all risk" insurance, or otherwise provided in these Supplementary Conditions, Contractor shall purchase and maintain similar property insurance on portions of the Work stored on or off the site or in transit when such portions of the Work are to be included in an *Application for Payment*. Such coverage shall be provided until the issuance of a certificate of substantial completion. The policies of insurance required to be purchased and maintained by Contractor in accordance with section 2.32 of the Rifle Public Works Manual shall contain a provision that the coverage afforded will not be canceled or materially changed until at least thirty (30) days prior written notice has been given to Owner.

2.03 Coverage Required (minimum):

1. Limits

- ### B. Automobile Liability

- ## 2. Coverages

- x Comprehensive Form

☒ Owned
☒ Hired
☒ Non-Owned

2.05 Certificates of Insurance from the contractor and subcontractor's insurance carriers shall name both the City of Rifle and CDOT as additional insured parties. Submission of Certificates of Insurance shall be provided prior to commencing any work.

3.00 TAX EXEMPTION.

Owner's tax-exempt number, when applicable, to be used as part of this project, will be provided to the successful bidder. The successful bidder shall then apply for sales tax exemption before working on a City Project. See www.revenue.state.co.us/PDF/dr0172.pdf. Subcontractors shall be provided copies of the contractors sales tax exemption certificate to avoid paying taxes when purchasing materials to be incorporated in the City project. Therefore, these taxes should not be included in the cost for performing the work.

4.00 FINAL PAYMENT.

Lien waivers from all prime Contractors and Subcontractors to be provided prior to issuance of final payment.

5.00 COMPLETION TIME.

Task	Start	End	Cal. Days
Bidding	4/20/2026	7/15/2026	86
Contract Execution	7/15/2026	7/29/2026	14
Subcontractor Buyout/Shop Drawings/Submittals	7/29/2026	8/26/2026	28
Mass Excavation	8/26/2026	9/9/2026	14
Concrete Slab	9/9/2026	9/16/2026	7
Concrete Wall	9/16/2026	9/30/2026	14
Concrete Deck	9/30/2026	10/14/2026	14
Cure, Backfill	10/14/2026	11/4/2026	21
Piping/sitework	10/17/2026	11/14/2026	28
Equipment, valves, electrical, generator Installation	11/14/2026	12/12/2026	28
Surface Restoration/Hydro mulch	12/12/2026	12/19/2026	7

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6.00 OWNER'S REPRESENTATIVE.

Unless provided for otherwise in writing by the Owner, any on-site Inspector or Representative of the Owner shall not have the authority to render any binding decisions nor make any binding judgments to the Contractor pertaining to any work which may change the Contract price or time of completion, or to the quality of Work, or to the manner in which the Work is being performed. The Representative of the Owner shall serve as a means of communication between the Owner and the Contractor and shall monitor the Work for the Owner. Any communication given to the Representative of the Owner by the Contractor shall be considered as being given to the Owner.

7.00 SAFETY REQUIREMENTS.

Nothing in the Contract Documents shall be construed as relieving the Contractor from protecting all property and persons or from strictly adhering to all applicable local, state and federal safety requirements. Where there is a conflict between the Contract Documents and any applicable safety requirement, the safety requirement shall take precedence.

8.00 LAWS AND ORDINANCES.

The Contractor shall at all times observe and comply with all federal, state and local laws, ordinances and regulations which in any manner affect the contract or Work, and shall indemnify and save harmless the Owner and the Owner's agent against any claim arising from the violations of any such laws, ordinances and regulations, whether by the Contractor or his employees.

If the Contractor performs any Work knowing it to be contrary to such laws, ordinances, rules or regulations, and without notice to the Engineer, he shall bear all costs arising there from.

9.00 WAIVER.

It is expressly understood and agreed that any waiver granted by the Engineer or Owner of any term, provision or covenant of this Contract shall not constitute a precedent nor breach of the same or any other terms, provisions or covenants of this Contract. Neither the acceptance of the Work by the Owner nor the payment of all or part of the sum due the Contractor hereunder, shall constitute a waiver by the Owner of any claim which the Owner may have against the Contractor or otherwise.

10.00 PROTECTION OF PUBLIC UTILITIES AND OTHER ADJOINING PROPERTY.

The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury, or loss to other property at the site or adjacent thereto, and he shall be liable for any and all claims for such damage on account of his failure to fully provide such protection.

The Contractor shall notify all public utility companies at least forty-eight (48) hours prior to commencement of any Work in the vicinity of the utilities. No Work shall commence until the utilities have been located and staked by the utility company or written consent to proceed has been given by the Owner. If utility service must be interrupted, the Contractor shall notify the head of local administrative services (i.e., City Manager, Mayor, and City Clerk), as applicable, and utility users affected by the interruption of service at least twenty-four (24) hours prior to interruption. Notice shall consist of publication in a local newspaper and/or announcement on local radio or television stations as determined by the Owner.

11.00 PROJECT PHOTOGRAPHS/VIDEOS

It is the Contractor's responsibility to take a sufficient number of pre-construction photographs/videos to resolve any disputes, which may arise regarding the conditions prior to and subsequent to construction. The Contractor shall provide copies of the pre-construction photographs/videos to the Owner prior to the start of work. Any potential problems should be identified at that time.

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Progress and record photographs/videos shall be provided by the Contractor as appropriate to resolve any disputes and to completely document the work performed as a supplement to the Record Drawings. In general, the photographs/videos should be sufficient to show that all work was properly completed in accordance with the plans and specifications.

12.00 DAMAGE TO CONSTRUCTION.

The Contractor shall safeguard, until all work embraced by this Contract is formally accepted, all construction, both complete and incomplete, against damage and destruction, and should damage result, he will be required to reconstruct or repair it at his expense in a manner conforming to the Plans and Specifications, reconstruction shall be in a manner suitable to the Engineer.

13.00 PRE-CONSTRUCTION CONFERENCE.

A pre-construction conference shall be held within fifteen (15) days after the *Notice To Proceed*, at the Owner's place of business. The purpose of such meeting shall be to explain as required to the Contractor, the requirements of the Contract Documents, the procedures to be used in the administration of the Contract, the requirements of any funding Agencies, and to discuss any item of concern to the Work. The Contractor, Owner and Engineer, or authorized representative of each, shall be required to attend such meeting as a condition of the Contract.

14.00 BIDDER EXPERIENCE.

Upon request, bidder to provide documentation of relevant experience with reference to a minimum of three (3) projects of similar scope and size. Statement shall include equipment and manpower available for utilization on project. Supervisory personnel for project shall be provided. Qualification information shall be submitted as stated in section 3.0 of the "Instructions to Bidders".

16.00 PERFORMANCE AND PAYMENT BONDS.

Payment and Performance Bonds are required (section 2.26 of the general conditions and Agreement Documents section of the Project Manual).

17.00 WARRANTY INSPECTION.

At the Owner's discretion, a warranty inspection will be held during the sixty (60) calendar days prior to the expiration of the two-year warranty period. Contractor agrees to provide an authorized representative at such inspection to represent Contractor's interests. All defects identified during the inspection shall be corrected at Contractor's expense at direction of Owner in a timely manner. Corrective work shall be commenced within ten (10) calendar days after written notice to Contractor.

18.00 SOILS INVESTIGATION

Where available, applicable portions of subsurface soils investigations are included as an attachment to these Specifications). Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not made a part of the Contract Documents. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any claim against OWNER, ENGINEER or any of ENGINEER'S Consultants with respect to: the completeness of such reports and drawings for CONTRACTOR'S purposes, including, but not limited to, any aspect of the means, methods, techniques, sequences and procedures of construction and programs incident thereto, or other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings, or any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information. Contractor shall perform such investigations ~~22/05/29~~ deemed necessary to determine his bid. 04/2026

19.00 JOB SITE RESTRICTIONS.

19.01 Salvage. All materials to be removed from the project site or demolished on site shall be disposed of by the Contractor off the project site within five days.

19.02 Staging Area. Staging may utilize right of way if the contractor provides adequate warning cones, reflectors, etc. Contractor takes sole responsibility for leaving any equipment or materials in the City right of way.

19.03. Disposal Area. Owner's property is not available for a Contractor disposal area.

19.04 Working Hours. Work will normally be permitted after 7:00 a.m. and before 5:00 p.m. Monday through Friday. Other work hours must be approved by Engineer in writing. Work may be permitted on Saturday with 48 hours prior notification given to the Owner's representative.

20.00 ARBITRATION.

Anything in the General Conditions of the Contract Documents notwithstanding the choice to submit any dispute to binding arbitration shall be solely that of the Owner and no other party to this Contract shall have the right to submit any controversy to binding arbitration.

21.00 PAYMENT RETAINAGE.

Retainage on Pay Estimates shall be five (5) percent.

22.00 REFERENCE TO OWNER.

The City of Rifle will be the Owner of this project and will be referred to as Owner in the Agreement.

23.00 NOTIFICATION TO ADJACENT PROPERTY OWNERS.

Contractor shall provide constant communication with adjacent property owners to schedule and discuss impacts the contractor's work will have on their access and utility service.

Access to property owners adjacent to the work site shall be open at all times unless other arrangements are made a minimum of twenty-four (24) hours in advance.

24.00 DRAWING ACCURACY AND EXISTING UTILITIES.

Contractor shall provide constant communication with adjacent property owners to schedule and discuss impacts the contractor's work will have on their access and utility service.

As such, information relating to locations, sizes, or elevation of existing facilities should be considered only approximate. It shall be the responsibility of the Contractor to contact the appropriate representatives of utility companies, or utility locate companies, a minimum of 48 hours prior to the commencement of Work which might affect utility installations and to secure from such representatives information as to accurate location, size and type of such installations. The Contractor shall assume all responsibility for protection, repair and relocation of all such items encountered. Should repair or replacement be required, work shall be performed according to the requirements of the respective utility company.

25.00 ABBREVIATIONS.

Whenever the following abbreviations are used in these Specifications or on the Drawings, they shall be construed the same as the respective expressions represented:

AASHO or	American Association of State Highway Officials
AASHTO	American Concrete Institute
ACI	American Institute of Steel Construction
AISC	American National Standards Institute, Inc.
ANSI	American Water Works Association
AWWA	Colorado Department of Transportation
CDOT	Colorado Department of Public Health & Environment
CDPHE	Concrete Reinforcing Steel Institute
CRSI	Commercial Standard, U.S. Department of Commerce
CS	Federal Specifications
FED. SPEC.	National Electric Code
NEC	National Electrical Manufacturers Association
NEMA	Occupations Safety and Health Act
OSHA	(Federal and/or State)
	Steel Structures Painting Council
SSPC	Uniform Building Code
UBC	Underwriters Laboratories, Inc.
UL	

25.01 Standard Specifications Reference. Where reference is made in these Specifications to other Standard Specifications, it is the intent that the latest available revisions of the CDOT Standard Specifications referenced be used. All portions of the CDOT Standard Specifications referenced shall be considered a part of these Specifications unless specifically superseded herein.

In case of conflict between the drawings and specifications, the specifications shall govern. Figured dimensions on drawings shall govern over scale dimensions, detailed drawings shall govern over General Drawings and Special Conditions shall govern over Standard Specifications.

Any discrepancies between the drawings and specifications and site conditions; or any inconsistencies, errors, omissions or ambiguities in the drawings or specifications; or any errors or omissions in the layout as given by survey points and instructions shall be immediately reported to the engineer, in writing, who shall promptly verify and correct such inconsistencies or ambiguities in writing. Work performed by the contractor after such discovery, until authorized or corrected by the engineer, shall be done at the contractor's risk.

26.00 PERMITS AND EASEMENTS.

The Contractor shall be responsible for securing any and all access rights he may require for construction convenience with private individuals and landowners. The Contractor shall provide the Engineer evidence of agreements for such access rights. All other permits required should be secured prior to commencement of Work at the Contractor's own expense.

The successful Contractor will be required to obtain a City of Rifle Contractor's license for construction operation. Proof of insurance shall be required.

27.00 SUBSTITUTION OF MATERIALS.

At no time shall materials be substituted for those shown on the Drawings or called for in the Specifications unless written approval is obtained from the Engineer in writing prior to construction. Any deviation from the Drawings and Specifications shall be accompanied by a written directive of the Engineer or his representatives. (See Article 6, General Conditions).

28.00 CONTROLLED AREA OF WORK.

The Contractor shall confine all the construction work and all related activities to the public roadways, utility easements, or construction areas designated by the Engineer. Access and egress to the work area shall be minimized to specific points.

29.00 INTERPRETATION OF ESTIMATED QUANTITIES.

Bidders are cautioned that the estimated quantities in the Bid Schedule are approximate only and are prepared for the comparison of bids. The basic of payment will be actual quantities of work performed and accepted or as stated in the Measurement and Payment section of each specification section. Prior to mobilization the contractor shall present their verification of quantities and final work plan for all aspects of work.

30.00 TEMPORARY FACILITIES.

The Contractor, at his expense, shall provide all necessary temporary facilities for his own convenience or to meet local, state, or federal requirements, including, but not limited to, potable water, sanitary waste facilities, power, telephone, etc. (See Article 6, General Conditions).

31.00 CLEAN-UP.

The Contractor will be responsible for immediately cleaning the job site during and after construction. A continuing effort shall be made through the duration of the contract to keep all areas clean and free of all rubbish, removed vegetation, construction waste, employee waste, debris and other objectionable materials generated from the project. All materials as part of this work shall be disposed off site in an acceptable manner. Final clean-up must be approved and accepted by the Owner before the contract may be considered complete.

32.00 MEASUREMENTS AND PAYMENT.

Payment for work done shall be as defined in *Bid Schedule*. Payment shall be complete compensation for the work unit completed and shall consist of furnishing and installing all materials, plant, equipment, labor and other items related to the work unless otherwise specified. All incidentals not specifically mentioned, but required to complete the Work, shall be paid for as part of the Work unit they are related to. All bid items shall be measured and paid in accordance with the appropriate section of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction unless revised by the Standard or Project Special Provisions.

33.00 SUBMITTALS.

The Contractor shall submit submittal data, as defined in the General Requirements. Submittals shall be required on all items of the submittal schedule contained in the Technical Specifications. At a minimum, the Engineer will retain Two (2) sets, and the Owner One (1) and the approved or rejected copy returned to the contractor.

34.00 COMMUNICATION.

Project will demand the need for communication with properties impacted by work performed. The Contractor shall notify, twenty-four (24) hours in advance of work, all property owners that may be affected by his work. This notification shall include times and duration of access or traffic interruptions. Anticipated interruptions shall be discussed with the City representatives daily.

The purpose of public notification is to reasonably inform the public of the work and to allow the public to schedule activities that may be impacted by the work. Owner, through its Representative, may stop work not consistent with the schedules prepared by the Contractor, which in the opinion of the Owner causes unreasonable hardship to the public.

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Contractor shall designate an Information Coordinator who shall be on site during all work hours and shall be responsible for:

1. Preparing a weekly work schedule that includes planned type of work and areas affected by work. Once schedule is confirmed, the City shall prepare door hangars for the Contractor to distribute the week prior.
2. Communication with adjacent properties of any change to traffic control that may affect their access via written notice for residents. The Contractor is responsible for any follow-up communications with residents after the initial door hangars are provided.
3. Communication with the media or by other means as appropriate, planned/scheduled changes in traffic control and other items that will affect the public traveling through the site. Also communicate with emergency services as to location of work and impacts.
4. Coordinate performed work to be consistent with weekly work schedule.

35.00 PROJECT SIGN.

A standard traffic sign (Orange Diamond, for example) with "Thank you CONTRACTOR, Phone number" shall be placed at a noticeable location in the neighborhood. The Contractor may, if they so choose, place a sign during active construction for their company contact pending approval by City Staff.

End of Section

Technical Specifications

These Technical Specifications supplement the specifications provided in the City Of Rifle Public Works Manual. All provisions, which are not so amended or supplemented, remain in full force and effect.

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DIVISION 1 – GENERAL REQUIREMENTS

SECTION 010100 SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work covered by contract documents
- B. Work by others
- C. Contractor use of site and premises
- D. Work sequence
- E. Easements and right-of-way
- F. Protection of public and private property
- G. Maintenance of traffic
- H. Barricades and lights
- I. Lines and grades
- J. Regulatory requirements
- K. Cutting and patching

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work will include all necessary labor, supervision, equipment, tools and materials for the construction of a new lift station located at the existing south side. Work will include the construction of a new 100,000 gallon buried concrete wetwell, packaged lift station pump system including system enclosure and control panel, new electrical and controls implementation, and new buried piping between headworks channel, and existing buried force main piping.
- B. Contractor shall furnish and pay for all materials, equipment, supplies, appurtenances; provide all construction equipment and tools; and perform all necessary labor and supervision
- C. Contractor shall coordinate the progress of the Work including coordination between trades, subcontractors, suppliers, public utilities and subsequent water treatment plant contractor performing work on site and Owner to insure the progress of Work
- D. It is the intent of this contract that Work proceed in the most expeditious manner possible
- E. Construct the Work under contract indicated in the Bid Form
- F. The cross-referencing of specification sections under the heading "Related Sections" and elsewhere within each specification section is intended as an aid to the Contractor and shall not relieve the Contractor from his responsibility to coordinate the Work under the Contract Documents. Listings of cross-references are not intended to be

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comprehensive. The omission of a cross-reference to an additional or related requirement shall not relieve the Contractor of his obligation to provide a complete Project.

1.3 CONTRACTOR USE OF SITE AND PREMISES

- A. Contractor shall limit use of the premises for Work and will use the available staging area on site west of the existing pump station and north of the solar array for field offices, equipment, and material storage. These areas have been designated for contractor's use
- B. Coordinate use of premises under direction of Engineer and/or Owner
- C. Assume full responsibility for the protection and safekeeping of equipment and products stored on site under this Contract
- D. Contractor should plan for workdays, Monday through Friday, within the hours of 6:00 am to 7:00 pm. Other work hours and days may be allowed by City upon 48 hours written notice

1.4 OWNER USE OF SITE AND PREMISES

- A. Owner reserves the right to occupy areas of the site for maintenance so long as such occupancy, placement, and installation of equipment does not interfere with Work completion. Placement and installation of equipment and partial occupancy shall not establish acceptance of total Work.
- B. Owner shall coordinate with Contractor the entrance into work site for work performed under the Contract Documents to ensure Contractor's health and safety plans are followed
- C. Existing facility to remain operational during construction. All access maintained.

1.5 WORK SEQUENCE AND WORK RESTRICTIONS

- A. Coordinate construction schedule with the Owner.
- B. Provide open access for Owner to property at all times during construction. Maintain minimum width clearance for access of City and Contractor personnel and emergency vehicles at all times.
- C. Contractor shall submit a detailed CPM format schedule outlining all steps required to assure complete and satisfactory construction, testing, and startup of work in such a manner as to result in the least possible disruption to the operations and staff of the treatment facility and to allow the facility to achieve the finished water quality requirements established by regulations at all times. Address all work sequence and constraints described in this Section.
- D. Conduct work in a manner that will not impair the operational capabilities of essential elements of the existing treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quantity of raw water to the quality limitations required.
- E. Indicate required shutdowns of existing facilities or interruptions of existing operations on Progress Schedule. Shutdowns will be permitted to the extent that existing operation of the plant will not be jeopardized and identified constraints are satisfied.
- F. Existing water treatment plant is an operating treatment plant and must remain in operation during the contract period. Raw water pumping to remain in service during construction

1.6 EASEMENTS AND RIGHT-OF-WAY

- A. Construction access to the site is available only via the driveway off of Hwy 6
- B. Work will be performed on the Owner's property only

- C. Confine construction operations to the immediate vicinity of the location indicated on drawings and use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies, so as to cause the least possible damage to property
 - D. Construction Area Limits
 - 1. Confine construction operations to the immediate vicinity of the location indicated on Drawings and in accordance with the Owner
 - 2. Areas not designated for access roads, parking areas, storage areas, existing facilities areas, and construction areas, Contractor shall not trespass in or on these areas
 - a. Contractor shall be responsible for keeping all their personnel out of areas not designated for Contractor use except in case of isolated Work located within these areas for which the Contractor shall coordinate with Owner and shall not proceed with such work without Owner approval
 - 3. Contractor shall use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies, so as to cause the least possible damage to property outside the City property
 - a. Responsibility for protection and safekeeping of materials and equipment on or near the work site shall be entirely that of the Contractor and no claim shall be made against the Owner for any reason
 - b. If the Owner needs access to the sites occupied by stored materials or equipment, Contractor shall provide access
 - E. On Private Property
 - 1. Do not enter for material delivery or occupy for any purpose with personnel, tools, equipment, construction materials, or excavated materials, any private property outside the designated construction easement without written permission of the owner and tenant
- 1.7 PROTECTION OF PUBLIC AND PRIVATE PROPERTY
- A. Protect, shore, brace, support, and maintain underground conduits, drains, and other underground construction uncovered or otherwise affected by construction operations
 - B. Contractor shall be responsible for all damage to streets, roads, highways, shoulders, street lighting and/or signage, embankments, culverts, location or character, which may be caused by transporting equipment, materials, or personnel to or from the Work or any part or site thereof, whether by him or his subcontractors
 - C. Make satisfactory and acceptable arrangements with the Owner of, or the agency or authority having jurisdiction over, any damaged property concerning its repair or replacement or payment of costs incurred in connection with the damage
- 1.8 PROTECTION OF WORK AND FACILITIES
- A. Contractor shall be solely responsible for the protection of Work until final acceptance
 - B. Contractor shall protect all and any previously performed Work, work in progress or completed by others, and existing facilities from damage during the performance of Work in the area
- 1.9 MAINTENANCE OF TRAFFIC
- A. Conduct Work to interfere as little as possible with public travel, whether vehicular or pedestrian
 - 1. Whenever it is necessary to cross, close, or obstruct private roads, driveways, multi use paths, and walks, provide and maintain suitable and safe detours, or other temporary expedients for accommodation of private travel
 - a. Submit traffic control plans for work within right-of-ways for approval by City prior to commencing any work
 - 2. Maintenance of traffic is not required if Contractor obtains written permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at the designated point
- 1.10 BARRICADES AND LIGHTS
- A. Protect streets, roads, highways, and other public thoroughfares which are closed to traffic by effective barricades with acceptable warning and directional signs
 - B. Locate barricades at the street intersecting public thoroughfare on each side of the blocked section

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- C. Provide suitable barriers, signs, and lights to the extent required to adequately protect the public
- D. Provide similar warning signs and lights at obstructions such as material piles and equipment
- E. Illuminate barricades and obstructions with warning lights from sunset to sunrise
- F. Store materials and conduct work to cause the minimum obstruction to the other contracts
- G. Install and maintain barricades, signs, lights, and other protective devices in conformity with applicable statutory requirements including the Manual of Uniform Traffic Control Devices and as required by Garfield County

1.11 LINES, GRADES AND SURVEY

- A. Construct all Work to the lines, grades, and elevations indicated on the Drawings
 - 1. The Owner may employ a separate surveyor to perform a verification survey to check final layout and grades.
 - 2. Contractor is responsible for correcting all incorrect grades or grades not meeting specified tolerances
- B. Engineer has established basic horizontal and vertical control points in the Drawings
 - 1. Use these points as datum for the Work
 - 2. Provide such competent personnel and tool, stakes, and other materials as Engineer may require in establishing or designating control points, in establishing construction easement boundaries, or in checking layout survey, and measurement work performed by Contractor
- C. Provide all survey, layout, and measurement work required
 - 1. Work performed by a qualified professional engineer or registered land surveyor acceptable to Engineer
 - 2. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction
 - a. Make no changes or relocations without prior written notice to Engineer
 - b. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations
 - c. Require surveyor to replace Project control points which may be lost or destroyed
 - d. Establish replacements based on original survey control
 - 3. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means
 - a. Temporary project benchmark
 - b. Stakes for grading, fill and topsoil placement
 - c. Utility slopes and invert elevations
 - 4. From time to time, verify layouts by the same methods
 - 5. Maintain a complete, accurate log of all control and survey work as it progresses
 - 6. On request of Engineer, submit documentation to verify accuracy or field engineering work

1.12 REGULATORY REQUIREMENTS

- A. Comply with all federal, state, and local laws, regulations, codes, and ordinances applicable to the Work
- B. References in the Contract Document to local codes shall mean the codes in effect in the City and Garfield County according to the jurisdiction in which the Work is performed
- C. Other standards and codes which apply to the Work are designated in the specific technical specifications
- D. Comply with all requirements of the U.S. Army Corps of Engineers

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 012200 MEASUREMENT AND PAYMENT - UNIT PRICES

PART 1 GENERAL

1.1 SUMMARY

- A. This section describes the procedure for Application for Payment by the Contractor. This section establishes the basis of payment, application format, application content and application review process required by the Owner before they will process the application for actual payment.

1.2 FORMAT AND DATA REQUIRED

- A. Submit Applications for Payment and all other required forms and information to the Engineer.
- B. Provide itemized data on continuation sheets.
- C. Format, schedules, line items, and values: Those of the approved Schedule of Values.

1.3 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

- A. Prepare Application for Payment and all other required information to Engineer in accordance with terms and schedule established in the General Conditions, Supplemental General Conditions and the Agreement Between Owner and Contractor, or as otherwise negotiated between Owner and Contractor.
- B. Application Form
 - 1. Required information completed, including that for Change Orders executed prior to the date of submittal of application.
 - 2. Summary of dollar values to agree with the respective totals indicated on the continuation sheets.
- C. Continuation Sheets.
 - 1. Total list of all scheduled component items of Work, with item number and the scheduled dollar value for each item.
 - 2. Dollar value in each column for each scheduled line item when work has been performed.
 - 3. Each Change Order executed prior to the date of submission shall be listed at the end of the continuation sheets.
 - 4. List by Change Order number and description as for an original component item of work.
- D. Contractor shall execute certification with the signature of a responsible officer of the Contractor's firm.

1.4 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

- A. When Owner or Engineer requires substantiating data, Contractor shall submit suitable information with a cover letter identifying:

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1. Project name and number.
2. Application number and date.
3. Detailed list of enclosures.

B. Submit one (1) copy of data and cover letter for each copy of application.

1.5 SCHEDULE OF VALUES

- A. Refer to General Conditions for requirements.
- B. Where payment is to be based on unit bid prices, correlate Schedule of Values with bid items.
- C. Where payment is to be based on fixed price, correlate Schedule of Values with divisions and sections of specifications, unless otherwise approved by the Engineer.

1.6 PREPARATION OF APPLICATION FOR FINAL PAYMENT

- A. Contractor shall complete Application form as specified for progress payments.
- B. Continuation sheets used for presenting the final statement of accounting as specified in Section 01 70 00-Contract Closeout.

1.7 SUBMITTAL PROCEDURE

- A. Submit Application for Payment and all required information to Engineer for review in accordance with the established schedule. Application and all related forms shall be properly executed by signature of a responsible officer of the Contractor's firm.
- B. Engineer to review and verify Application for Payment within established schedule. Contractor shall make corrections noted by Engineer and re-submit three copies of Application to Engineer.
- C. When Engineer finds the Application complete and correct, Engineer will transmit two copies of the complete Application packet to Owner for processing.

1.8 BASIS OF PAYMENT

A. LUMP SUM PRICES

1. Where lump sum prices are given for a described portion of the work, that price shall cover all materials, equipment, and labor necessary to acquire, deliver, store and install that portion of the work, complete and in place, as shown and indicated in the drawings and as described in the Project Manual.
2. Quantities given in the bid form are estimates for the purpose of evaluating bids. Consequently, some differences may arise in actual and bid quantities.
3. Quantities given for lump sum items, including earthwork, are estimates only. The Contractor should satisfy himself as to the actual quantities required to complete the work described in the plans and these specifications. Unit costs for earthwork will not be employed to determine payment.

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B. UNIT PRICE BID ITEMS

1. Payment for work included in unit price bid items shall be based on the completed value of each unit in such quantity actually installed as measured and determined by the Engineer unless the approved Schedule of Values provides sufficient detail for measurement and payment of partial progress of work.
2. Unit pricing shall include all materials, equipment and labor necessary to complete the bid item as shown and indicated in the project documents.
3. Quantities given in the bid form are estimates for the purpose of evaluating bids. Consequently, some differences may arise in actual and bid quantities.
4. Contractor or Owner may request re-negotiation of Unit Price for an item if the actual field measured work done for that item differs from the estimated quantity by more than 50% under the following terms:
 - a) Contractor shall not make any claim for damages for any work item for which the actual field measurement does not differ from the estimated quantity by more than 50%, higher or lower.
 - b) Re-negotiated Unit Prices shall be based on actual costs to Contractor for the specific work item plus a reasonable allowance for overhead and profit.
 - c) Re-negotiating the Unit Price shall not increase or decrease the Unit Price by more than 10 percent.
 - d) Contractor shall submit to Owner satisfactory data substantiating the actual costs and overhead rate to perform the Work covered by the Unit Price being re-negotiated.
5. No payment will be made if the entire bid item is unused.

C. MINOR CONTRACT REVISIONS

1. If provided on the Bid Schedule, the Minor Contract Revisions line item is for the sole use of Owner at Owner's discretion for changes to the project.
2. The Contractor's shall include the dollar amount provided by the Owner for Minor Contract Revisions in his base bid total.
3. The intent of this line item is provide the Owner's designated project manager a mechanism to approve minor changes to the work, either from Contractor requested changes or from Owner modification, without unnecessary project delay and without further approval by the Owner.
4. The Owner shall retain all unused monies in this line item.
5. The Owner shall direct Contractor in writing when this line item is to be used along with the amount to be included in the Application for Payment.

1.9 BID ITEMS

Bid Item # 1 – Mobilization and Site Preparation

1. Description
 - a) Contractor to plan, organize, and develop scheduling, equipment purchases, prepare and submit submittals, and prepare site for work in any and all necessary ways.
 - b) Contractor prepare site for work including temporary facilities, utilities, road and access work, and staging areas.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all overhead, labor, and all other associated costs for Contractor to mobilize to site
2. Payment Basis
 - a) Lump Sum.

Bid Item # 2 – Traffic Control

1. Description
 - a) This line item is for the development of a traffic control plan and for all traffic control required during construction.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all overhead, labor, equipment, materials, incidentals, and all other associated costs for traffic control during all phases of construction.
 - b) Signage, cones, and all other materials should be included in this bid item.
 - c) The preparation, submission, and revision of a City approved Traffic Control Plan is required.
 - d) Plan shall meet requirements as described in City Public Works Manual.
3. Payment Basis
 - a) Lump Sum.

Bid Item # 3 – Erosion Control

1. Description
 - a) This line item is for the cost, installation, and removal of temporary erosion control measures in accordance with the City PW Manual.
 - b) This line item is for the material cost, installation, and removal of the vehicle tracking pads for the purpose of erosion control within the roadway.
 - c) This line item shall include the cost of reseeding, and replanting for permanent and temporary controls.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to install and remove erosion control measures.
 - b) This line item is for the material cost, installation, and removal of the vehicle tracking pad for the purpose of erosion control.
 - c) Erosion control shown on the drawings and around disturbed gardens, riverbank, and excavated pipe in floodplain area should be included in this item.
3. Payment Basis
 - a) Lump Sum

Bid Item # 4 – Construction Surveying

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1. Description
 - a) This line item is for construction surveying at all points throughout construction. This should include laying out the alignment, structures, and confirming depth and inverts in the field.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to verify location and elevation for all utilities which are to be abandoned and for installed utilities and grading.
3. Payment Basis
 - a) Lump sum.

Bid Item # 5 – Demolition and Removal of Structures

1. Description
 - a) This line item is for the removal of existing lift station equipment, and abandonment of the existing wetwell.
 - b) Removal of existing electrical equipment as needed.
 - c) Removal of all trees, shrubs, and bushes shown on drawings.
 - d) Removal of all infrastructure as noted on drawings.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all labor, materials and equipment involved with the removal of sewer manholes, sewer pipe, service connections, and storm sewer pipe in accordance with City of Rifle standards and details.
 - b) The rehabilitation of the surrounding surface with existing material or landscaping that may be.
 - c) Cost of hauling, landfill fees, and disposing of materials shall be included in bid number.
3. Payment Basis
 - a) Lump Sum

Bid Item # 6 – Influent Headworks Channel Modifications

1. Description
 - a) This line item is for the complete rehabilitation of the existing channel including by-pass pumping required during the work.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all labor, materials and equipment involved with installation of new piping connection to the concrete channel and removal of existing Parshall Flume and grout.
 - b) Cost shall include all concrete repair and cleaning.
 - c) Cost shall include by-pass pumping for the complete installation of the work, including cure time required by all specified products.
 - d) Cost shall include disposal and hauling of materials.
3. Payment Basis

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- a) Lump Sum

Bid Item # 7 – 15-in SDR 35 Gravity Pipe

1. Description
 - a) This line item is for the complete installation of all 15-inch gravity pipe.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to install the 15-inch gravity pipe.
 - b) Care should be taken not to disturb the concrete curb or sidewalk during work and any damage is at cost to the contractor to return to existing condition.
 - c) Cost shall include dust mitigation and worksite cleanliness in accordance with Town and District standards.
3. Payment Basis
 - a) 100 linear feet

Bid Item # 8 – 18-inch Gravity Pipe

1. Description
 - a) This line item is for the complete installation of all 18-inch gravity pipe.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to saw cut asphalt in preparation of full depth asphalt and subsurface removal.
 - b) Care should be taken not to disturb the concrete curb or sidewalk during work and any damage is at cost to the contractor to return to existing condition.
 - c) Cost shall include dust mitigation and worksite cleanliness in accordance with Town and District standards.
3. Payment Basis
 - a) 100 linear feet

Bid Item #9 – 8-inch HDPE Force Main

1. Description
 - a) This line item is for the complete installation of the 8-inch HDPE Force Main piping and all associated fittings, connections, and bedding and backfill work.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to excavate, prepare bedding and subgrade, and install the HDPE pipe.
 - b) Care should be taken not to keep all pipes operational during crossing. Cost shall include crossing flowfill as noted on drawings.
 - c) Cost shall include dust mitigation and worksite cleanliness in accordance with City standards.
3. Payment Basis
 - a) 150 linear feet

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Bid Item # 10 – 4FT Diameter Manhole

1. Description
 - a) This line item is for the two manholes on-site, and associated appurtenances in each.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to procure and install the two concrete manholes as shown on drawings.
 - b) Cost shall include all appurtenances, slide gates, actuator and operators under the lid as specified on drawings.
 - c) Cost shall include workmanship in accordance with City PW Manual.
3. Payment Basis
 - a) 1 – each

Bid Item # 11 – 6 FT Diameter Manhole

1. Description
 - a) This line item is for the one 6-foot diameter manhole on-site, and associated appurtenances in each.
2. Specific inclusions, exclusions, or special considerations
 - b) This line item shall include all costs for equipment, materials, incidentals, and labor to procure and install the two concrete manholes as shown on drawings.
 - c) Cost shall include all appurtenances, slide gates, hatch, actuator and operators under the lid as specified on drawings.
 - d) Cost shall include workmanship in accordance with City PW Manual.
3. Payment Basis
 - e) 1 - each

Bid Item # 12 – Buried 8-inch C900 DR 14 Pipe

1. Description
 - a) This line item is for the installation of C900 piping to connect from HDPE pipe to the existing force main piping as shown on the drawings in details.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all labor, materials and equipment involved with the installation and testing of the C900 pipe, fittings, gaskets, bolt kits, and hangers.
 - b) Cost shall include the protection of shallow utilities and verification of bury depth as needed and described elsewhere in the contract.
3. Payment Basis
 - a) 15 Linear Feet.

Bid Item # 13 – Interior 8 and 6 inch DIP

1. Description

- a) This line item is for ductile iron piping not included with the Gorman Rupp package plant to complete the installation of the lift station as shown on the drawings. This includes 8-inch and 6-inch DIP.
- 2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all overhead, labor, equipment, materials, incidentals, and all other associated costs for procuring, storing, and installing pipe per drawings.
 - b) Cost shall include all saddles, taps, and appurtenances as shown on drawings.
 - c) Cost shall include pipe supports.
 - d) Cost shall include pipe coating system.
 - e) Cost shall not include valves.
- 3. Payment Basis
 - b) Lump Sum.

Bid Item # 14 – Process Valves

- 1. Description
 - a) This line item is for the process valves included in the lift station not provided by Gorman Rupp. This includes, two plug valves, one butterfly, and smaller 1 and 2 inch valves for taps and sample lines.
- 2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all overhead, labor, equipment, materials, incidentals, and all other associated costs for procuring, storing, and installing valves.
 - b) Cost shall include all gaskets, bolt kits, and other necessary pieces to connect valves to piping as shown on drawings.
 - c) Cost shall include coating system.
- 3. Payment Basis
 - c) Lump Sum.

Bid Item # 15– Wetwell Slide Gates

- 1. Description
 - a) This line item is for the two slide gates separating the wetwell walls located on the interior of the wetwell and actuated by stem guides and nuts in the lift station.
- 2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all overhead, labor, equipment, materials, incidentals, and all other associated costs for procuring, storing, and installing gates and actuators.
 - b) Cost shall include all guides, stems, with appropriate WW compliant coatings as noted in specifications.
 - c) Cost shall include handwheel and actuation cover inside lift station.
- 3. Payment Basis
 - d) Lump Sum.

Bid Item # 16 – Packaged Lift Station

- 1. Description

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- a) This line item is for the specified Package Lift Station from Gorman Rupp. If substitutions are proposed, then this may modify this Bid Item inclusions and exclusions.
- 2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all overhead, labor, equipment, materials, incidentals, and all other associated costs for enclosure building, electrical panels, valves, appurtenances and other ancillary equipment as listed in Specification.
 - b) Cost shall include shipping, freight, start-up, and testing of the packaged plant.
 - c) Cost shall not include specific instrumentation and controls detailed in other Bid Items.
 - d) Cost shall include Gorman Rupp time on-site for start-up.
- 3. Payment Basis
 - e) Lump Sum

Bid Item # 17 – Electrical Power and Panels.

- 1. Description
 - a) This line item is for the conduit, wire, and power changes required at the site to power the new lift station.
- 2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to install necessary conduit, wiring, panels, and other associated equipment to bring power to the new lift station site.
 - f) This line item shall include all earthwork, bedding, backfill, and compaction work to install conduit.
 - g) This line item shall include any necessary work to keep the existing lift station online during construction of the new lift station, including temporary relocation of electrical utilities as needed.
- 3. Payment Basis
 - a) Lump Sum.

Bid Item # 18 – Instrumentation and Controls

- 1. Description
 - a) This line item is for the installation of all new instruments (level sensors, flow meters, pressure assemblies), and re-installation of existing instruments. Including wiring and programming back to new panels located at the new lift station.
- 2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to install the instruments and complete control wiring modifications.
 - b) This line item shall include all earthwork, bedding, backfill, and compaction work to complete the pipeline installation in accordance with the contract documents and the City of Rifle standards.
- 3. Payment Basis
 - c) Lump Sum

Bid Item # 19 – SCADA Programming and Start-Up

- | | | |
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| 1. Description | 22 05 29- | 04/2026 |
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- a) This line item is for SCADA programming and Lift Station Start-Up, to be completed in conjunction with Gorman Rupp representatives.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to safely disconnect existing sanitary sewer services from the existing sanitary sewer main and reconnect all services to the proposed sanitary sewer main. This includes any repair clamp, or other materials needed to repair the existing service if the pipe is clay.
 - b) It is possible that some service connections may not be 8 inch PVC SDR 35. The contractor must either provide all connection materials necessary to transition these services to the proposed sewer main or provide and install the pipe extension to match the existing service line material upon consultation with the Engineer.
 - c) This line item shall include all earthwork, excavation, backfill, bedding, and compaction work to complete the pipeline reconnection in accordance with Basalt Sanitation District standards and requirements.
3. Payment Basis
 - a) Lump Sum

Bid Item # 20 – Back-Up Generator

1. Description
 - a) This line item is for the proposed generator, generator pad, and all associated appurtenances and site work to install a functional Generator.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to pour the reinforced concrete pad for the generator, and conduit in pad as required by manufacturer.
 - b) This line item shall include all earthwork, subgrade preparation, bedding, backfill, and compaction work to complete conduit layout from generator to panels, and installation of ATS and associated mounting equipment.
 - c) This line item shall include delivery and placement of the generator on the pad.
 - d) This line item includes contractor time to commission the generator with generator manufacturer.
3. Payment Basis
 - a) Lump Sum.

Bid Item # 21 – Concrete wetwell

1. Description
 - a) This line item is for the complete installation of the concrete wetwell including all subgrade preparation, site work preparation, final grading, and concrete placement.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all labor, materials and equipment involved with pouring, testing, and curing of the concrete for the wetwell.
 - b) Cost shall include all walls, sloped floors, sumps work, and associated formwork to complete the wetwell per drawings.
 - c) Cost shall include all concrete curbs around hatches, grating, and manholes.
 - d) Cost shall include disposal and hauling of materials off-site for site preparation if necessary.
 - e) Cost shall include excavation work for preparation work.
 - f) Cost shall include dewatering of the hole for concrete placement, excavation, and safe working conditions.
 - g) Cost shall include final native material placement and grading prior to Hydro seeding.

3. Payment Basis
 - a) Lump Sum

Bid Item # 22 – Wetwell Appurtenances

1. Description
 - a) This line item is for all appurtenances associated with the wetwell including manhole lids, ladders, hatches, and pump out connections.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all overhead, labor, equipment, materials, incidentals, and all other associated costs for complete installation of these appurtenances.
 - b) Any necessary permitting, temporary power, or other measures needed for a fully operational by-pass system should be included in this cost.
 - c) By-pass pumping plan should be prepared and approved by the District and Town.
3. Payment Basis
 - h) Lump Sum

Bid Item # 23– Concrete Coating System

1. Description
 - a) This line item is for the complete installation of the specified coating system on the interior of the wetwell. This should include the proper preparation, cleaning, curing, and testing as required by the coating manufacturer.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all labor, materials and equipment involved with the complete installation of the coating system.
 - b) Coating system surface preparation shall be inspected and approved by a third party prior to placement.
 - c) All environmental conditions must be met for proper placement.
3. Payment Basis
 - a) Lump Sum

Bid Item # 24– Pipe Coating System

1. Description
 - a) This line item is for the complete installation of the specified coating system on the interior and buried piping as described in the specifications. This should include the proper preparation, cleaning, curing, and testing as required by the coating manufacturer.
2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all labor, materials and equipment involved with the complete installation of the coating system.
 - b) Coating system surface preparation shall be inspected and approved by a third party prior to placement.

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- c) All environmental conditions must be met for proper placement.
- 3. Payment Basis
 - a) Lump Sum

Bid Item # 25 – Hydro Seeding

- 1. Description
 - a) This line item is for all work related to restoring the site back to pre-construction conditions, including any topsoil placement and hydroseeding using CDOT dryland equivalent.
- 2. Specific inclusions, exclusions, or special considerations
 - a) This line item shall include all costs for equipment, materials, incidentals, and labor to restore the site to pre-construction conditions and fix any soil or drainage issues.
- 3. Payment Basis
 - a) Lump Sum.

Bid Item # 26 – Fence Relocation

- 1. Description
 - b) This line item is for all work related to relocating and replacing the fence as needed to meet site requirements and drawings.
- 2. Specific inclusions, exclusions, or special considerations
 - b) This line item shall include all costs for equipment, materials, incidentals, and labor to procure new fence, relocate existing usable fence, and install new fence as shown on drawings.
- 3. Payment Basis
 - b) Lump Sum.

END OF SECTION

SECTION 012900 PAYMENT PROCEDURES

- PART 1 GENERAL
 - 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.
 - B. This information is supplemental to the requirements as stated in the General Conditions.
 - 1.2 SUMMARY
 - A. This Section includes additional administrative and procedural requirements necessary to prepare and process Applications for Payment. Refer to General Conditions for most requirements of the Owner.

1. Schedule of Values assisting in processing Applications for Payment
2. Unit Prices for administrative requirements governing use of unit prices
3. Construction Progress Schedules

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 PROCEDURES FOR THE SCHEDULE OF VALUES

- A. Coordination: coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule and bid form.
 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets
 - b. Submittals Schedule
 - c. O&M Manuals Schedule
 2. Submit the Schedule of Values to Engineer at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment
 3. Sub-schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
 1. Identification: include the following Project identification on the Schedule of Values:
 - a. Project name and location
 - b. Name of Engineer
 - c. Engineer's project number.
 - d. Contractor's name and address
 - e. Date of submittal
 2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Change Orders (numbers) that affect value.
 - d. Dollar value.
 - e. Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
 6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
 9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders result in a change in the Contract Sum.

1.5 APPLICATION FOR PAYMENTS

- A. General
 - 1. Submit itemized payment request as required in General Conditions together with Schedule of Values and other submittals as specified herein
 - 2. Contractor shall not "project" work completed beyond the date of Application for Payment submittal for the purpose of payment request
- B. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.
 - 1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements
- C. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction Work covered by each Application or Payment is the period indicated in the Agreement
- D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
 - 2. Include amounts of Change Orders issued prior to the last day of the construction period covered by the application
- E. Transmittal
 - 1. Submit copy of each Application for Payment to the Engineer by means ensuring receipt within 24 hours
 - 2. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Engineer
- F. Initial Application for Payment
 - 1. Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:
 - a. List of subcontractors
 - b. List of principal suppliers and fabricators
 - c. Schedule of Values
 - d. Contractor's Construction Schedule (preliminary if not final)
 - e. Schedule of principal products
 - f. List of Contractor's staff assignments
 - g. Copies of building permits
 - h. Copies of authorizations and licenses from governing authorities for performance of the Work
 - i. Certificates of insurance and insurance policies
 - j. Performance and payment bonds, if required
- G. Application for Payment at Substantial Completion
 - 1. Following issuance of the Certificate of Substantial Completion, submit an Application for Payment. This application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of Work
 - a. Administrative actions and submittals that shall precede or coincide with this application include:
 - i) Occupancy permits and similar approvals
 - ii) Warranties (guarantees) and maintenance agreements
 - iii) Test/adjust/balance records
 - iv) Maintenance instructions
 - v) Meter readings
 - vi) Start-up performance reports
 - vii) Change-over information related to Owner's occupancy, use, operation and maintenance
 - viii) Final cleaning
 - ix) Application for reduction of retainage, and consent of surety
 - x) Advice on shifting insurance coverages
 - b. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion

- H. Application for Final Payment
 - 1. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.
 - 2. Application for Final Payment will not be considered until the following have been accomplished:
 - a. Completion of Project closeout requirements
 - b. Completion of items specified for completion after Substantial Completion
 - c. Assurance that unsettled claims will be settled
 - d. Assurance that Work not complete and accepted will be completed without undue delay
 - e. Transmittal of required Project construction records to Owner
 - f. Proof that taxes, fees and similar obligations have been paid
 - g. Removal of temporary facilities and services
 - h. Removal of surplus materials, rubbish and similar elements

1.6 PROCEDURES FOR THE CONSTRUCTION PROGRESS SCHEDULE

- A. Coordination: coordinate preparation and updates of Contractor's Construction Schedule with the preparation of Schedule of Values.
 - 1. Correlate line items in the Construction Schedule with required project tasks, including the following:
 - a. Mobilization/demobilization
 - b. Permits and regulatory requirements
 - c. Submittals
 - d. Equipment
 - e. O&M Manuals
 - f. Work breakdown of major project work
 - g. Major subcontractors work
 - h. Startup and commissioning
 - i. Training
 - j. Substantial completion
 - k. Final completion
 - l. Milestones and operational shutdown requirements
- B. Utilize the Critical Path Method (CPM) type construction schedule to establish preliminary progress schedule and track Work progress
 - 1. After acceptance by Engineer of preliminary Progress Schedule submitted per requirements of General Conditions, set preliminary Progress Schedule as the Construction Baseline Schedule
 - 2. Update and submit the construction progress schedule on a monthly basis with the pay application
 - a. Monthly submittal should indicate progress of tasks, changes to baseline schedule logic, work additions such as change orders, milestone and contract date changes
 - b. Submit two (2) color print copies, 11" x 17" size, and one Adobe pdf copy
 - c. Upon request provide copy of project schedule CPM data file

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 013100 CONSTRUCTION SCHEDULES

PART 1 GENERAL

1.01 SUMMARY

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- A. Within ten (10) days after EFFECTIVE DATE OF AGREEMENT or by the pre-construction conference, the Contractor shall submit a Critical Path Project Schedule covering the duration of the project, beginning with the Notice to Proceed and indicating Substantial Completion and "Contract Completion". The purpose of the Project Schedule shall be to:
1. Assure adequate planning, scheduling and reporting during the execution of the Work by the Contractor.
 2. Assure coordination of the Work of the Contractor and various Subcontractors at all tiers.
 3. Establish a critical path for the completion of the Work to assist the Contractor, Owner, and Engineer in monitoring the progress of the Work and evaluating proposed changes to the Contract Duration and the Project Schedules resulting from changes in the Work and/or potential weather delays.
 4. Assist in the coordination of construction activities so as to complete the Work within the Contract Time.
- B. The Project Schedule shall be based upon the Critical Path Method (CPM) for planning, scheduling and progress reporting of the Work.
- C. The Project Schedule shall include a graphic network prepared by the Contractor. The Contractor shall transmit all schedule submissions to the Owner or his representative as both a printed or plotted pure logic diagram and a bar chart with an accompanying computer disk of the schedule. The computer disk shall be in a file format published by Primavera Project Planner (Windows versions), Primavera Sure Trak, or Microsoft Projects.
- D. The Contractor shall provide a Network, which shall be a reasonable representation of how the Work is planned to be performed and shall be used to monitor the progress of the work of the Contract. All costs associated with the development and maintenance of the schedule shall be borne by the Contractor.

1.02 SCHEDULING

- A. The Contractor shall submit a preliminary Project Schedule as stated above. The Owner or his representative shall review the preliminary Project Schedule and return comments to the Contractor within ten (10) working days after receipt. The Contractor then shall have five (5) working days to review the schedule and return it to the Owner or his representative for review. The five (5) working day review and review cycles shall continue until an acceptable schedule is received by the Owner.

The owner's review of the project schedule is for compliance with this article and other contractor requirements. Acceptance by the owner of the contractor's project schedules does not relieve the contractor of any of his responsibility whatsoever for the accuracy or feasibility of the project schedule, or of the contractor's ability to meet the contract completion date, nor does such acceptance expressly or impliedly warrant, acknowledge or admit the reasonableness of the activities, logic, duration or, when included, cost loading of the contractor's project schedule. An approved schedule shall be required prior to submission of the first progress payment in accordance with the Contract Documents. The following guidelines must be met:

1. The Project Schedule shall contain a sufficient number of activities to allow effective monitoring of the progress of the work.
2. Each activity shall contain only the work of a single trade or subcontractor.
3. Each activity shall be less than fifteen (15) working days in duration. Procurement and material delivery, surveying and shop drawing approvals may exceed fifteen (15) working days in duration. Activities exceeding fifteen (15) working days in duration shall be separated into two or more individual activities of less than sixteen (16) working days by area, type of work, etc. to allow for effective monitoring of the Work.
4. Each activity shall include a description of the work, original duration, contractor or subcontractor

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performing the work, the equipment and manpower required to do the work, all specific area, phasing or milestone classifications and the activity's relationship to other activities (contained in the Methods Statement).

5. The Project Schedule shall begin with the Notice to Proceed and end with Contract completion activities. A critical path (zero float path) through Contract completion must be generated.
6. Normally anticipated weather conditions shall be included in the Project Schedule.
7. Anticipated utility relocation activities must be shown in the schedule as they affect the contractor's activities.
8. Failure by the Contractor to include any element of work required for performance of the Contract shall not excuse the Contractor from completing all work within the Contract Time.
9. Work times shall be included showing number of days per week, shifts per day and hours per shift.
10. The Project Schedule shall contain activities for the anticipated submittal cycle of equipment or materials that could affect timely completion of the project.
11. The schedule shall include activities for anticipated procurement and delivery of material or equipment with lead times greater than three (3) weeks.
12. The progress schedule shall include all activities for all work on the project, including subcontracted work, delivery dates for critical material, submittal and review periods, milestone requirements and no work periods. Where the project has specific phases, each phase shall be described separately for each salient feature.

1.03 PROJECT SCHEDULE UPDATES

- A. The Project Schedule updating shall be done on a monthly basis. The revision shall indicate actual progress to date, changes resulting from change orders, and planned changes necessary to complete the Work in accordance with the Contract Documents.
- B. Should the Project Schedule update indicate that the project is more than ten (10) days behind schedule it shall be revised to indicate the means which the Contractor shall use to regain the Contract Completion Date.
- C. Updating the Project Schedule to reflect actual progress made up to the date of a schedule update shall not be considered revisions to the Project Schedule.
- D. Failure by the Contractor to update the schedule shall result in a material breach of contract and will also result in the withholding of progress payments until an acceptable update is submitted by the Contractor and accepted by the Owner.

1.04 TIME IMPACT ANALYSIS FOR CHANGE ORDERS, DELAYS & CONTRACTOR REQUESTS

- A. When Change Orders are initiated or delays are experienced a Time Impact Analysis shall be completed to determine the effect on the Contract Completion Date. The durations of effected activities shall be altered as mutually agreed upon and the schedule recalculated. The Contract Completion Date will not be extended unless the schedule recalculation indicates a completion date beyond the current Contract Completion Date. A delay must impact the critical path of the Project Schedule as a condition to extending the Contract Completion Date.
- B. Delays caused by weather shall be reviewed at the monthly update meetings. Seasonal weather conditions shall be considered and included in the planning and scheduling of all work influenced by high or low ambient temperatures, wind, and/or precipitation to ensure completion of all work within the Contract Time. Seasonable weather conditions shall be determined by an assessment of average historical climatic conditions.
- C. Float is not for the exclusive use or benefit of either the Owner or the Contractor. Extension of the Contract

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Time will be granted only to the extent the equitable time adjustments to the activity or activities affected by the Change Order or delay exceeds the total (positive or zero) float of a critical activity (or path) and extends the Contract Time as set forth in the Contract.

1.05 SUBMITTALS

- A. Electronic copies of schedule are acceptable. Contractor to submit electronic copies to ENGINEER first for review.
- B. Distribution
 - 1. After review, ENGINEER will distribute electronic copies of schedule to:
 - a) One (1) copy to OWNER.
 - b) One (1) copy to Resident Project Representative.
 - c) One (1) copy to be retained in ENGINEER's file.
 - d) One (1) copy to CONTRACTOR to be kept on file at CONTRACTOR's field office.
 - e) Remainder to CONTRACTOR for his distribution following modifications if required.
- C. Schedule recipients will report promptly to ENGINEER and CONTRACTOR, in writing, any problems anticipated by the projections shown on the schedules.

END OF SECTION

SECTION 010350 MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. The Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on a JVA Field Order Form.
- B. The Contractor may request additional information or clarification by using and submitting a "Request for Information" (RFI).

1.3 WORK CHANGE DIRECTIVE (WCD)

- A. Owner-Initiated Work Change Directive: A written statement to the Contractor issued on or after the Effective Date of the Agreement and signed by the Owner and recommended by the Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be

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incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1. Within 7 days of receipt of a Work Change Directive Form, submit an estimate of cost necessary to execute the change to the Engineer for the Owner's review.
 - a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

1.4 CHANGE ORDER (CO)

- A. Owner-Initiated Change Order: The Engineer will issue a detailed Change Order Form indicating any changes in the Work that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 1. The Change Order Form issued by the Engineer is for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
 2. Within 7 days of receipt of a Change Order Form, submit an estimate of cost necessary to execute the change to the Engineer for the Owner's review.
 - a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.
- B. There will be no Contractor initiated Change Orders, the Contractor may only request additional information or clarification by using and submitting a "Request for Information" (RFI), on the Contractor's RFI form. Additional forms may be obtained from the Engineer, and Contractor-Initiated Proposals may also be provided.
- C. Upon the Owner's and the Engineer's approval and signature from the Contractor the Change Order Form becomes valid

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 010390 COORDINATION AND MEETINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General requirements
- B. Coordination
- C. Field engineering
- D. Alteration project procedures
- E. Preconstruction conference
- F. Progress meetings

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- G. Requests for information

1.2 RELATED SECTIONS

- A. Section 01010 – Summary of Work
- B. Section 01340 – Shop Drawings and Product Data
- C. Section 01700 – Contract Closeout

1.3 GENERAL REQUIREMENTS

- A. Refer to General Conditions for Owner meetings and other requirements
- B. Engineer will schedule and administer pre-construction meeting according to agenda
 1. Prepare agenda for meetings including items required by Owner and Contractor
 2. Notify Contractor and Owner 4 days in advance of meeting date
 3. Preside at meeting
- C. Contractor will schedule and administer site mobilization and weekly progress meetings. Contractor will also be responsible for coordination, field engineering, alteration, project procedures, cutting and patching procedures outlined herein. If work progress does not warrant a meeting, all parties can mutually agree to postpone meeting.
 1. Arrange for the attendance of Contractor's agents, employees, subcontractors, and suppliers as appropriate to the agenda
 2. Record the minutes; include all significant proceedings and decisions
 3. Reproduce and distribute copies of minutes within one week after each meeting
 - a. To all participants in the meetings
 - b. To Engineer
 - c. To Owner
 4. Owner and other inspecting parties such as the geotechnical engineer/technician as well as plant operators may attend meetings
 5. Engineer will attend weekly meetings either via phone or on site
- D. Representatives of contractors, subcontractors, and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents

1.4 COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various Sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later by others.
- B. Verify that utility requirement characteristics of operating equipment are compatible with available utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment, and coordinate preparation of grading and other requirements for installation utility work by others.
- C. Coordinate completion and clean-up of Work of separate Sections in preparation for final completion and for portions of Work designated for Owner's use
- D. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.5 FIELD ENGINEERING

- A. Employ a Land Surveyor registered in the State of Colorado and acceptable to the Engineer and Owner.
- B. Contractor will locate and protect survey control and reference points.
- C. Control datum for survey is that established by ~~22-05-29~~ provided survey and shown on Drawings.

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- D. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

1.6 ALTERATION PROJECT PROCEDURES

- A. Materials: As specified in product Sections; match existing products and work for patching and extending work.
- B. Where new work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent work in texture and appearance.
- C. When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer.
- D. Where a change of plane of 1/4-inch or more occurs, submit recommendation for providing a smooth transition for Engineer review.
- E. Patch or replace portions of existing surfaces, which are damaged, lifted, or showing other imperfections.
- F. Finish surfaces as specified in individual product sections.

1.7 PRECONSTRUCTION CONFERENCE

- A. Engineer will schedule a conference after Notice of Award
- B. Location: On site
- C. Attendance
 - 1. Owner's Representative
 - 2. Engineer and his professional consultants
 - 3. Geotechnical Engineer
 - 4. Contractor's Project Manager
 - 5. Contractor's Superintendent
 - 6. Major Subcontractors
 - 7. Others as Appropriate
- D. Agenda:
 - 1. Execution of Owner Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of subcontractors and suppliers, list of products, Schedule of Values, and Construction Project Schedule in critical path format.
 - 5. Designation of personnel representing the parties in Contractor, Owner, and the Engineer.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, cost proposal requests, Change Orders and Contract closeout procedures.
 - 7. Construction scheduling and updates.
 - 8. Scheduling activities of Geotechnical Engineer, equipment manufacturers representatives, and other field tests
 - 9. Critical work sequencing
 - 10. Major equipment deliveries and priorities
 - 11. Procedures for maintaining Record Documents
 - 12. Construction facilities, controls and construction aids
 - 13. Temporary utilities provided by Owner
 - 14. Safety and first-aid procedures
 - 15. Security and housekeeping procedures
 - 16. Procedures for testing

1.8 PROGRESS MEETINGS

- A. Contractor will schedule and administer meetings throughout progress of the Work at weekly intervals. If work progress does not warrant meeting, all parties can agree to postpone the weekly meeting.

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B. Location of the Meetings: The project field office of the Contractor, or other locations arranged for by Contractor, convenient to all parties

C. Contractor will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within one week to Contractor, Owner, participants, and those affected by decisions made.

D. Attendance

1. Owner's Representative
2. Engineer, and his professional consultants as needed
3. Contractor's Superintendent
4. Subcontractors as appropriate to the agenda
5. Suppliers as appropriate to the agenda
6. Others, as appropriate

E. Suggested Agenda

1. Review Minutes of Previous meetings
2. Review Unresolved issues from Last Meeting
3. Review of Work Progress
4. Field Observations, Problems, Conflicts and Decisions
5. RFI Review
6. Review of Submittals Schedule and Status of Submittals
7. Schedule
 - a. General Schedule Issues
 - b. Review of off-site fabrication and delivery schedules
 - c. Planned progress during succeeding work period (3-week "Look ahead")
 - d. Maintenance of construction project schedule
 - e. Corrective measures to regain project schedules
8. Maintenance of Quality and Work Standards
9. Change Orders
10. New PR's
11. Accepted Change Orders
12. Pay Requests
13. Other Business

1.9 REQUESTS FOR INFORMATION (RFI)

A. The Contractor shall prepare and submit an RFI upon the discovery of the need for interpretation of the Contract Documents or additional information.

1. Only the Contractor shall submit RFIs to the Engineer.
2. RFIs shall be submitted on Engineer's RFI form. Engineer will provide a template for the Contractor upon request.

B. RFI shall include:

1. Project Name
2. Engineer Job Number
3. Date
4. Name of Contractor
5. Name of Engineer
6. RFI number, numbered sequentially
7. Related specification section number, title, and related paragraphs, as needed
8. Drawing number and detail references, as needed
9. Field conditions
10. Contractor's proposed solution. If the Contractor's solution(s) affect contract times or contract price, Contractor shall state the effects on the RFI.
11. Contractor's signature
12. Relevant attachments including but not limited to drawings, descriptions, measurements, photos, product data, and shop drawings

C. Electronically Submitted RFIs

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1. Contractor shall submit one (1) complete RFI file in Adobe Acrobat PDF format

D. Engineer's Response

1. Engineer will review each RFI, determine action required, and respond.
2. Engineer will review and respond to each RFI within seven (7) working days
3. If Engineer receives an RFI after 1:00 P.M. local time, the RFI will be considered as received the following working day.
4. Engineer will not respond to RFIs requesting approval of submittals, approval of substitutions, coordination and information already indicated in Contract Documents, adjustment in contract time or contract amount, or erroneous RFIs.
5. Engineer may respond to RFIs on related issues with a single response.
6. If Engineer requests additional information as a result of the RFI, any further action or RFIs submitted by the Contractor will restart a new seven (7) day review period.
7. Contractor shall submit any request for change of contract time or contract price utilizing proper Change Order forms.

E. Contractor shall log and track all RFIs submitted organized by RFI number.

1. RFI log shall be submitted at each progress meeting
2. RFI log shall include:
 - a. Project name
 - b. Name, address, and phone number of Contractor
 - c. Contractor representative name
 - d. RFI number
 - e. RFI description
 - f. RFI submittal date
 - g. RFI response date
 - h. Related Change Order number, as needed

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 013400 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submission of all shop drawings and product data as required by the Contract Documents for all equipment and materials to be furnished under this contract unless specifically indicated otherwise

1.2 RELATED SECTIONS

- A. Section 01600 – Materials and Equipment
- B. Section 01730 – Operations and Maintenance Data
- C. Specification Divisions 2 thru 11

1.3 SUBMITTALS

- A. Definitions

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1. Technical submittals: Shop drawings, product data and samples prepared by Contractor, subcontractors, suppliers, or manufacturers
 - a. Shall be submitted by the Contractor to Engineer for approval for the use of Equipment and Materials to complete the Work or as needed to describe the following:
 - i) Operation and maintenance
 - ii) Technical properties
 - iii) Installation
 - b. Shop drawings: Custom prepared data for the Project and Work including performance and capacity curves, diagrams, bills of material, instructions, and other information
 - c. Product data: Non-custom prepared printed information for the Project and Work on materials and products
 - d. Samples: Fabricated and non-fabricated tangible samples of products and material
 - i) Used for visual inspection and testing and analysis
 2. Informational submittals: Reports, administrative informational submittals, certification and guarantees not including and defined as shop drawings, samples and product data
 - a. Reports: Include laboratory reports and tests, technical procedures and records and design analysis
 - b. Administrative informational submittals: Submittals necessary for administrative records such as construction photographs, work records, schedules, standards, record project data, safety data, and similar information submittals
 - c. Certification: Includes manufacturer or supplier certificates and guarantees
- B. General Requirements
1. Quality
 - a. Shall be of suitable quality for legibility and reproduction purposes
 - b. Shall be useable for reproduction yielding legible hard copy
 - c. Submittals not conforming to specified requirements herein and as specified in Divisions 2 through 16 shall be subject to rejection by Engineer and upon Engineer request, Contractor shall resubmit documents that are in conformance
 2. Dimensions
 - a. English units shall be provided on submittals
 - b. Metric units are acceptable in addition to English units
 - c. English units shall govern
 3. Form of submittals
 - a. Submittals shall be transmitted in electronic format as specified herein
 - b. Scanned submittals are acceptable
 - c. Electronic project documents and submittals shall be transmitted in the following format:
 - i) Native electronic format, nonproprietary
 - ii) Adobe PDF produced from native electronic format
 - d. Filename:
 - i) Shall be consistent for the initial and any subsequent submission revisions for a single submittal
 - ii) Contractor shall use a consistent naming convention for all submittals
 - a) Use number of original submittal followed directly by a capital letter corresponding to the number of times a submittal is resubmitted (i.e., #001, #001A, #001B, etc.)
 4. Non-conforming submittals shall be subject to rejection by Owner and/or Engineer
 5. Submittal completion requirements
 - a. Submittals shall include design criteria, dimensions, construction materials and all other information specified for a complete submittal to facilitate Engineer review of the submittal information adequately
 - b. In the event various drawings are included a submittal for a class of Equipment, Contractor shall annotate clearly which parts apply to furnished Equipment
 - i) Information not pertaining to the submittal shall be clearly annotated. Highlighting of such information will cause rejection of the submittal by the Engineer
 - c. Contract Drawings
 - i) Copies or portions thereof will not be allowed as acceptable fabrication or erection drawings
 - ii) In the event Contract Drawings are used by the Engineer for erection drawings to annotate information on erection or identify reference details, Engineer title block and professional seal shall be removed and replaced with the Contractor's title block on the Contract Drawing(s). Contractor shall revise such erection drawings for subsequent revisions by the Engineer to Contract Drawings
- C. Preparation
1. Shop Drawings

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- a. Drawings shall be presented in a clear and thorough manner:
 - b. Identify details by reference to sheet and detail, schedule or room numbers shown on Contract Drawings
 - c. Identify equipment by reference to equipment name and tag number shown on Contract Drawings
 - d. Scale and Measurements: Make drawings accurate to a scale with sufficient detail to show the kind, size, arrangement and function of component materials and devices
 - e. Minimum sheet size: 8.5" by 11"
 - f. Fabrication drawing size: 11" by 17" or 24" by 36"
 - 2. Product Data
 - a. Clearly mark each copy to identify pertinent products or models submitted for review
 - b. Identify equipment by reference to equipment name and P&ID number
 - c. Catalog cut sheets: Cross-out or hatch irrelevant data
- D. Technical Submittals: Shop Drawings and Product Data Submittal Requirements
1. Shop Drawings and Product Data shall include the following, at a minimum:
 - a. Specifications of manufacturer(s)
 - b. Equipment parts and catalogs
 - c. Bills of materials, material lists, and schedules
 - d. Shop erection and fabrication drawings
 - e. Drawings shall include equipment dimensions, weights, installation location requirements, plates required, main components, support details, anchor bolt details/sizes/locations, support base sizes, baseplate sizes, spacing and clearance requirements for installation, erection, operation and maintenance disassembly
 - f. Electrical requirements:
 - i) Shall include schematic diagrams including one-line diagrams, terminal block numbers, internal wiring diagrams, external connections, controls, and any other information as requested in individual specification sections
 - g. List of spare parts
 - h. Instruction and Operation and Maintenance (O&M) manuals
 - i) As specified herein and in Specification Section 01730
 - i. Manufacturer's performance testing of equipment
 - j. Concrete mix design data and information
 - k. Performance characteristics and capacities
 - l. External connections, anchorages, and supports required
 - m. Other drawings, parts, catalogs, specifications, samples, or data necessary for the Engineer to determine conformance with Contract Documents
 2. Samples – Office samples shall be of sufficient size and quantity to clearly illustrate:
 - a. Functional characteristics of the product, with integrally related parts and attachment devices
 - b. Full range of color, texture and pattern
 - c. Comply with requirements identified in individual specification sections
- E. Construction Schedule: Designate in the construction schedule, or in a separate coordinated shop drawing schedule, the dates for submission and the dates that reviewed Shop Drawings and Product Data will be needed, if accelerated review is requested
- 1.4 CONTRACTOR RESPONSIBILITIES
- A. Review shop drawings and product data prior to submission for accuracy and completeness of each submission
 - B. Approve and stamp each submission before submitting to Engineer
 - C. Determine and verify:
 1. Field measurements
 2. Field construction criteria
 3. Catalog numbers and similar data
 4. Conformance with specifications and identification of all deviations
 5. Confirm assignment of unit responsibility
 - D. Prior to each submission, carefully review and coordinate all aspects of each item being submitted

- E. Verify that each item and the corresponding submittal conform in all respects with specified requirements of the Work and of the Contract Documents with respect to means, methods, techniques, sequences, and operations of construction, and safety precautions and programs incidental thereto
- F. Make submissions promptly in accordance with Construction Schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor
- G. Limit requirement for accelerated submittal review by Engineer to no more than 10% percent of total number of submittals
 - 1. Accelerated submittal review period: less than 14 calendar days
- H. Notify Engineer in writing, at time of submission, of any deviations in the submittals from Contract Document requirements:
 - 1. Identify and tabulate all deviations in transmittal letter
 - 2. Indicate essential details of all changes proposed, including modifications to other facilities that may be a result of the deviation
 - 3. Include required piping and wiring diagrams

1.5 SUBMISSION REQUIREMENTS

- A. Make submissions far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmissions, and for placing orders and securing delivery
- B. In scheduling, allow fourteen (14) calendar days for review by Engineer following receipt of submission in Engineer's office:
 - 1. Time required to mail submissions or resubmissions is not considered a part of review period
- C. Submittal Naming and Numbering
 - 1. Assign a unique number to include all shop drawings, product data and other information required for individual specification sections, beginning with #001.
 - 2. Resubmissions shall have the original number with a letter, starting with "A". If the first submittal required resubmission, it would be labeled #001A.
 - 3. Each specification section may still have more than one submittal number for later submissions (i.e., Preliminary O&M Manuals, Final O&M Manuals, etc.)
 - 4. Contractor shall use a consistent naming convention for all submittals
- D. Quantity of Submittals Required
 - 1. Shop Drawings and Product Data:
 - a. Initial submittal:
 - i) Electronic – One (1) copy to Engineer
 - b. Resubmittal:
 - i) Electronic – One (1) copy to Engineer
 - c. Final Submittal for Distribution
 - i) One (1) electronic copy to Engineer
 - d. As -constructed document submittals
 - i) Electronic – One (1) copy to Engineer and one (1) copy to Owner
 - 2. Samples
 - a. Initial submittal:
 - i) Submit three (3) of each sample unless specified otherwise in individual specification section
 - b. Resubmittal:
 - i) Submit three (3) to Engineer
 - c. One (1) sample of approved sample submittal will be returned to Contractor
 - 3. Informational submittals
 - a. Technical reports and administrative submittals
 - i) Electronic – One (1) copy to Engineer
 - ii) Paper: Three (3) copies to Engineer
 - b. Certificates and guarantees:
 - i) Electronic – One (1) copy to Engineer
 - ii) Paper: Three (3) copies to Engineer

- c. Test reports
 - i) Paper
 - a) Owner: Two (2) copies
 - b) Engineer: One (1) copy
 - c) Contractor: Two (2) copies
 - d) Manufacturer/supplier: One (1) copy
 - 4. Instruction and O&M manuals
 - a. In accordance to Specification Section 01730
 - 5. At no additional cost to the Owner and whether or not submittals are copyrighted, the Owner may copy and use for staff training and/or internal operations any submittals approved for final distribution as well as required by this Contract
- E. Submittal Transmittal Requirements
- 1. Accompany each submittal with a letter of transmittal showing all information required for identification and checking
 - 2. Shall include:
 - a. Drawing numbers and titles
 - b. Revision number
 - c. Electronic filename
 - d. Deviations from Contract Documents: As specified herein
 - e. Submittals unidentifiable will be returned for proper identification
 - f. Date
- F. Submittals Requirements
- 1. Submittal number
 - 2. Date of submission and dates of any previous submissions
 - 3. Project title and number
 - 4. Owner Contract identification number if applicable
 - 5. Names of:
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
 - 6. Identification of the product, with the specification section number
 - 7. Field dimensions, clearly identified as such
 - 8. Relation to adjacent or critical features of the Work or materials
 - 9. Applicable standards, such as ASTM or Federal Specification numbers
 - 10. Identification of deviations from Contract Documents:
 - a. If Contractor proposes to provide material or equipment of Work which deviates from the Project Manual, Contractor shall indicate so under "deviations" on the transmittal form accompanying the submittal copies
 - b. Identify all requested deviations as specified and on the copies of Specifications and Drawings required by paragraph below.
 - 11. Confirmation of compliance with Contract Documents and, if applicable, identification of deviations from Contract Documents:
 - a. Provide the following documents to demonstrate compliance with the contract specifications:
 - i) A copy of the relevant Drawing(s) with all addendum updates that apply to the equipment in various Divisions marked to show specific changes necessary for the equipment proposed in the Contractor's submittal
 - a) If no changes are required, the Drawing(s) shall be clearly marked "No Changes Required"
 - b) Failure to include copies of relevant Drawing(s) with the submittal, whether changes are required or not, shall be cause for rejection of the entire submittal with no further review by Engineer
 - c) Relevant Drawing(s) include as a minimum the control diagrams, process and instrumentation diagrams (P&IDs), and Process (P) drawings.
 - ii) A copy of each pertinent specification section with all addendum updates included, all referenced and applicable specifications sections, with their respective addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate the requested deviations from the specification requirements:
 - a) If deviations from the specifications are indicated and, therefore requested, by the Contractor, the submittal shall be accompanied by a detailed, written justification for each deviation

- b) Failure to include a copy of the marked up specification sections, along with justification for any requested deviations to the specification requirements, with the submittal shall be cause for rejection of the entire submittal with no further review by Engineer
- 12. Identification of revisions on resubmissions
- 13. An 8" by 4" blank space for Contractor's and Engineer's stamps
- 14. Stamp cover sheet of each submittal as identified in letter of transmittal
- 15. Contractor's stamp: Initialed or signed, certifying review and approval of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents. Use stamp to include wording similar to the following:

This submittal has been reviewed by [Name of Contractor] and approved with respect to the means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incidental thereto. [Name of Contractor] also warrants that this submittal complies with contract documents and comprises no deviations thereto:

Section No: _____ Submittal No: _____

Date: _____ By: _____

- G. For equipment that is provided directly by manufacturer without specification provide:
 - 1. Shop drawings: Illustrate complete assembly of products; foundation, installation and anchor requirements; dimensions and total weights of each, electrical wiring diagrams
 - 2. Product data: Provide manufacturer's literature including general assembly, materials of construction, model and type, detailed data describing parts and accessories, sufficient data to verify compliance with specifications
 - 3. Manufacturer's installation instructions: Provide detailed connection requirements and startup instructions
 - 4. Manufacturer's field report: Indicate personnel present and actual start-up procedures that were performed by manufacturer's representative
 - 5. Field report and test results shall be submitted to the Engineer by the Contractor
 - H. Submittal Log:
 - 1. Maintain an accurate submittal log for duration of the Work showing current status of all submissions
 - 2. Show submittal number, section number, section title, submittal description, dates and disposition of submittal
 - 3. Make submittal log available to Engineer for Engineer's review upon request
 - I. Unless specified otherwise, make submissions in groups to facilitate efficient review and approval:
 - 1. Include all associated items from individual specification sections to assure that all information is available for checking each item when it is received
 - 2. Submit a complete initial submittal including all components when an item consists of components from several sources
 - 3. Partial submittals may be rejected as not complying with provisions of the Contract
 - 4. Engineer will not be held liable for delays due to poorly organized or incomplete submissions
 - 5. Do not include items from more than one specification section for any one submittal number
 - J. Contractor may require subcontractors to provide drawings, setting diagrams and similar information to help coordinate the Work, but such data shall remain between Contractor and his subcontractors and will not be reviewed by Engineer unless specifically called for within the Contract Documents
 - K. All submittals for each component of multi-component systems shall be compiled and submitted through the Contractor to the Engineer by the manufacturer having System Responsibility
- 1.6 DISPOSITION OF SHOP DRAWINGS, PRODUCT DATA, AND INFORMATION SUBMITTALS
- A. "No Exceptions Taken": Approved with No Corrections Noted
 - 1. One copy sent to Owner
 - 2. One copy sent to Resident Project Representative
 - 3. One copy retained in Engineer's file

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4. Remaining copies returned to Contractor for his use
 - a. One copy to be kept on file at Contractor's office at job site
 - b. Remaining copies for Contractor's office file, suppliers, or subcontractors
 5. No corrections or comments noted on the submittal or on a Submittal Response Summary Sheet
 6. Issues or miscellaneous comments pertaining to other related items of the Work may be included in transmittal letter
 7. Resubmission not required
- B. "Exceptions Noted": Approved with Corrections Noted
1. One copy sent to Owner
 2. One copy sent to Resident Project Representative
 3. One copy retained in Engineer's file
 4. Remaining copies returned to Contractor for his use
 - a. One copy to be kept on file at Contractor's office at job site
 - b. Remaining copies for Contractor's office file, suppliers or subcontractors
 - c. Copies of submittal data in operation and maintenance manuals to be revised according to corrections
 5. Comply with corrections or comments as noted on the submittal or on a Submittal Response Summary Sheet
 6. Resubmission not required
- C. "Revise And Resubmit": Incorrect information provided or Significant Information Still Required
1. One copy sent to Resident Project Representative
 2. One copy retained in Engineer's file
 3. All remaining copies returned to Contractor for revision and re-submittal
 4. Copy of transmittal letter and/or Submittal Response Summary Sheet sent to Owner. A "No Exceptions Taken" or "Exceptions Noted" submittal it will be forwarded to Owner after review per above disposition requirements
 5. Submittal is either: incorrectly annotated; specific comments need to be addressed and incorporated in re-submittal; and/or additional information may be required as noted on the submittal or on a Submittal Response Summary Sheet
 6. Submitted information may not include or address specific item required per the specification as identified on the submittal or on a Submittal Response Summary Sheet
 7. Specific information related to identified item may be required for final approval of submittal
 8. Resubmission of entire submittal may be required or resubmission of specific item may be required as identified on the submittal or on a Submittal Response Summary Sheet
- D. "Rejected": Returned for Correction
1. One copy sent to Resident Project Representative
 2. One copy retained in Engineer's file
 3. All remaining copies returned to Contractor
 4. Copy of transmittal letter and/or Submittal Response sent to Owner
 5. Contractor required to resubmit complete submittal package in accordance with Contract Documents
 6. Submittal does not comply with provisions of Contract Documents as noted on the submittal or on a Submittal Response Summary Sheet
 7. Resubmission required
- E. "Receipt Acknowledged": For Reference Purposes Only, or for Record Copy:
1. Applicable to manufacturer or Contractor provided calculations and other miscellaneous documentation no subject to Engineer review and approval
 2. One copy sent to Resident Project Representative
 3. One copy retained in Engineer's file
 4. One copy returned to Contractor
 5. Copy of transmittal letter sent to Owner
 6. Remaining submittal copies destroyed
 7. Detailed review and comment by Engineer not required
 8. Resubmission not required

1.7 DISPOSITION OF SAMPLES

- A. "No Exceptions Taken": Approved with No Corrections Noted
1. One sample sent to Owner

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2. One sample sent to Resident Project Representative
3. One sample retained in Engineer's file
4. Acknowledgement: Copy of transmittal letter sent to Contractor
5. Resubmission not required

- B. "Exceptions Noted": Approved with Corrections Noted
1. One sample sent to Owner
 2. One sample sent to Resident Project Representative
 3. One sample retained in Engineer's file
 4. Acknowledgement: Copy of transmittal letter sent to Contractor
 5. Work performed or products furnished to comply with exceptions noted in acknowledgement
 6. Resubmission not required

- C. "Rejected": Returned for Correction
1. One sample retained in Engineer's file
 2. Remaining samples sent to Contractor for resubmittal and compliance with the Contract Documents as noted in transmittal letter
 3. Copy of transmittal letter sent to Owner
 4. Resubmission required

1.8 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in submittals required by Engineer and resubmit until approved
- B. Transmit each resubmission under new letter of transmittal. Use number of original submittal followed directly by a capital letter corresponding to the number of times a submittal is resubmitted (i.e., #001, #001A, #001B, etc.)
- C. Shop Drawings and Product Data
1. Revise initial drawings or data and resubmit as specified for the initial submittal
 2. Indicate any changes which have been made other than those requested by Engineer
- D. Samples: Submit new samples as required for initial submittal
- E. Reimbursement of Resubmission Review Costs:
1. Review of first submittal and one resubmittal will be performed by Engineer at no cost to Contractor
 2. Cost for review of subsequent resubmissions will be directly paid by Contractor
 3. Engineer will document work-hours required for review and costs for Engineer review will be deducted from payments due Contractor as Change Order deducts
 4. Charges for review of resubmissions will include Engineer at maximum rate of \$150 per hour and administrative staff at maximum rate of \$75 per hour

1.9 PROJECT RECORD SUBMITTALS

- A. After completion of the Work and prior to final payment, Contractor shall furnish record documents and final approved shop drawings and samples (as-constructed shop drawings and samples) in the number of copies specified herein.
1. Contractor shall provide additional copies of final approved shop drawings and samples for insertion in Equipment instruction and O&M manuals as required
 2. All copies shall be clearly marked "Project Record"

1.10 ENGINEER'S DUTIES

- A. Review submittals with reasonable promptness and in accordance with approved submission schedule provided that each submittal has been called for by the Contract Documents and is stamped by Contractor as indicated above
1. No extensions of time are allowed due to Engineer's delay in reviewing submittals unless all the following criteria are met:
 - a. Contractor has notified Engineer in writing that timely review of particular submittal in question is critical to the progress of the Work and Contractor has identified the requested submittal return date.
 - b. Engineer has failed to return submittal within 21 days of receipt of the submittal or receipt of said notice, whichever is later

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- c. Contractor demonstrates that delay in progress of the Work was directly attributable to Engineer's failure to return submittal within 21 days
 - 2. No extensions of time are allowed due to delays in progress of the Work caused by rejection and subsequent resubmission of data, including multiple resubmissions
 - 3. Engineer's review shall not extend to means, methods, techniques, sequences, construction operations, and safety precautions and programs incidental thereto. No information regarding these items will be reviewed whether or not included in submittals
 - 4. In the event that Engineer will require more than 21 calendar days to perform review, Engineer shall so notify Contractor
- B. Review drawings and data submitted only for general conformity with Contract Documents
- 1. Engineer's review of drawings and data returned marked No Exceptions Taken or Exceptions Noted does not indicate a thorough review of all dimensions, quantities, and details of material, equipment device or items shown
 - 2. Engineer's review does not relieve Contractor of responsibility for errors, omissions or deviations nor responsibility for compliance with the Contract Documents
- C. Assume that no shop drawing or related submittal comprises a deviation to the Contract Documents unless Contractor advises Engineer otherwise in writing which is acknowledged by Engineer in writing:
- 1. Consider and review only those deviations from the Contract Documents clearly identified as such on the submittal and tabulated on the Contractor's transmittal sheet.
- D. Review informational submittals for indications of Work or Material deficiencies and will respond to Contractor regarding such deficiencies
- E. Return submittals to Contractor for distribution or for resubmission
- F. Transmit, unreviewed, to Contractor all copies of submittals received directly from suppliers, manufacturers and subcontractors
- G. Transmit, unreviewed, to Contractor all copies of submittals not called for by the Contract Documents or which have not been approved by Contractor
- H. Engineer will not review uncalled-for shop drawings or product data except by special arrangement
- I. Affix stamp and indicate approval for submittal or resubmission requirements.

1.11 SUBMITTAL SCHEDULE

- A. Unless indicated otherwise, provide all submittals required by individual sections of the Contract Documents to establish compliance with the specified requirements.
- B. Contractor to produce schedule of submittals for Engineer review

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 013800 CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Construction record photographs prior to commencing and during the course of the Work

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1.2 RELATED SECTIONS

- A. Section 01010 – Summary of Work
- B. Section 01700 – Contract Closeout: Project Record Documents

1.3 PHOTOGRAPHY REQUIRED

- A. Take photographs of the existing conditions prior to commencing work to document existing conditions
- B. Take photographs on the date on which each scheduled Application for Payment is due. Intent is for digital photos to be kept as project record
- C. CD of Digital photos become the property of Owner

1.4 COSTS OF PHOTOGRAPHY

- A. Pay all costs for specified photography and printing
 - 1. Parties requiring additional photography or prints will pay for them directly

1.5 DELIVERY OF PHOTOS

- A. Submit digital photos to the Engineer with monthly pay requests or within 20 days of photo date

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 TECHNIQUE

- A. Factual Presentation
- B. Correct Exposure and Focus
 - 1. High resolution and sharpness
 - 2. Maximum depth-of-field
 - 3. Minimum distortion

3.2 VIEWS REQUIRED

- A. Photograph from locations to adequately illustrate the condition of construction and the state of the Project
 - 1. Photographic survey of the existing site
 - a. Show all areas to be modified
 - b. Show all areas in which Contractor will conduct operations or store equipment
 - 2. Weekly photographs
 - a. Minimum of eight (8) views weekly until final acceptance
 - b. Views as designated by the Engineer or Owner

3.3 PHOTOGRAPH REQUIREMENTS FOR PROGRESS SITE PHOTOGRAPHS

- A. Responsibility
 - 1. Site photographs for Owner record of construction progress shall be the responsibility of the Contractor
 - 2. Contractor shall be responsible for site photographs including the existing and progress of Work
- B. Photographs shall include, but not limited to, the following:
 - 1. Existing site: Photographs of existing site conditions before site work commences
 - a. Number of views shall be sufficient to cover the existing site conditions

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- 2. Progress of work: Shall include photographs from clearing throughout construction
 - a. Number of views shall be sufficient to cover progress in Work and shall include a minimum of eight (8) different views
 - 3. After completion of Work: Shall be sufficient to show completed and finished Work
- C. Digital images
- 1. Provide images in uncompressed JPEG format
 - 2. Minimum resolution: 1500 x 2200
 - 3. Submitted digital images shall not be cropped
- D. Identify each digital image file
- 1. Name of project
 - 2. Orientation and description of view
 - 3. Date and time of exposure
- 3.4 ADDITIONAL PHOTOGRAPHS
- A. Contractor shall provide additional photographs upon the request of the Engineer
- B. Additional photographs may include, but not limited to, the following:
- 1. Publicity photographs
 - 2. Special events at Project site
 - 3. Major phase of Work
 - 4. Substantial Completion
 - 5. Follow-up investigations for on-site events such as construction damage or losses
 - 6. Additional record photographs during final acceptance
- 3.5 PROJECT RECORD
- A. Submit CD of all photos, grouped by date
- B. Engineer will distribute, after review
- 1. One copy of each view to Owner
 - 2. One copy of each view to Engineer's file
 - 3. One copy of each view returned to Contractor for inclusion in Project Record Document

END OF SECTION

SECTION 014000 QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance / Control of installation
- B. Inspection and testing laboratory services
- C. Qualification of laboratory
- D. Laboratory duties
- E. Limitations of authority of testing laboratory
- F. Contractor's responsibilities
- G. Field testing

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- H. Testing and services schedule

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work
- B. Section 01340 - Shop Drawings, Product Data, and Samples
- C. Section 01600 - Material and Equipment

1.3 REFERENCES

- A. Conform to reference standard by date of issue current on date of Contract Documents
- B. Obtain copies of standards when required by Contract Documents
- C. Where specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding
- D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340
- B. Provide copies of written reports for materials, equipment or systems as scheduled at the end of this section. Reference each report by respective section number.
- C. Laboratory Test Reports: Provide written reports of each test and inspection to Engineer. Each report shall include:
 - 1. Date issued
 - 2. Project title and number
 - 3. Testing laboratory name, address and telephone number
 - 4. Name and signature of laboratory inspector
 - 5. Date and time of sampling or inspection
 - 6. Record of temperature and weather conditions
 - 7. Date of test
 - 8. Identification of product and specification section
 - 9. Location of sample or test in the Project
 - 10. Type of inspection or test
 - 11. Results of tests and compliance with Contract Documents
 - 12. Interpretation of test results when requested by Engineer
- D. Shop Test Reports: Provide reports detailing results of tests and certification from manufacturer to verify compliance with specifications
- E. Field Test Reports: Provide reports detailing results of the tests. Indicate compliance or non-compliance with Contract Documents. Identify corrective action for materials and equipment which fails to pass field tests.

1.5 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality
- B. Comply fully with manufacturer's instructions, including each step in sequence
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding

- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship
- E. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement
- F. Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities: Conditions of the Contract
- G. Certification of products: Respective sections of specifications
- H. Laboratory tests required and standards for testing: Respective sections of specifications

1.6 INSPECTION AND TESTING LABORATORY SERVICES

- A. Owner will employ and pay for the services of a testing agency to perform specified laboratory testing of materials where the technical specifications specifically obligate the Owner to provide the services
 - 1. It is the Contractor's responsibility to initiate and coordinate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency no less than two (2) working days advance notification to schedule tests.
 - 2. Employment of the testing agency shall in no way relieve Contractor's obligations to perform the Work of the Contract
 - 3. Contractor shall employ and pay for the services of a testing agency to perform all specified services and testing not specifically identified in the technical specifications to be provided by Owner related to the design of mixes, products and equipment, to Engineer's review of proposed materials and equipment before, during and after incorporation in the Work and to retest materials and equipment which fail original tests
- B. Retesting required because of non-conformance to specified requirements shall be performed by the same testing agency on instructions by the Engineer. Payment for retesting will be charged to the Contractor by deducting inspection or testing charges from the Contract Sum/Price

1.7 QUALIFICATION OF TESTING AGENCY

- A. Meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories
- B. Meet basic requirements of ASTM E 329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction" as applicable
- C. Authorized to operate in the State in which the Project is located

1.8 TESTING AGENCY DUTIES

- A. Cooperate with Engineer and Contractor; provide qualified personnel after due notice
- B. Perform specified inspections, sampling, and testing of materials and methods of construction
 - 1. Comply with specified standards
 - 2. Ascertain compliance of materials with requirements of Contract Documents
- C. Promptly notify Engineer and Contractor of observed irregularities or deficiencies of work or products

1.9 LIMITATIONS OF AUTHORITY OF TESTING AGENCY

- A. Testing Agency Is Not Authorized To
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents
 - 2. Approve or accept any portion of the Work
 - 3. Owner employed testing agency shall not perform any duties of the Contractor

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1.10 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory and testing agency personnel and provide access to Work
- B. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other material mixes which require control by the testing laboratory
- D. Furnish copies of product test reports as required
- E. Furnish Incidental Labor and Facilities
 - 1. To provide access to Work to be tested
 - 2. To obtain and handle samples at the project site or at the source of the product to be tested
 - 3. To facilitate inspections and tests
 - 4. For storage and curing of test samples
- F. Cooperate with testing agency; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested
 - 1. Notify Engineer and testing agency 24 hours prior to expected time for operations requiring services to allow for scheduling of tests and laboratory assignment of personnel
 - 2. Make arrangements with testing agency and pay for additional samples and tests required for Contractor's use

1.11 FIELD TESTING

- A. Owner shall pay all costs associated with standard field testing of materials as detailed in these specifications. Contractor shall pay all costs for testing of piping and equipment as detailed in these specifications. Owner's testing agency will take concrete samples, cure and break samples and report results. Owner's testing agency will also provide compaction testing and proctors for backfill operations. Contractor shall pay for all retesting due to tests indicating failed conditions.
- B. Provide all required materials, labor, equipment, water, and power required for testing
- C. Perform all tests in presence of Engineer and provide one copy of field test results to Engineer same day of tests
- D. Repair with no additional compensation all materials and equipment which fail during testing

1.12 LABORATORY TESTING AND SERVICES SCHEDULE

- A. Testing laboratory services shall be provided for, but shall not be limited to, the following:

Specification Section	Type of Material, Equipment, or System	Owner (O) or Contractor (C) Provided
02300	Earthwork	C
03000	Concrete Mixes	C

1.13 FIELD TESTING AND SERVICES SCHEDULE

- A. Field testing shall be provided for, but shall not be limited to, the following:

Specification Section	Type of Material, Equipment, or System	Owner (O) or Contractor (C) Provided
-----------------------	--	--------------------------------------

02300	Earthwork	O
02616	Site Piping	C
03300	Cast-In-Place Concrete	O

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 015000 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heating, ventilating, telephone service, water and sanitary facilities
- B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.
- C. Construction Staging Facilities: Access roads, parking areas, progress cleaning, project signage, storage and temporary buildings.

1.2 GENERAL REQUIREMENTS

- A. Furnish, install and maintain all temporary utilities to assure continuous service required for the Work, except as allowed herein, and remove on completion of Work. Modify and extend systems, as work progress requires.
- B. Furnish, install and maintain all construction aids required for the Work, except as allowed herein, and remove on completion of the Work
- C. Furnish, install and maintain fences and barriers as required for protection of the public, property and the Work
- D. Contractor may use existing roadways for access and parking only where designated by Owner.
- E. Provide a field office for the use of the Contractor's Superintendent, Owner's Representatives, and Engineer in the designated staging area
- F. Products may be new or used, but must be serviceable, adequate for the intended purpose, and must not violate the requirements of any applicable codes or standards
- G. Clean and repair damage caused by temporary installations or use of temporary facilities. Grade and seed all disturbed areas not detailed on the drawings for other treatment
- H. Provide contractor information sign posted at accessible location with contractor name and emergency phone contact information.

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies
 - 1. Comply with applicable Federal and State rules and regulations, local codes and ordinances

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- 2. Comply with utility company requirements

1.4 TEMPORARY ELECTRICITY

- A. Contractor shall pay all costs associated with power service to the field offices and pay all costs for energy used.
- B. Arrange for and pay all costs associated with temporary power service either from the local utility or a portable engine-generator
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at the site. Provide flexible power cords as required
- D. Provide main service disconnect and over current protection at convenient location
- E. Pay all costs for installation and removal of temporary electrical service

1.5 TEMPORARY LIGHTING

- A. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes as required
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required
- C. Maintain lighting and provide routine repairs

1.6 TEMPORARY WATER SERVICE

- A. Potable water does not exist on the site.
- B. Provide all drinking water required by construction personnel and Owner's representatives. Pay all costs for temporary water service.

1.7 TEMPORARY SANITARY FACILITIES

- A. Provide sanitary facilities at staging area
 - 1. As required by laws and regulations
 - 2. Not less than 1 facility
- B. Service, clean and maintain facilities and enclosures

1.8 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required by personnel and to facilitate the execution of the Work: scaffolds staging, ladders, stairs, ramps, runways, platforms, railways, hoists, cranes, chutes and other such facilities and equipment
- B. Relocate construction aids as required by progress of construction, by storage or work requirements, and to accommodate legitimate requirements by Owner
- C. Completely remove temporary materials, equipment, and services at completion of the Project
- D. Clean, repair damage caused by installation or by use of temporary facilities
 - 1. Remove foundations and underground installations for construction aids
 - 2. Grade the areas for the site affected by temporary installations to required elevations and slopes and clean the area and seed unless specified as shown on the drawings to be different

1.9 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition
- B. Provide suitable barriers as required for public protection of Owner's employees
- C. Protect non-owned vehicular traffic, stored materials, site and structures from damage
- D. Install facilities of a neat and reasonable uniform appearance, structurally adequate for the required purposes
- E. Relocate barriers as required by progress of construction
- F. Completely remove barriers, including foundations, when construction has progressed to the point that they are no longer needed
- G. Clean and repair damage caused by installation, fill and grade the areas of the site to required elevations and slopes and clean the area

1.10 TEMPORARY FENCING

- A. Construction: Commercial grade chain link fence
- B. Provide additional fencing to protect stored materials & products or to insure public safety and the safety of Owner's employees
- C. Provide Owner two (2) keys to lock(s)
- D. The site of the work is fenced

1.11 STORMWATER MANAGEMENT

- A. Refer to SWMP in the drawings and comply with all conditions of CDPHE Stormwater Discharge Permit. Contractor responsible for both permit filing and any required reporting.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment as necessary.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Perform work in phases and restore areas where work is complete.

1.12 CONSTRUCTION DEWATERING

- A. Comply with all conditions and requirements of CDPHE Construction Dewatering Permit. The Contractor shall be responsible for any permit filing and reporting necessary.

1.13 EROSION AND SEDIMENT CONTROL

- A. Install sediment control fencing at site perimeter where necessary to prevent erosion and sedimentation from occurring off site.
- B. During and after site grading, maintain a roughened surface on all disturbed areas to minimize erosion potential.
- C. Construct and maintain drainage swales with staked straw bale barriers to control drainage patterns and minimize erosion.
- D. Provide and maintain gravel sediment traps at inlets to prevent siltation.

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- E. Provide and maintain rock check dams if required.
 - F. Soils can be stockpiled on site as directed by Owner. Rock to be hauled off not crushed and stockpiled onsite.
- 1.14 PROTECTION OF INSTALLED WORK
- A. Protect installed Work and provide special protection where specified in individual specification Sections
 - B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage
 - C. Protect finished driving surfaces, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects
 - D. Prohibit construction traffic from entering future landscaped areas after grades have been established and topsoil restored
- 1.15 SECURITY
- A. Provide security and facilities to protect Work from unauthorized entry, vandalism, or theft
 - B. Coordinate with Owner's security program
- 1.16 ACCESS ROADS
- A. Maintain existing roads accessing public thoroughfares to construction staging area.
 - B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow
 - C. Provide and maintain access to existing fire hydrants free of obstructions
 - D. Provide means of removing mud from vehicle wheels before entering public paved streets as required by SWMP and Owner
- 1.17 PARKING
- A. Paved and unpaved surfaces adjacent to the staging area can accommodate construction personnel until the designated building staging area has been established
 - B. If staging area space is not adequate, provide additional off-site parking at location designated by Owner
- 1.18 PROGRESS CLEANING
- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition
 - B. Remove waste materials, debris, and rubbish from site periodically and dispose off-site in accordance with local and state regulations. Due to high winds experienced at the site, waste removal must be done immediately after it is generated
- 1.19 FIELD OFFICES AND SHEDS
- A. Construction
 - 1. Structurally sound, weather-tight, with floors raised above ground
 - 2. Temperature transmission resistance: Compatible with occupancy and storage requirements
 - 3. At Contractor's option, portable or mobile buildings modified for office use may be used
 - 4. Fill and grade sites for temporary structures to provide surface drainage
 - 5. Construct temporary field offices and storage sheds on proper foundations, provide connections for utility services
 - a. Secure portable or mobile buildings for winds to 110 mph
 - b. Provide steps and landings at entrance door

6. Mount thermometer at convenient outside location, not in direct sunlight
7. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment and services
8. Remove temporary field offices, contents, and service at a time they are no longer needed
9. Remove storage sheds when they are no longer needed
10. Remove foundations and debris; grade the site to required elevations and clean the areas

B. Contractor's Office and Facilities

1. Size: As required for general use
2. Other furnishings: Contractor's option

C. Existing facilities at the site shall not be used for field offices or storage

D. Fire protection equipment. Contractor shall provide and maintain fire extinguishers and active fire hydrants where indicated, maintain fire lanes to hydrants, and provide other equipment as necessary for proper fire protection during construction. Such equipment shall be for fire protection only.

1.20 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Final Application for Payment
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated
- C. Clean and repair damage caused by installation or use of temporary work

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 016000 MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements governing Contractor's selection of products for use in Project and for Work including, but not limited to, the following:
 1. Definitions
 2. General Requirements for Materials and Equipment
 3. Submittals
 4. Quality Assurance and Qualifications
 5. System Responsibility
 6. Transportation and Shipment
 7. Delivery, Storage and Handling
 8. Maintenance Materials
 9. Warranty
 10. Equipment and Product Selection and Identification
 11. Examination, Installation, Adjusting and Cleaning

1.2 RELATED SECTIONS

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- A. Section 01010 – Summary of Work
- B. Section 01340 – Shop Drawings, Product Data, and Samples
- C. Section 01400 – Quality Control
- D. Section 01730 – Operation and Maintenance Data
- E. Section 03300 – Concrete

1.3 REFERENCES

- A. American Gear Manufacturer Association (AGMA)
- B. ANSI B1.1-89 – Unified Screw Threads
- C. ANSI B 1.20. 1-83-Pipe Threads, General Purpose (Inch)
- D. ANSI B16.1-89-Cast Iron Pipe Flanges and Flanged Fittings, Class 125
- E. ANSI B18.2.1-81-Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Log Screws
- F. ANSI B18.2.2-87-Square and Hex Nuts
- G. NSF/ANSI 60-2012 – Drinking Water Treatment Chemicals – Health Effects
- H. NSF/ANSI 61-2012 – Drinking Water System Components – Health Effects
- I. Hazardous (Classified) Locations: Conform to requirements of NFPA70 Articles 500 through 504

1.4 DEFINITIONS

- A. Definitions used in this specification section are not intended to change the meaning of other terms used in the Contract Documents, such as “specialties,” “systems,” “structure,” “finished,” “accessories,” and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry
- B. Products: Items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term “product” includes the terms “material”, “equipment”, “system”, and terms of similar intent
- C. Named products: Items identified by manufacturer’s product name, including make or model number of other designation, shown or listed in the manufacturer’s published product literature that is current as of date of Contract Documents
- D. Foreign products: Distinguished from “domestic products” are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens or, nor living within, the United States and its possessions are also considered to be foreign products
- E. Materials: Products substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form a part of the Work
- F. Equipment: Product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping
- G. Special tools, instruments, devices, or accessories: Any tools, instruments, devices or accessories required for repair, adjustment or maintenance of equipment which are designed especially for the equipment in question or which are not normally kept in stock by local tool suppliers

- H. Responsible manufacturer: Unless otherwise specified, responsible manufacturer shall be manufacturer of driven equipment. Agents, representatives or other entities who are not a direct component of manufacturing corporation will not be acceptable as a substitute for manufacturer's corporation in meeting this requirement

1.5 GENERAL REQUIREMENTS

- A. The section applies to all equipment provided under this contract
- B. The requirements of detailed specifications take precedence over this section in the event of an apparent conflict
- C. Provide all new equipment and materials, except as specified or required by testing
- D. Equipment and materials removed from existing structure: Do not use in completed Work except where specifically indicated or specified
- E. Contractor to coordinate equipment with other parts of the Work, including verification or compatibility of structures, piping, wiring and equipment components
- F. Contractor is responsible for all alterations in the Work to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Drawings or specifications:
 - 1. The arrangement of equipment shown on the Drawings is based upon information available to the Owner at the time of the design and is not intended to show exact dimensions unique to a specific manufacturer
 - 2. More than one manufacturer has been used for mechanical layout and design to accommodate all named manufacturer's
 - 3. The Drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements as provided by the Contractor
 - 4. Structural supports, foundations, connected piping, valves and electrical conduit specified may have to be altered as coordinated by the Contractor during the submittal process to accommodate the actual equipment provided by the Contractor
 - 5. No additional payment will be made to the Contractor for such revisions and alterations
- G. Do not use any material or equipment for any purpose other than that for which is designed or specified
- H. Equipment lists presented in these specifications and as specified on the Drawings are included for the convenience of the Engineer and Contractor and are not to be considered as complete listings of all equipment, devices and material to be provided under this contract:
 - 1. Contractor shall prepare his own material and equipment take-off lists as necessary from the contract Drawings, addenda and this project manual to meet the requirements of this project

1.6 SUBMITTALS

- A. Provide submittals in accordance with Section 01340 – Shop Drawings, Product Data, and Samples
- B. Submittals for products are specified in Section 01340 – Shop Drawings, Product Data, and Samples and in Divisions 2 through 11
- C. All submittals for each component of multi-component systems shall be compiled and submitted through the Contractor to the Engineer by the manufacturer having system responsibility
- D. Provide a copy of this specification section with all addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate the requested deviations from the specification requirements.
- E. Provide Certificate of System Responsibility

1.7 QUALITY ASSURANCE AND QUALIFICATIONS

- A. Source limitations and interchangeability: To the fullest extent possible, provide products of the same kind from a single source

- B. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplate or trademarks on exposed surface of products that will be exposed to view in occupied spaces or on the exterior
1. Labels: Locate required product labels and stamps on concealed surfaces, or where required for observation after installation, on inconspicuous, accessible surfaces.
 2. Equipment nameplates: Provide a permanent nameplate on each item of service –connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. Nameplate shall contain, but not limited to, the following information and other essential operating data:
 - a. Name of product and manufacturer
 - b. Model and serial number
 - c. Capacity
 - d. Speed
 - e. Ratings
 - f. Operating and power characteristics
 - g. Labels of tested compliance with codes and standards
 3. Refer to additional requirements specified in Divisions 2 through 16
- C. Installers Qualifications:
1. Equipment and material: Installed and placed in service by or under guidance of qualified personnel having knowledge and experience necessary for proper results
 2. Where Contractor's or subcontractor's employees are not properly qualified, use personnel such as factory authorized field representative of equipment supplier

1.8 SYSTEM RESPONSIBILITY

- A. Equipment systems made up of two or more components shall be provided as a single system by the responsible manufacturer. Unless otherwise specified, the Contractor shall assign system responsibility to, and obtain each system from the manufacturer of the driven equipment. The manufacturer shall design and provide all components of the system to enhance proper operation, compatibility of all components, ease of construction and efficient maintenance. The responsible manufacturer shall coordinate selection and design of all system components such that all equipment is compatible and operates properly to achieve the performance requirements specified. The Contractor is responsible to the Owner for performance of all systems as provided in the General and Special Conditions.
- B. Nothing in this provision shall be construed as relieving the Contractor of overall responsibility for the Work of this Contract and the performance of all systems as specified under paragraphs 00700 – Standard General Conditions, Article 13

1.9 TRANSPORTATION AND SHIPMENT

- A. Shipment preparation: Contractor shall require manufacturers and suppliers to prepare equipment and materials for shipment in a manner to facilitate unloading and handling, and to protect against damage or unnecessary exposure in transit and storage, for contractor supplied equipment. Provisions for protection shall include the following:
1. Crates or other suitable packaging materials
 2. Covers and other means to prevent corrosion, moisture damage, mechanical, injury, and accumulation of dirt in motors, electrical equipment, and machinery
 3. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel
 4. Grease packing or oil lubrication in all bearings and similar items
- B. Marking
1. Each item of equipment and material shall be tagged or marked as identified in the delivery schedule or on submittals
 2. Complete packing lists and bills of material shall be included with each shipment.
 3. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Delivery

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1. Arrange deliveries of equipment and materials in accordance with construction schedules, in ample time to facilitate inspection prior to installation and to avoid delay of Work. Coordinate to avoid conflict with work and conditions at the site
2. Deliver products in undamaged condition, in manufacturer's sealed, weather tight, original container or packaging, with identifying labels intact and legible, all in accordance with manufacturer's instructions and recommendations using means and methods that will prevent damage, deterioration, and loss, including theft
3. Control delivery schedules to minimize long-term storage at the Site and to prevent overcrowding of construction spaces. Coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss
4. Products delivered to Work site shall be in undamaged condition, in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing
5. Mark deliveries of component parts of equipment to identify the equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units
6. Immediately on delivery, inspect shipment to ensure:
 - a. Product complies with requirements of Contract Documents and reviewed Submittals
 - b. Quantities are correct
 - c. Containers and packages are intact and labels are legible
 - d. Equipment and materials are properly protected and undamaged
7. Include complete packing lists and bills of material with each shipment including equipment identification number assigned by Drawings and Specifications of this Contract
8. Deliver anchor bolts together with templates sufficiently early to permit setting when structural concrete is placed

B. Storage

1. If there is no interior space available from the Owner for storage of delivered equipment and material at the project site:
 - a. Provide adequate facilities for storage in accordance with Section 01500
 - b. Provide off-site storage and protection when site does not permit on-site storage or protection and if acceptable to Owner in accordance with the General Conditions
2. Submit and maintain insurance for equipment and materials at off-site storage
3. Requests for payment of stored equipment and materials by the Contractor may be rejected if storage facilities do not conform to these specifications or manufacturer's written recommendations.
4. Store equipment and materials immediately on delivery, and protect until completion of the Work. Store in accordance with manufacturer's instructions with seals and labels intact and legible
5. Store equipment and materials in a manner that will not endanger the supporting construction
6. Store equipment and materials that are subject to damage by elements in weathertight enclosures
7. Maintain temperature and humidity within ranges required by manufacturer
8. Protect motors, electrical equipment, plumbing fixtures, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter
9. Protect electrical equipment, controls, and insulation against moisture, water, and dust damage
10. Immediately after delivery and inspection, connect and operate continuously all space heaters furnished in electrical equipment
11. Protect exposed-machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds
12. Protect bearings and similar items with grease packing or oil lubrication
13. Handle and store steel plate, sheet metal, and similar items in a manner to prevent deformation
14. Exterior storage:
 - a. Provide substantial platforms, blocking, or skids to support fabricated products aboveground and to prevent soiling or staining. Cover products subject to discoloration or deterioration from exposure to elements, with impervious sheet coverings. Provide adequate ventilation to avoid condensation
 - b. Store loose granular materials on solid surface areas to prevent mixing with foreign matter
 - c. Provide surface drainage to prevent flow or ponding of rainwater
15. Equipment and materials shall not show any pitting, rust, decay or other deleterious effects of storage prior to final acceptance of Work
16. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure products are maintained under specified conditions and free from damage or deterioration
 - a. Prepare stored materials lists with schedules of maintenance activities and frequency of activities required to maintain the quality of the equipment and the warranty from the manufacturer

- b. List dates and activities of storage requirements such as rotating moveable parts
 - c. Update lists weekly and include in progress meeting agenda
- 17. Protect painted surfaces against impact, abrasion, discoloration or other damage:
 - a. Repaint any damaged areas with manufacturer provided touch-up paint
- 18. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation
- 19. Installed products stored prior to start-up:
 - a. Equipment and materials shall not show any pitting, rust, decay or other deleterious effects of storage when installed in the Work
 - b. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations, dust, dirt, water and paint. Remove when no longer needed
- C. Handling
 - 1. Provide equipment and personnel necessary to unload and handle equipment and materials, by methods to prevent damage or soiling to equipment and materials or packaging
 - 2. Handle by methods to prevent bending or oversteering. Where lifting points are designated, lift components only at those points
 - 3. Provide additional protection to surrounding surfaces as necessary to prevent damage
- D. Maintenance of storage
 - 1. Inspect stored equipment and materials on a scheduled basis
 - 2. Verify that storage facilities comply with manufacturer's product storage requirements, including environmental conditions continually maintained
 - 3. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents
 - 4. For mechanical and electrical equipment in long-term storage, provide manufacturers service instructions to accompany each item, with notice of enclosed instructions on exterior of package. Service equipment on a regularly scheduled basis.
- E. Protection after installation
 - 1. Provide substantial coverings as necessary to protect installed equipment and materials from damage from subsequent construction operations
 - 2. Remove when no longer needed or as specified
- 1.11 MAINTENANCE MATERIALS
 - A. Spare Parts:
 - 1. Store spare parts, wherever required by detailed technical specification sections, in accordance with the provisions of this paragraph
 - 2. Tag all spare parts with permanent, labeled tags or packaging by equipment designation number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate)
 - 3. Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping
 - 4. Unless otherwise specified, spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box:
 - a. Provide box with a hinged wooden cover and locking hasp
 - b. Hinges to be strap type
 - c. Paint the box and identify with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts"
 - 5. Prepare and provide a neatly typed inventory of spare parts taped to the underside of the box cover
- 1.12 WARRANTY
 - A. Warranty all equipment and materials against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, leakage, breakage or other failure
 - B. Unless otherwise specified, for all equipment and materials provide manufacturer's warranty for a period of 2 years from the date of Substantial Completion

- C. Warranties that begin at the time of shipment, delivery or within a limited time period from date of shipment or delivery or any other qualification that does not conform to the definition of Substantial Completion are not acceptable
- D. Cost of all manufacturer warranties are considered as part of the Bid price

PART 2 PRODUCTS

2.1 MATERIALS

- A. Suitable for the intended service conditions
- B. Structural and miscellaneous fabricated steel in equipment shall conform to American Institute of Steel Construction (AISC) standards, except as otherwise specified

2.2 FABRICATION

- A. Design, fabricate, and assemble in accordance with the best modern manufacturing and shop practices
- B. Manufacture parts to standard sizes and gages
- C. Two or more items of the same type shall be identical by the same manufacturer and interchangeable

2.3 EQUIPMENT AND PRODUCT SELECTION

- A. General product requirements: Provide products that comply with the Contract Document, are undamaged, and unless otherwise indicated or specified, are new at time of installation
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a 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. Continued availability: Where, because of the nature of its application, the Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard, domestically produced product for which the manufacturer has published assurances that the product and its parts shall be available to the Owner at a later date. A reasonable doubt regarding such future availability will be grounds for rejection of products other than named products
 - 4. As specified in each applicable Specification Sections, Drawings, codes, standards, and regulatory agencies
 - 5. Fabricated products:
 - a. Design, fabricate, and assemble products in accordance with best engineering and shop practices
 - b. Manufacture like parts of duplicate units to standard interchangeable sizes and gauges. Two or more items of same kind shall be identically made by the same manufacturer
 - c. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically accepted in writing by Owner
 - d. Ensure that material or equipment are not used for any purpose other than that for which it is designed or is specified
 - e. Labels and nameplates shall be provided where required by regulatory agencies or in accordance to state identification and essential operation data
 - 6. Provide products of the same kind from a single source to the fullest extent possible

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install any equipment showing such effects. Replace damaged equipment with identical new equipment

3.2 INSTALLATION

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- A. Install all equipment, accessories and materials in accordance with the manufacturer's written recommendations unless otherwise specified in the individual equipment detailed technical specifications
- B. Each product shall be securely anchored in place except as required for proper movement and performance
- C. Each product shall be located and aligned with other Work
- D. Manufacturer's Instructions
 - 1. Contractor shall obtain and distribute hard copies and electronic copies of manufacturer's instructions and recommendations to parties involved in installation including a copy to Engineer
 - 2. Maintain one (1) set of complete instructions at job site during installation and until completion
 - 3. Handle, install, connect, clean, conditions, and adjust products in accordance with such instructions and in conformity with specified requirements

3.3 ADJUSTING

- A. Perform all required adjustment tests, operation checks, and other startup activities required

3.4 CLEANING

- A. Perform under provisions of Section 01700 – Contract Closeout
- B. Repaint all painted surfaces which are damaged prior to final equipment acceptance to Owner's satisfaction
- C. Clean exposed surfaces and protect as necessary and required to prevent any damage or deterioration at the time of Substantial Completion

END OF SECTION

SECTION 016700 PIPE SCHEDULE AND TESTING

PART 1 GENERAL

1.01 Summary

- A. Piping designations, materials, locations, and test conditions.

PART 2 PRODUCTS

- A. Not applicable

PART 3 EXECUTION

1.01 Pipe schedule

- A. See following pages:

PIPE SCHEDULE

Media	Description	Material	Spec. Section	Installation	Temp. Deg F	Test Pressure	Test Type	Remarks
Sewage	Buried	PVC SDR 35	33 31 26	Buried	40-100	5 psi/Air	P	Testing per Spec
Sewage	Buried	HDPE DR 17	33 31 26	Buried	40-100	100 psi/HH	H	Testing per Spec

Sewage	Buried	C900 DR 14	33 31 26	Buried	40-100	100 psi/HH	H	Testing per Spec
Sewage	Interior	DIP	33 31 26	Interior	40-100	100 psi/HH	H	Testing per Spec

Abbreviations

- A. Test Type
 - 1. H – Hydraulic (water) pressure testing procedures.
 - 2. P – Low pressure (air) testing procedures.
- B. Pipe
 - 1. DIP – Ductile Iron Pipe.
 - 2. CML – Cement Mortar Lined.
 - 3. STL – Steel Pipe.
 - 4. RCP – Reinforced Concrete Pipe.
 - 5. HDPE – High Density Polyethylene Pipe.
 - 6. CI – Cast Iron Pipe.
 - 7. RJ – Restrained Joint.

END OF SECTION

SECTION 017000 CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Substantial completion
- B. Final acceptance
- C. Project record documents
- D. Closeout procedures
- E. Final cleaning
- F. Final adjustment of accounts
- G. Final application for payment

1.2 RELATED SECTIONS

- A. Section 01500 – Construction Facilities and Temporary Controls
- B. Section 01340 – Shop Drawings and Product Data

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1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Prior to requesting inspection for certification of Substantial Completion, complete the following and list exceptions in the request:
1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100% completion for the portion of the Work claimed as Substantially Complete
 - a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Price
 - b. If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete Work, and reasons the Work is not complete. All items remaining outstanding on the Contractor's punch list shall include a projected date of completion and/or correction with an explanation of why such item is not presently completed
 2. Advise Owner of pending insurance changeover requirements
 3. Submit specific warranties, workmanship Bonds, maintenance agreements, final certifications, and similar documents
 4. Obtain and submit releases enabling Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases
 5. Submit record drawings, instruction books and operating manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information
 6. Deliver tools, spare parts, extra stock, and similar items
 7. Make final changeover of permanent locks and transmit keys to Owner. Advise Owner's personnel of changeover in security provisions
 8. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes
- B. Inspection Procedures: On receipt of a request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled requirements. Engineer will prepare the Certificate of Substantial Completion following inspection or advise Contractor of construction that must be completed or corrected before the certificate will be issued
1. Engineering will repeat inspection when requested and assured by Contractor that the Work is Substantially Complete.
 2. Results of the completed inspection will form the basis of requirements for final acceptance

1.4 FINAL ACCEPTANCE

- A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required
 2. Submit an updated final statement, accounting for final additional changes to the Contract Price
 3. Submit a certified copy of Engineer's final inspection list of items to be completed or corrected, endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Engineer.
 4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the Date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work
 5. Submit consent of surety to final payment
 6. Submit evidence of final, continuing insurance coverage complying with insurance requirements
- B. Reinspection Procedure: Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Engineer.
1. Upon completion of reinspection, Engineer will prepare a certificate of final acceptance. If the Work is incomplete, Engineer will advise Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance
 2. If necessary, reinspection will be repeated, but at the expense of the Contractor who will reimburse the Owner for these services by the Engineer

1.5 PROJECT RECORD DOCUMENTS

A. General

1. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours
2. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 - a. Contract Drawings
 - b. Specifications
 - c. Addenda
 - d. Change Orders and other Modifications to the Contract
 - e. Reviewed shop drawings, product data, and samples
 - f. Field test reports
 - g. Construction photographs
3. Store Record Documents and samples separate from documents used for construction
 - a. Provide files and racks for storage of documents
 - b. Provide locked cabinet or secure storage space for samples

B. Record Drawings

1. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings
2. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown
3. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings
4. Give particular attention to concealed elements that would be difficult to measure and record at a later date
 - a. Record information concurrently with construction progress
 - b. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "Project Record" in neat, large, printed letters
 - c. Mark new information that is important to Owner but was not shown on Contract Drawings or Shop Drawings
 - d. Note related Change Order numbers where applicable
 - e. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set
 - f. Upon completion of the Work, submit record drawings to Engineer for Owner's records
5. Contract Drawings and approved Shop Drawings: Legibly mark each item to record actual construction, including:
 - a. Measured depths of elements of foundation in relation to finish grade or first floor datum
 - b. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvement
 - c. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
 - d. Field changes of dimensions and details
 - e. Changes made by Addenda or Change Order(s), if any
 - f. Details not on original Contract Drawings
 - g. References to related Shop Drawings and Modifications

C. Record Specifications: Maintain one complete copy of the Project Manual including addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and Modifications issued in printed form during construction

1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
3. Note related record drawing information and product data.
4. Upon completion of the Work, submit record Specifications to Engineer for Owner's records

D. Record Product Data: Maintain one copy of each product data Submittal. Note related Change Orders and markup of record drawings and specifications.

1. Mark record documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the Site and from the manufacturer's installation instructions and recommendations.

2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
 3. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records
 4. Legibly mark and record at each Product section description of actual Products installed, including the following:
 - a. Manufacturer's name, product model, number, trade name and supplies
 - b. Product substitutions or alternates utilized
 - c. Changes made by Addenda, field order or change order
- E. Record Samples Submitted: Immediately prior to Substantial Completion, Contractor shall meet with Engineer and Owner's personnel at the Project Site to determine which Samples are to be transmitted to Owner for record purposes. Comply with Owner's instructions regarding packaging, identification, and delivery to Owner.
- F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records, and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to Engineer for Owner's records
- G. Maintenance Manuals: Contractor shall organize operation and maintenance data as specified in Section 01730
- H. Submit documents to Engineer with claim for final Application for Payment
- I. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes
- J. Make documents and samples available at all times for inspection by Engineer
- K. Label each document "Project Record" in neat, large printed letters

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 CLOSEOUT PROCEDURES

- A. General
1. Comply with requirements stated in the Owner's General Conditions of the Contract and in these specifications for administrative procedures in closing out the Work
 2. 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 inspection
 3. Provide submittals to Engineer/Owner that are required by governing or other authorities
 4. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due
- B. Operation and Maintenance Instructions: Arrange for each installer of Equipment that requires regular maintenance to meet with Owner's personnel at Project Site to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:
1. Maintenance manuals
 2. Record documents
 3. Spare parts, materials and tools
 4. Lubricants and fuels
 5. Identification systems
 6. Control sequences
 7. Hazards, hazardous chemicals data sheets
 8. Cleaning
 9. Warranties and bonds
 10. Maintenance agreements and similar continuing commitments

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3.2 FINAL CLEANING

- A. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
 - 1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion
 - a. Remove labels that are not permanent labels
 - b. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition
 - c. Wipe surfaces of mechanical and electrical Equipment. Remove excess lubrication and other substances
 - 2. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction
 - 3. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the Site and dispose of lawfully.
 - a. Where extra materials of value remaining after completion of associated Work become Owner's property. Dispose of these materials as directed by Owner

3.3 CONTRACTOR'S CLOSEOUT SUBMITTALS

- A. Evidence of Payment and Release of Liens: As specified in the General Conditions
- B. Final inspection reports by all regulatory agencies demonstrating the agencies' final approval
- C. At Contract close-out, deliver Record Documents to Engineer for the Owner
- D. Accompany Submittal with Transmittal Letter in Duplicate, Containing
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. Title and number of each Record Document
 - 5. Signature of Contractor or his authorized representative

3.4 FINAL ADJUSTMENTS OF ACCOUNTS

- A. Submit a Final Statement of Accounting to Engineer
- B. Statement Shall Reflect All Adjustments to the Contract Sum
 - 1. The original Contract Sum
 - 2. Additions and deductions resulting from
 - a. Previous Change Orders
 - b. Deductions for uncorrected Work
 - c. Deductions for liquidated damages
 - d. Deductions for reinspection payments
 - e. Other adjustments
 - 3. Total Contract Sum, as adjusted
 - 4. Previous payments
 - 5. Sum remaining due

3.5 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the General Conditions of the Contract

END OF SECTION

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SECTION 017500 STARTING OF SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Starting systems
- B. Demonstration, instructions, and training
- C. Testing, adjusting, and balancing

1.2 RELATED SECTIONS

- A. Section 01 78 23 - Operation and Maintenance Data

1.3 STARTING SYSTEMS

- A. Provide Engineer with start-up and training schedule at least 14 days prior to the startup of the system
- B. Verify that each system has been checked for proper installation, flow line, and placement
- C. Execute start-up under supervision of responsible manufacturer's representative in accordance with manufacturers' instructions
- D. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and supervise placing equipment or system in operation
- E. Submit a written report certifying that equipment or system has been properly installed and is functioning correctly

1.4 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel within 7 days prior to date of Substantial Completion
- B. Utilize Operation and Maintenance Manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation, maintenance, and troubleshooting
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at equipment location
- D. Prepare and insert additional data in Operations and Maintenance Manuals when need for additional data becomes apparent during instruction
- E. The amount of time required for instruction on each item of equipment and system is that specified in individual sections
- F. Owner may videotape training sessions. Contractor and manufacturer's trainer to cooperate with videotaping

1.5 TESTING, ADJUSTING, AND BALANCING

- A. Contractor will employ and pay for services of an independent firm to perform testing, adjusting, and balancing as required by individual specification sections or on the Drawings.

- B. Reports will be submitted by an independent firm to the Engineer, through the Contractor, indicating observations and results of tests and indicating compliance or non-compliance with specified or regulatory requirements and with the requirements of the contract.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 017800 OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals
- B. Format
- C. Content of each volume
- D. Manual for equipment and systems
- E. Instruction of Owner's personnel

1.2 QUALITY ASSURANCE

- A. Preparation of data shall be done by personnel
 - 1. Trained and experienced in maintenance and operation of the described products
 - 2. Completely familiar with requirements of this section
 - 3. Skilled as a technical writer to the extent required to communicate essential data
 - 4. Skilled as a draftsman competent to prepare required drawings
- B. Manuals for equipment systems shall be prepared by the equipment manufacturer or system supplier
- C. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract
- D. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 23
- B. Manuals for equipment and systems
 - 1. Submit 1 preliminary electronic copy prior to the date of shipment of the equipment or system
 - a. Engineer will review
 - b. If acceptable, 1 copy will be returned to Contractor, 1 copy sent to Owner, and 1 copy retained in Engineer's file
 - c. If unacceptable, 1 electronic copy will be returned to Contractor with Engineer's comments for revision and 1 copy retained in Engineer's file. Resubmit electronic revised copy to Engineer for approval
 - d. No partial payments will be made for equipment and systems on hand or installed until preliminary manuals are submitted and acceptable
 - e. See Section 01 33 23 for electronic submittal requirements, for the preliminary copy of the O&M manual an electronic submittal is allowable
- C. Submit 3 final copies no less than 30 days prior to putting the equipment or system in service. If final manuals differ from accepted preliminary manuals, submit an electronic copy to the Engineer with any necessary supplemental

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material with instructions for insertion for conforming Engineer's and Owner's copies of preliminary manuals to final manuals.

1. Engineer will compare with accepted preliminary manual
2. If identical or otherwise acceptable, Contractor will be so notified.
3. If not acceptable, 4 copies will be returned to Contractor for revision or retained by Engineer and the necessary revision data requested from Contractor at Engineer's option.
4. No portion of the Work is substantially complete until final equipment and system manuals relating to that portion of the Work are accepted by Engineer
5. Submit one electronic and one paper copy with any revisions found desirable during instruction of Owner's personnel with instructions for insertion for revising Owner's and Engineer's copies of manual

D. Manual for materials and finishes

1. Submit 2 preliminary copies 15 days prior to request for final inspection
 - a. Engineer will review
 - b. One copy will be returned to Contractor with comments, 1 retained in Engineer's file
 - c. No final inspection shall be conducted until preliminary manuals are submitted
2. Submit 3 final copies, revised in accordance with Engineer's comments, within 10 days after final inspection
 - a. One copy will be transmitted to Contractor and 2 copies retained by Engineer for later transmittal to Owner
 - b. No final payment shall be made until final manuals are submitted
3. Additional requirements for specialized instruction of Owner's personnel are given in the detailed equipment specifications

1.4 FORMAT

A. Prepare data in the form of an instructional manual for use by Owner's personnel

B. Presentation of Information

1. Size: 8 1/2" by 11"
2. Paper: 20 lb weight minimum, white, for typed pages
3. Text: Manufacturer's printed data or neatly typewritten
4. Drawings
 - a. Provide reinforced punched binder tab, bind in with text
 - b. Reduced to 11" by 17" and folded to 8 1/2" by 11"
 - c. Where reduction is impractical, folded and placed in 8 1/2" by 11" envelopes bound in text
 - d. Suitably identified on drawings and envelopes
5. Provide flysheets for each separate product or each piece of operating equipment
 - a. Provide typed description of product and major component parts of equipment
 - b. Provide indexed tabs, may be in color
6. Spine and cover: identify each volume with typed or printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" preceded by the word. "PRELIMINARY" or "FINAL" as applicable. Final manuals to list information on the cover and the spine. List the following:
 - a. Title of project, reference Owner and project location as applicable
 - b. Identification of separate structure as applicable
 - c. Identification of general subject matter covered in manual and specification section number
7. As much as possible, assemble and bind material in the same order as specified

C. Binders

1. Preliminary manuals: Commercial quality permanent 3-ring or 3 post binders with durable, cleanable, hard plastic covers. GBC bound manual may be accepted upon review by Engineer
2. Final manuals: Commercial quality permanent 3-ring or 3 post binders with durable, cleanable, hard plastic covers with clear plastic cover and spine pockets suitable for title and cover inserts. Manufacturer's pre-printed binder may be accepted upon review by Engineer. "Deluxe Round Ring View Binder" as manufactured by Wilson Jones or accepted substitution
3. Final electronic manual: Provide two copies in digital format, all documents to be in native file format (Word, Excel, AutoCAD, pdf) or converted from native file format into Adobe pdf. Provide two copies on an electronic disk, CD, DVD, or USB flash drive

D. Arrange content by systems under section numbers and sequence of table of contents of this Project Manual

E. Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment

F. Electronic Manual: Compile in an electronic book format with Chapter bookmarks (equal to tabbed flyleaves) and OCR (optical character recognition) to allow for document searches.

1.5 CONTENTS OF EACH VOLUME

A. Neatly typewritten table of contents for each volume, arranged in a systematic order

1. Contractor, name of responsible principal, address and telephone number

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2. A list of each product required to be included, indexed to the content of the volume
3. List, with each product, the name, address and telephone number of
 - a. Subcontractor or installer
 - b. Maintenance contractor, as appropriate
 - c. Identify the area of responsibility of each
 - d. Local source of supply for parts and replacement
4. Identify each product by product name and other identifying symbols as set forth in Contract Documents
- B. Product Data
 1. Include only those sheets which are pertinent to the specific product
 2. Annotate each sheet to
 - a. Clearly identify the specific product of part installed
 - b. Clearly identify the data applicable to the installation
 - c. Delete references to inapplicable information
- C. Drawings
 1. Supplement product data with drawings as necessary to clearly illustrate
 - a. Relations of component parts of equipment and systems
 - b. Control and flow diagrams
 2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation
 3. Do not use Project Record Documents as maintenance drawings
- D. Written text, as required to supplement product data for the particular installation
 1. Organize in a consistent format under separate headings for different procedures
 2. Provide a logical sequence of instructions for each procedure
- E. Copy of each warranty, bond and service contract issued
 1. Provide information sheet for Owner's personnel, give
 - a. Proper procedures in the event of fracture
 - b. Instances which might affect the validity of warranties or bonds
- 1.6 MANUALS FOR EQUIPMENT AND SYSTEMS
 - A. Provide an operation and maintenance manual for each item of equipment or system listed in the schedule of manuals in the quantity listed in the submittal schedule
 - B. Content for each of equipment and system as appropriate
 1. Description of unit and component parts
 - a. Function, normal operating characteristics and limiting conditions
 - b. Performance curves, engineering data and tests
 - c. Complete nomenclature and commercial number of all replaceable parts
 2. Operating procedures
 - a. Startup, break-in, routine and normal operating instructions
 - b. Regulation, control, stopping, shutdown and emergency instructions
 - c. Summer and winter operating instructions, as applicable
 - d. Special operating instructions
 3. Maintenance procedures
 - a. Routine operations
 - b. Guide to "trouble-shooting"
 - c. Disassembly, repair and reassembly
 - d. Alignment, adjusting and checking
 4. Servicing and lubrication schedule
 - a. List of lubricants required
 5. Manufacturer's printed operating and maintenance instructions
 6. Description of sequence of operation by control manufacturer
 7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance
 - a. Predicted life of parts subject to wear
 - b. Items recommended to be stocked as spare parts
 8. As-installed control diagrams by controls manufacturer
 9. Each contractor's coordination drawings
 - a. As-installed color-coded piping diagrams
 10. Charts of valve tag numbers with the location and function of each valve
 11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage
 12. Other data as required under pertinent sections of specifications

- C. Content for each electric and electronic item or system, as appropriate
 - 1. Description of system and component parts
 - a. Function, normal operating characteristics and limiting conditions
 - b. Performance curves, engineering data and tests
 - c. Complete nomenclature and commercial number of replaceable parts
 - 2. Circuit directories of panelboards
 - a. Electrical service
 - b. Controls
 - c. Communications
 - 3. As-installed color-coded wiring diagrams
 - 4. Operating procedures
 - a. Routine and normal operating instructions
 - b. Sequences required
 - c. Special operating instructions
 - 5. Maintenance procedures
 - a. Routine operations
 - b. Guide to "trouble-shooting"
 - c. Adjustment and checking
 - 6. Manufacturer's printed operating and maintenance instructions
 - 7. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage
 - 8. Other data as required under pertinent sections of specifications
- D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel
- E. Additional requirements for Operation and Maintenance Data: The respective sections of specifications
- 1.7 INSTRUCTIONS OF OWNER'S PERSONNEL
 - A. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and system
 - B. Operation and maintenance manual constitutes the basis of instruction
 - 1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance
- 1.8 ADDITIONAL REQUIREMENTS FOR SPECIALIZED INSTRUCTION OF OWNER'S PERSONNEL ARE GIVEN IN THE DETAILED EQUIPMENT SPECIFICATIONS
 - A. Equipment and systems Operation and Maintenance manuals shall be prepared for each of the following:

<u>Specification Section</u>	<u>Type of Equipment or System</u>
Not applicable.	Lift Station – Gorman Rupp
Division 16	Electrical and Controls Equipment

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 018600 PRE-SELECTED EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pre-Selected Equipment Specification
- B. Section does not include equipment for which substitutions will not be accepted.

1.2 RELATED SECTIONS

- A. Section 26 25 00 – Diesel Generator
- B. Section 46 07 53 – Gorman Rupp Packaged Lift Station

1.3 EQUIPMENT INFORMATION

- A. The units listed below are pre-selected by the City. No substitutions will accepted.

Project Specification	Model and Manufacturer	Quantity
Section 26 25 00	1. CAT Wagner Diesel Generator 80 KW Model C4 4GCABR	2. 1
Section 46 07 53	Gorman Rupp Lift Station Package T6A35-B/WW	1

- B. Should the Contractor wish to or need to submit an acceptable substitution, the subsequent specifications should be used. Redesign costs will be the responsibility of the Contractor.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

DIVISION 2 – DEMOLITION

SECTION 024100 DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Demolition, removal, salvage and disposal of existing site features, buried and above ground utility piping, and materials where indicated on the drawings and as specified in this section.
- B. Demolition and removal of a light pole, manholes, and sewer piping.

1.2 RELATED SECTIONS

- A. Section 01 50 00 – Construction Facilities and Temporary Controls
- B. Section 00 31 32 – Geotechnical Investigation
- C. Section 31 23 00 – Earthwork
- D. Section 31 25 00 – Erosion Control and Protection
- E. Section 32 92 19 - Seeding

1.3 SUBMITTALS

- A. Permits and Certificates
 - 1. All permits and certificates are the responsibility of the Contractor and copies of executed permits and certificates should be submitted to the Owner for their records.
 - 2. Permits and notices required for proper disposal of all materials per County and State regulations.
 - 3. Certificates of severance of utility service
 - a. Applicable when gas, electric, or telephone utility service must be demolished or abandoned.
 - 4. Permit for transport and disposal of debris.
- B. Demolition Plan
 - 1. Contractor to submit detailed plan on demolition methods, scheduling, and impact to utility service and access for Owner approval.
 - 2. Plan must be submitted three weeks prior to mobilization on-site.

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3. Plan should include the following key components:
 - a. Schedule and estimated time of task
 - b. Disposal plan of materials
 - c. Impact to water or sewer service
 - d. Impact to access for each unit
 - e. Plan for demolition of any temporary structures or other means/methods required to implement proper demolition

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1 specifications.
- B. Surveyed location and record map of actual locations of capped utilities and subsurface obstructions. All capped utilities should be surveyed using project datum and marked in field accordingly.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, and disposal.
- B. Obtain required permits from authorities.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not close or obstruct roadways, sidewalks, or hydrants without written permission from Owner.
- E. Do not suspend utility service (water and sewer) to residents without prior written approval. Residents will require a minimum of **48-hour notice** of loss of service.
- F. The temporary loss of service shall not exceed **8 hours** and no work impacting service to residents shall be done on Fridays.
- G. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

1.6 SCHEDULING

- A. Schedule and submit under provisions of Division 1 specifications.
- B. Notify Engineer and Owner of any demolition work two (2) weeks prior to commencement.
- C. Coordinate all demolition work with Engineer and Owner.

PART 2 PRODUCTS

2.1 SALVAGE OF MATERIALS

- A. Remove and return to Owner the following Equipment and Materials:
 - a. Existing Pumps, Panels, and Valves.
- B. All existing construction and items not salvaged to Owner shall be considered waste and shall become the property of Contractor for off-site disposal in accordance with local and State law.
- C. Remove and reinstall as indicated on Drawings and herein the following Equipment and Materials:
 1. Any shallow utilities that must be relocated during the project should be reinstalled per utility provider's standards and requirements.
 2. This includes gas, electric, telephone, and any other communication utility.

2.2 HANDLING AND STORAGE

- A. Contractor shall carefully disassemble Equipment and Materials that are to be reused and returned to Owner in such a way to avoid any damage. Contractor shall store such Equipment and Materials in such a way to avoid any damage, corrosion, or staining

2.3 FILL MATERIALS

- A. Existing lift station wetwell shall be filled with approved backfill material and compacted to 95% Standard.
- B. Fill Material: Use on site fill material under provisions of Section 31 23 00 and in accordance with Geotechnical recommendations. When in conflict Geotechnical recommendations precede information in this specification.
 - 1. Unsuitable material would include topsoil, organics, trash, ash, frozen material, hard lumps and clods, and any rocks larger than 6 inches.
 - a. Topsoil makes up approximately the first foot below the surface, and its use as backfill should be avoided. Reference Geotechnical report for specific layer thickness.
 - 2. Maximum loose lift thickness shall be 12 inches.
 - a. If compaction cannot be achieved, decrease size of lifts until compaction is achieved.
 - b. Compaction must meet all requirements under provisions of Section and as stated in the Geotechnical Report.
 - 3. Fill should not be placed if material is frozen or surface to be placed is frozen.
 - 4. Compaction specifications
 - a. Moisture content should be +/- 3% of OMC
 - b. Relative compaction should be greater than 98%
 - c. Standard Proctor used is (ASTM D698)

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify areas to be demolished are unoccupied and discontinued in use
- B. Do not commence work until conditions are acceptable to Engineer and Owner
- C. Existing conditions of Equipment and Materials, structures, surfaces, or properties that could be misinterpreted as damaged as a result of demolition work shall be photographed and filed with Owner and Engineer prior to commencement of Work.
 - 1. Any existing infrastructure which is damaged during demolition should be replaced or fixed by Contractor at no charge to the Owner.

3.2 PREPARATION

- A. Provide, erect, and maintain temporary barriers, enclosures, security fences and shoring at demolition locations in accordance with Division 1 and other related specifications to protect personnel.
- B. Protect existing structures and utilities which are not to be demolished.
- C. Provide temporary wiring and connections to maintain existing telephone, electrical, instrumentation and control systems in service during construction.
- D. Protect existing electrical and controls equipment and cabinets from dust and debris intrusion. Set up temporary barriers to preclude dust from being introduced into cabinets and equipment. Additionally, seal all cabinets and equipment while demolition is occurring. Control and or turn off existing heating and ventilation systems that will introduce or distribute dust and debris from the demolition operations.
- E. Mark location of existing utilities prior to the start of the demolition work. Confirming location of existing utilities prior to marking is the responsibility of the Contractor. The marking of existing utility locations is the responsibility of the Contractor.

3.3 GENERAL REQUIREMENTS

- A. Sprinkle work with water to minimize dust where applicable. Provide hoses and water connections for this purpose.
- B. Do not use water to excess, causing flooding, contaminated runoff, or icing.
- C. Remove demolished material from the site.
- D. Repair damage to adjacent structures.
- E. Existing wetwell shall be filled with native material and compacted to 95% ASTM Proctor Standard.
- F. Remove existing exposed piping and electrical wiring and conduit to be abandoned to structural surface, cut flush, and finish to match existing surfaces.
- G. Remove buried piping, wiring, and conduit to be abandoned as required for the Work. Plug the remainder flush.
- H. Compaction Specifications for backfill
 - a. Moisture content should be +/- 3% of OMC
 - b. Relative compaction should be greater than 98%
 - c. Standard Proctor used is (ASTM D698)

3.4 DISPOSAL

- A. Do not store or burn waste materials on-site
- B. Transport demolition debris to designated off-site disposal area.
- C. If hazardous materials are encountered during demolition work, Contractor shall comply with applicable regulations and laws regarding the removal, handling, and protection of environment and human health.

3.5 CONNECTION TO EXISTING CONSTRUCTION

- A. Cut and remove portions of existing construction as necessary to allow for proper installation of new construction Equipment and Materials.
- B. Shore and brace existing structures to maintain safe structure conditions and until permanent structures and supports are completed
 - 1. Contractor shall repair all damage in result of installation of shoring and bracing
- C. Cap, seal or abandon pipe and cable as indicated on Drawings and specified herein

3.6 CLEANUP AND REPAIR

- A. Contractor shall remove tools, equipment and demolished materials from Site upon completion of demolition work
 - 1. Remove protections
 - 2. Interior areas shall be broom clean
 - 3. Inspect and clean all electrical control cabinets, interior and exterior, exposed to dust and debris during the demolition process
- B. Contractor shall repair demolition performed in excess of what is required or indicated on drawings or in contractor.
 - 1. Surfaces and structures to remain shall be repaired to the existing conditions prior to commencement of demolition work this includes impacts from construction traffic, wet weather, storage of construction related materials or other construction related activities.

3.7 SITE DEMOLITION

- A. Identify and mark existing utilities within demolition area, and protect in place.
- B. When applicable, remove asphalt paving, parkway, and other concrete work to facilitate construction. Remove concrete to nearest joint beyond demolition area.
- C. Backfill areas excavated caused as a result of demolition, shall be completed in accordance with Section 31 23 00.
- D. Rough grade and compact areas affected by demolition to maintain site grades and contours as shown on drawings
- E. Remove demolished materials from site. Storage of large materials on-site should not exceed 24 hours.
- F. Do not burn or bury materials on site, unless otherwise directed by Owner. Leave site in clean condition at the end of each day and prior to each weekend.

END OF SECTION

DIVISION 3 – CONCRETE

SECTION 030310 LEAKAGE TESTING OF HYDRAULIC STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes the method of testing concrete hydraulic structures for leakage. Tank shall be leak tested per the requirements of the American Concrete Institute (ACI) 3510.1 – latest edition.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete: 03 30 00.
- B. Concrete Finishing: 03 35 00.

PART 2 - MATERIALS

Provide water, piping, and equipment to test concrete structures for leakage.

PART 3 - EXECUTION

3.01 GENERAL

- A. Hydrostatically test reinforced concrete structures which will contain water to determine that they conform to "Leakage Test Procedure" herein and are free of detectable leaks. Do not hydrostatically test walls which are to be restrained or laterally supported by slabs until slab concrete has obtained the specified compressive strength.
- B. Prior to testing, clean exposed surfaces by thoroughly hosing and removing surface laitance and loose matter from walls and slabs. Remove wash water and debris from the structures by means through tank piping.

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- C. Conduct testing before backfill is placed against walls and after concrete has attained the specified compressive strength, the concrete has cured, and joint sealants have set and cured a minimum of 14 days.

3.02 LEAKAGE TEST PROCEDURE

- A. Fill hydraulic structures to be subjected to leakage tests with water to the maximum operating liquid level line. Filling shall not exceed 8 feet of water depth per 24-hour period. Filling shall be at a uniform rate over a 24-hour period with continuous monitoring. For structures with adjacent bays, fill all bays simultaneously. Empty adjacent bays alternately. Repair any running leaks which appear during filling before continuing.
- B. After the structure has been kept full for 48 hours, it will be assumed for the purposes of the test that the absorption of moisture by the concrete in the structure is complete. Close all valves and gates to the structure and measure the change in water surface each day for a three-day period.
- C. During the test period, examine exposed portions of the structure, and mark visible leaks or damp spots. Repair visible leaks or damp spots after dewatering. If the drop in water surface in a 24-hour period exceeds 1/10 of 1% of the normal volume of liquid contained in the structure, the leakage shall be considered excessive. Crystalline waterproofing shall be assumed to be fully effective within three days after filling the structure. Repair leaks and damp spots that still exist three days after filling.
- D. The determination of surface moisture evaporation shall be aided with a 24-inch-deep, white-colored, watertight container with not less than 10 square feet of surface area exposure. Position container to experience environmental conditions similar to the structure being tested. Subtract the water loss due to evaporation from the measured water loss in the structure to determine the water loss due to leakage.
- E. If the leakage is excessive, drain the structure, repair leaks and damp spots, and refill the structure and again test for leakage. Continue this process until the drop in water surface in a 24-hour period meets the test requirements.
- F. Inspect the manholes of the underdrain system for evidence of leaks in floor slabs. If leakage is indicated, locate and repair.
- G. Repair visible leaks and damp spots whether leakage exceeds the allowable leakage or not.
- H. Make repairs and additional filling and testing (including the cost of water) at no additional cost to the Owner.

3.03 REPAIR METHODS

Methods for repairing concrete not passing the leakage test shall be as described in Section 03 35 00.

END OF SECTION

SECTION 031110 CONCRETE FORMWORK

PART 1 GENERAL

1.01 DESCRIPTION

This section describes materials and installation of concrete forms.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Leakage Testing of Hydraulic Structures: 03 05 10.
- B. Concrete Joints, Water Stops, and Sealants: 03 15 00.
- C. Concrete Reinforcement: 03 21 00.

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- D. Concrete: 03 30 00.
- E. Concrete Finishing: 03 35 00.
- F. Painting and Coating: 09 90 00.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Submit manufacturer's literature for form ties, spreaders, corner formers, form coatings, and bond breakers.

PART 2 - MATERIALS

2.01 FORM CONSTRUCTION AND DESIGN

- A. Design forms according to the applicable portions of ACI 347. Form all concrete, except as specified otherwise.
- B. Provide form windows or stage forms to allow visual observation at all times of the concrete being placed and vibrated. Provide a formwork design and placement schedule that will limit free fall of concrete in walls 8 inches or less in thickness to 4 feet and for walls thicker than 8 inches, limit this fall to 6 feet. Total vertical lift made in a single pass shall not exceed 2 feet in height.
- C. Notify the Owner's Representative prior to concrete placement (48 hours minimum).
- D. Steel forms shall be minimum 24 gauge, with tongue-and-groove joints, complete with steel stakes and splice plates.

2.02 CLASSES OF FORMS

- A. Class I Forms: Use steel forms, ply form, or smooth-surface plywood 3/4-inch minimum thickness for straight surfaces and 1/2-inch minimum thickness for curved surfaces.
- B. Class II Forms: Use plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue-and-groove or ship-lap joints.
- C. Class II forms may be used for exterior concrete surfaces that are 1 foot or more below finished grade. Use Class I forms for all other surfaces.

2.03 FORM MATERIAL

- A. Use plywood, lumber, and steel of sufficient strength and surface smoothness to produce the specified finish.
- B. Lumber used in form construction shall be Douglas fir, No. 2 grade, S4S, Standard Grading and Dressing Rules No. 16, West Coast Lumber Inspection Bureau; or Southern Yellow Pine, No. 2, S4S, Standard Grade Rules Southern Pine Inspection Bureau. Boards shall be 6 inches or more in width.
- C. Plywood used in form construction shall be Grade B-B, Class 1 plyform, mill-oiled, and sanded on both sides in conformance with U.S. Product Standard PS-1.

2.04 FORM TIES

- A. Locate form ties on exposed surfaces in a uniform pattern or as indicated in the drawings. Place form ties so they remain embedded in the concrete except for a removable portion at each end and do not leave an open hole through the concrete. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch. Construct form ties so that no metal is within 1 inch of the concrete surface when the forms, inserts,

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and tie ends are removed. Do not use wire ties. Ties shall withstand all pressures and maintain forms within acceptable deflection limits.

- B. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1 inch and sufficient dimensions to permit patching of the tie hole.
- C. Ties for water-holding structures or dry structures with access, such as basements or pipe galleries, that are below finish grade shall have an integral steel water stop that is tightly and continuously welded to the tie. The water stop shall be at least two times larger in area than the tie cross-sectional area and shall be oriented perpendicular to the tie and symmetrical about the center of the tie. Construct the ties to provide a positive means of preventing rotation or disturbance of the center portion of the tie during removal of the ends.
- D. Tapered form ties shall be tapered through-bolts at least 1 inch in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size.

2.05 BOND BREAKER

Bond breaker shall be a Colorado V.O.C.-compliant nonstaining type that will provide a positive bond prevention, such as Clean Lift 90 W.B. as manufactured by Edoco Burke; Silcoseal 97EC as manufactured by Nox-Crete, Inc.; or equal.

2.06 FORM RELEASE AGENT

- A. Form release agent shall effectively prevent absorption of moisture by the form and prevent bond with the concrete. Agent shall be nonstaining, Colorado V.O.C.-compliant, leave concrete with a coatable surface, and be nontoxic after 30 days.
- B. For steel forms, release agent shall prevent discoloration of the concrete due to rust.

PART 3 - EXECUTION

3.01 FORM TOLERANCES

- A. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

	Maximum Tolerance (inch)
Sleeves and inserts	+1/4 -1/4
Projected ends of anchors	+1/4 -0.0
Anchor bolt setting	+1/4 -1/4
Finished concrete, all locations	+1/4 -1/4 in 10 feet
	Max ±1-inch in total length

- B. The planes or axes from which the above tolerances are to be measured shall be as follows:

Sleeves and inserts:	Centerline of sleeve or insert.
Projected ends of anchors:	Plane perpendicular to the end of the anchor as located in the drawings.
Anchor bolt setting:	Centerline of anchor bolt.
Finish concrete:	The concrete surface as defined in the drawings.

- C. Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

- D. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.

3.02 FORM SURFACE PREPARATION

- A. Clean form surfaces to be in contact with concrete of foreign material prior to installation. Tape, gasket, plug, and/or caulk joints, gaps, and apertures in forms so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.
- B. Coat form surfaces in contact with concrete with a form release agent prior to form installation.
- C. Keep form coatings off steel reinforcement, items to be embedded, and the previously placed concrete.
- D. Coat face and edges of Class I forms with a two-coat system of one-component polyurethane coating applied by roller at the rate of 500 square feet per gallon.

3.03 BEVELED EDGES (CHAMFER)

Form 3/4-inch beveled edges on exposed concrete edges and corners, beam soffit corners, and where indicated in the drawings. Reentrant corners in concrete members shall not have fillets, unless otherwise shown in the drawings. The top edges of slabs, walkways, beams, and walls may be beveled with an edging trowel in lieu of using chamfer strips.

3.04 FORM PLACEMENT

- A. Provide means for holding adjacent edges and ends of form panels tight and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Forms shall be tight and shall prevent the loss of mortar and fines during placing and vibration of concrete.
- B. Provide exterior corners in concrete members with bevels as specified.
- C. Provide means for removing forms without injury to the surface of finished concrete.
- D. Do not embed any form-tying device or part thereof other than metal in the concrete.
- E. Locate large end of taper tie on the "wet" side of the wall.
- F. Use only form or form-tying methods that do not cause spalling of the concrete upon form stripping or tie removal.
- G. Form surfaces of concrete members except where placement of the concrete against the ground is shown in the drawings or as indicated below. The dimensions of concrete members shown in the drawings apply to formed surfaces, except where otherwise indicated. Add 2 inches of concrete where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement of concrete against the ground shall be limited to footings and other nonexposed concrete and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.

3.05 FORM REUSE

Reuse only forms that provide a uniform surface texture on exposed concrete surfaces. Apply light sanding or other surface treatment between uses for uniform texture. Plug unused tie rod holes with corks, shave flush, and sand the concrete surface side. Do not patch forms other than filling tie rod holes, except in the case of Class II forms. Do not use metal patching discs on Class I forms.

3.06 REMOVAL OF FORMS

- A. Forms and shoring for elevated structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and reshore. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, and bracing may be removed:

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Sides of footings and encasements	24 hours
Walls, vertical sides of beams, girders, columns, and similar members not supporting loads	72 hours
Slabs, beams, and girders	10 days (forms only)
Shoring for slabs, beams, and girders	Until concrete strength reaches specified 28-day strength
Wall bracing	Until top or roof slab concrete reaches specified 28-day strength

- B. Do not remove forms from concrete that has been placed with outside air temperature below 50°F without first determining if the concrete has properly set without regard for time. Do not apply heavy loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

3.07 FORMED OPENINGS

Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure watertightness. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

3.08 EMBEDDED ITEMS

Set anchor bolts and other embedded items accurately before placing concrete and hold securely in position until the concrete is placed and set. Check special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after placing concrete. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to placing concrete.

3.09 ALUMINUM SURFACES IN CONTACT WITH CONCRETE

Coat aluminum surfaces that will be in contact with concrete per Section 09 90 00, System No. 54.

3.10 PIPES AND WALL SPOOLS CAST IN CONCRETE

- A. Install wall spools, wall flanges, and wall anchors before placing concrete. Do not weld, tie, or otherwise connect the wall spools or anchors to the reinforcing steel.
- B. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will occur during construction.
- C. Pipes or spools located below operating water level shall have water stop ring collars and shall be cast in place. Do not block out such piping and grout after the concrete section is cast. Pipes fitted with thrust rings shall be cast in place.

END OF SECTION

SECTION 031500 CONCRETE JOINTS, WATER STOPS, AND SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, testing, and installation of construction and expansion joints, PVC water stops, hydrophilic waterstops, premolded joint filler, joint sealant, bond breaker tape, preformed control joints, backing rod, and steel expansion joint dowels.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Leakage Testing of Hydraulic Structures: 03 05 10.
- B. Concrete Formwork: 03 11 10.
- C. Concrete Reinforcement: 03 21 00.
- D. Concrete: 03 30 00.
- E. Concrete Finishing: 03 35 00.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Submit manufacturer's literature, catalog data, and statement of compliance with referenced standards and specifications for materials specified herein.
- C. Submit material samples of PVC water stops.
- D. Provide technical data sheets for the Contractor's personnel and the Owner covering joint preparation, priming, and sealant materials application.
- E. Submit layouts for construction joints.
- F. For potable water, provide certification that all joint materials meet the requirements of ANSI/NSF 61 for contact with potable water.

1.04 MANUFACTURER'S SERVICES

Prior to joint preparation for joints receiving sealant materials, the Contractor shall require joint manufacturer's technical representative to demonstrate at the site joint preparation, priming, and sealant materials application for the Contractor's personnel performing joint work.

PART 2 - MATERIALS

2.01 PVC WATER STOP

Water stop shall be:

- A. Extruded from a virgin elastomeric PVC compound and shall be center-bulb type as manufactured by Greenstreak, or equal. Water stop shall comply with Corps of Engineers Specification CRD-C-572.
- B. Of the dimensions and profile shown in the drawings.

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- C. Resistant to chemical action with portland cement, alkalies, acids, and not affected by mildew or fungi. It shall show no effect when immersed for 10 days in a 10% solution of sulfuric or hydrochloric acid, saturated lime solution or salt water. Water stops shall be such that any cross section will be dense, homogeneous, and free from porosity and other imperfections. They shall be symmetrical in shape. When tested in accordance with Federal Standard No. 601, the material shall meet the following minimum requirements:

Requirement	ASTM Spec.
Tensile strength, 2,000 psi	D638
Hardness, Shore durometer, 79+/-3	D2240
Elongation, ultimate, 300%	D638
Water absorption, dry weight, maximum (48 hours) 0.15%	D570
Specific gravity, 1.38 max	D792
Stiffness in flexure, 700 psi	D747
Cold brittleness, -35°F	D746
Tear resistance, 300 lbs/inch	D624

2.02 HYDROPHILIC WATERSTOP (BENTONITE / POLYMER TYPE)

- A. SIKA HYDROTITE CJ-1020-AK-ADH as manufactured by Sika Corporation or approved equal.
- B. Preformed, adhesive-backed, hydrophilic waterstop composed of modified chloroprene rubber with hydrophilic expansion agents.
- C. Waterstop shall expand upon contact with water to form a watertight seal within construction joints.
- D. Nominal cross-section: 1" x 3/4" (or confirm CJ-1020 profile) unless otherwise indicated on the drawings.
- E. Performance requirements:
- Controlled expansion (non-bentonite or low-pressure expansion suitable for structural concrete joints).
 - Reversible expansion and contraction characteristics.
 - No degradation in potable or wastewater environments.
 - Suitable for use in continuously submerged conditions.
- F. Compatible with potable water systems where required (NSF 61 certification if applicable to project).
- G. Resistant to chemicals typical of wastewater environments.

2.03 JOINT SEALANT FOR CONCRETE STRUCTURES

- A. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, gun grade polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25 for horizontal joints and Grade NS, Class 25 for vertical joints and be recommended by the manufacturer for continuous immersion in water.
- B. Sealant for above grade and in non-immersion areas shall be Sikaflex 1A as manufactured by Sika Corporation.

2.04 BACKING ROD FOR EXPANSION JOINTS

Backing rod shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware, or equal. The rod

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shall be 1/4 inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices. Apply backup rod and bond breaker tape in expansion joints.

2.05 BOND BREAKER TAPE

Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape that will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

2.06 PREFORMED CONTROL JOINT

Prefomed control joint shall be a one-piece, flexible, PVC joint former, such as Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex Corp., Knoxville, Tennessee, or a one-piece steel strip with preformed groove, such as Keyed Kold Retained Kap, manufactured by Burke Concrete Accessories, Inc., San Mateo, California, or equal. Provide the preformed control joint material in full-length unspliced pieces.

2.07 PREMOLDED JOINT FILLER FOR PAVEMENTS AND SLABS

Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D1752, Type I, as manufactured by W. R. Grace Company of Cambridge, Massachusetts; W. R. Meadows, Inc., Elgin, Illinois.

2.08 PREMOLDED JOINT FILLER FOR HYDRAULIC STRUCTURES

Sponge rubber per ASTM D1752, Type I.

2.09 STEEL EXPANSION JOINT DOWELS

- A. Steel expansion joint dowels shall conform to one of the following:
 - 1. Steel bar dowels with a 12-mil-thick epoxy coating. Steel bar dowels shall conform to ASTM A36 or ASTM A615, plain rounds, Grade 40. Epoxy coating shall be in conformance with ASTM A775; or
 - 2. Stainless steel bar dowels conforming to ASTM A276, Type 316.
- B. Thoroughly grease expansion joint prior to placing adjoining wall or slab concrete.

2.10 STYROFOAM FILLER BLOCK

Styrofoam filler blocks for future construction and expansion joints shall be Styrofoam SM brand as manufactured by Dow Chemical Company or equal.

PART 3 - EXECUTION

3.01 PVC WATER STOPS

- A. Water stops shall be heat spliced at ends and intersections to ensure continuity. Bend water stops up from footing and slab joints and splice to wall water stop to result in a watertight structure. Construct forms for construction joints in such a manner as to prevent injury to water stops. Hold water stops securely in position in the construction joints by wire ties, continuous bars, and rings as indicated. Install water stops in construction and expansion joints in hydraulic structures or where shown in the drawings.
- B. Make field splices with a thermostatically controlled heating iron in conformance with the manufacturer's current recommendations. Allow at least 10 minutes before pulling or straining the new splice in any way. The finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80% of the unspliced materials.

3.02 HDYROPHILIC WATERSTOPS

- A. Install hydrophilic waterstops where indicated on the drawings.
- B. Substrate shall be clean, dry, and free of laitance, dirt, oil, grease, and loose material. Keep clean and dry. Install waterstop centered along the construction joint unless otherwise indicated. Maintain minimum 2 inches concrete cover from all exposed surfaces. Do not place in locations where swelling pressure may cause concrete spalling.
- C. Secure using manufacturer's adhesive backing. Protect from premature exposure to moisture prior to concrete placement.

3.03 CONSTRUCTION JOINTS

- A. Provide construction joints where shown in the drawings. For purposes of maximum spacing requirements, expansion joints are considered to be construction joints. The foregoing applies unless otherwise indicated in the drawings.
- B. For slabs-on-grade that are not subject to hydraulic loading, use formed construction joints. Maximum size of pour shall be 75 feet each way for slabs with bar reinforcement. Allow 24 hours between pours of adjacent slabs. Provide joints as specified or shown. Set continuous expansion joint strips between slabs and abutting vertical surfaces as indicated in the drawings.
- C. For control joints of nonstructural slabs, provide partial depth plastic strips set flush with finished surface or 1/8-inch-wide joints cut with a diamond saw. Use control joints one-quarter to one-third the depth of the slab unless otherwise indicated.
- D. Construction joints shall be keyed, unless otherwise detailed. Form keyways by beveled strips or boards placed at right angles to the formed face. Except where otherwise shown in the drawings or specified, keyways shall be at least 1 1/2 inches in depth over at least 25% of the width of the section.
- E. After the pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose or defective concrete, and foreign material, and expose clean aggregate by sandblasting the surface of construction joints before placing the new concrete. Cover horizontal construction joints with mortar. Spread uniformly and work thoroughly into all irregularities of the surface. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed, and the consistency of the mortar shall be suitable for placing and working.
- F. In case of emergency, place additional construction joints. (An interval of 45 minutes between two consecutive batches of concrete shall constitute cause for an emergency construction joint.)

3.04 EXPANSION JOINTS

Provide expansion joints with continuous edge reservoirs, which shall be filled with a joint sealant. Leave the material used for forming the reservoirs in place until immediately before cleaning the grooves and filling them with joint sealant. After removing edge forms from the reservoir, remove grout, loose concrete, and fins; then sandblast the slots. Allow the reservoirs to become thoroughly dry; then blow out the reservoirs and immediately prime and fill with the expansion joint sealant and backup materials. The joint sealant manufacturer shall supply the primer used.

3.05 INSTALLATION OF PREMOLDED JOINT FILLER

Install in joint accurately as shown. Attach to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

3.06 INSTALLATION OF JOINT SEALANTS

- A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.

- B. Apply masking tape along the edges of the exposed surface of the exposed joints.
- C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.
- D. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.
- E. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.
- F. After applying the sealant, remove the masking tape and any sealant spillage.

3.07 INSTALLATION OF STEEL EXPANSION JOINT DOWELS

Install parallel to wall or slab face, perpendicular to the joint face, and in true horizontal position. Secure tightly in forms with rigid ties. Orient dowels to permit joint movement.

3.08 CRACKING

- A. Saw joints in slabs before the formation of uncontrolled cracking (i.e., cracking that occurs at locations other than construction, control, or contraction joints) and as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing. Saw joints both during the day and night as required.
- B. If concrete cracks at locations other than construction, control, or contraction joints, the Contractor may be required to remove and replace the defective work (cracked concrete) in accordance with the provisions of this section, at no additional cost to the Owner.

3.09 LEAKAGE TESTING

Test hydraulic structures in accordance with Section 03 05 10.

END OF SECTION

SECTION 032100 CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, testing, and installation of reinforcing steel in concrete.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete Formwork: 03 11 00.
- B. Concrete Joints, Water Stops, and Sealants: 03 15 10.
- C. Concrete: 03 30 00.
- D. Concrete Finishing: 03 35 00.

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1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions Section 01 33 00.
- B. Submit mill test certificates identifying chemical and physical analyses of each load of reinforcing steel delivered. If mill test reports are unavailable and the quantity of steel for a structure exceeds 5 tons, provide a laboratory test to prove conformance with the specified ASTM standard.
- C. Submit reinforcing bending lists and placing drawings for all reinforcing. Placing drawings shall indicate all openings (mechanical, electrical, equipment, and architectural) including additional reinforcing at openings and corner bar arrangements at intersecting beams, walls, and footings indicated in the typical detail and structural drawings. Placing drawings shall be coordinated with the concrete placing schedule. Each bending list and placing drawing submitted shall be complete for each major element of a structure (grade slabs, footings, walls, deck, floor, or roof slabs) including dowels and corner bars. Furnishing such lists shall not be construed that the lists will be reviewed for accuracy. The Contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown in the drawings and as specified. Placing drawings shall be prepared by the Contractor and shall not incorporate photocopies of the contract drawings.
- D. Submit manufacturer's certification that epoxy-coated reinforcing complies with ASTM A775 or ASTM A934, including coating thickness, holiday testing, and material properties. Submit product data for epoxy repair materials, including application procedures and compatibility with reinforcing coating.

PART 2 - MATERIALS

2.01 REINFORCING STEEL

- A. Reinforcement shall conform to ASTM A615 or A706, Grade 60.
- B. Where indicated on the drawings, reinforcing steel shall be epoxy-coated in accordance with:
 - 1. ASTM A775 – Fusion-bonded epoxy coating for reinforcing steel; or
 - 2. ASTM A934 – Epoxy-coated reinforcing bars (prefabricated after coating), where applicable
- C. Coating Requirements:
 - 1. Coating thickness: 7 to 12 mils
 - 2. Coating shall be continuous, holiday-free, and uniform
 - 3. Bars shall be free of cracks, pinholes, or damage prior to placement
- D. Handling and Storage:
 - 1. Store coated reinforcing on nonconductive supports.
 - 2. Protect from UV exposure, moisture, and mechanical damage.
 - 3. Do not drag bars on the ground or against each other.
- E. Fabricate reinforcing in accordance with CRSI Manual of Standard Practice.
- F. For epoxy-coated bars, bending shall be performed prior to coating unless ASTM A934 bars are specified.
- G. Deliver reinforcing steel to the site bundled and with identifying tags.

2.02 WELDED WIRE REINFORCEMENT

Welded wire reinforcement shall conform to ASTM A185.

2.03 TIE WIRE

Tie wire shall be 16-gauge minimum, black, soft annealed.

2.04 BAR SUPPORTS

- A. Bar supports in beams and slabs exposed to view after form stripping shall be galvanized and plastic coated. Use concrete supports for reinforcing in concrete placed on grade.
- B. Bar supports for epoxy-coated reinforcing shall be plastic-coated, stainless steel, or dielectric material to prevent damage to the coating.

PART 3 - EXECUTION

3.01 PLACING

- A. Place reinforcing steel in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.
- B. Place reinforcing in accordance with the following, unless otherwise indicated:
 - 1. Reinforcement indicated in the drawings is continuous through the structure to the farthest extent possible. Terminate bars 2 inches clear from faces of concrete.
 - 2. Splices may be used to provide continuity due to bar length limitations. Minimum length of bars spliced for this reason is 30 feet. Do not splice reinforcement that is detailed to be continuous in the drawings.
- C. Reinforcing steel, before being positioned and just prior to placing concrete, shall be free from loose mill and rust scale and from any coatings that may destroy or reduce the bond. Clean reinforcing steel by sandblasting or wire brushing and remove mortar, oil, paint, or dirt to remove materials that may reduce the bond.
- D. For epoxy coated reinforcing, reinforcing steel shall be free from loose mill scale, rust, oil, or other deleterious materials. Epoxy-coated reinforcing shall not be wire brushed or sandblasted. Damaged coating shall be repaired in accordance with this specification.
- E. Handle epoxy-coated reinforcing using padded slings or nonmetallic devices. Do not drop, drag, or mechanically damage coating. Replace or repair damaged coating prior to concrete placement.
- F. Do not straighten or rebend reinforcing steel in the field. Do not use reinforcing with bends not shown in the drawings.
- G. Position reinforcing steel in accordance with the drawings and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms to provide the specified concrete coverage. Bars additional to those shown in the drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position, shall be provided by the Contractor at his own expense.
- H. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.
- I. Secure reinforcing dowels in place prior to placing concrete. Do not press dowels into the concrete after the concrete has been placed.

J. Roll wire mesh used for reinforcement flat before placing concrete. Support and tie wire mesh to prevent movement during concrete placement.

K. Position dowels for masonry walls to occur at reinforced block cells.

3.02 SPLICES

A. Splices shall be as indicated in the drawings. Unless otherwise shown, stagger splices in adjacent horizontal bars as indicated in the drawings.

B. For epoxy-coated reinforcing, lap splice lengths shall be increased as required by ACI 318/ACI 350.

3.03 ADDITIONAL REINFORCEMENT AROUND OPENINGS

Place additional reinforcement around pipe or openings as indicated in the drawings.

3.04 WELDING REINFORCEMENT

Do not weld reinforcing steel unless specifically noted. Welding of reinforcing steel shall be in accordance with AWS D1.4.

3.05 PLACING WELDED WIRE FABRIC

Extend fabric to within 2 inches of the edges of the slab and lap splices at least 1 1/2 courses of the fabric and a minimum of 6 inches. Tie laps and splices securely at ends and at least every 24 inches with 16-gauge black annealed steel wire. Pull fabric into position as the concrete is placed by means of hooks, and work concrete under the steel to ensure that it is placed at the proper distance above the bottom of the slab.

3.06 FIELD REPAIR OF EPOXY COATING

A. Repair all damaged epoxy coating, including damage caused by handling, cutting, bending, or installation.

B. Repair Material:

1. Use patching material conforming to ASTM A775 and recommended by the coating manufacturer.
2. Acceptable products include materials from Sika Corporation, Sherwin-Williams, or approved equal.

C. Surface Preparation:

1. Clean damaged area of dirt, oil, and loose coating.
2. Remove rust by light hand cleaning where required.
3. Ensure surface is dry prior to application.

D. Application:

1. Apply repair material to all exposed steel.
2. Extend repair coating onto intact epoxy coating a minimum of 1 inch.
3. Apply to achieve a minimum thickness of 7 mils

E. Damage Threshold:

1. Repair all coating damage greater than 1/16 inch in diameter.

- 2. If total damaged area exceeds 2% of bar surface area in any 1-foot length, bar shall be rejected or recoated
- F. Curing: Allow repair material to cure per manufacturer recommendations prior to concrete placement.
- G. Engineer or inspector may require visual inspection and holiday testing of repaired areas.

END OF SECTION

SECTION 033000 CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, mixing, testing, and placing of concrete and grout.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Leakage Testing of Hydraulic Structures: 03 05 10.
- B. Concrete Formwork: 03 11 00.
- C. Concrete Joints, Water Stops, and Sealants: 03 15 10.
- D. Concrete Reinforcement: 03 21 00.
- E. Concrete Finishing: 03 35 00.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Prepare concrete and mortar mix designs and laboratory 7-day and 28-day compressive tests, or submit test reports of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects. Prepare mix designs in accordance with ACI 318, and ACI 350, except as modified herein. Submit mix design in writing for review by the Owner at least 15 days before placing of any concrete.
- C. Submit reports of drying shrinkage testing from subsection on "Trial Batch and Laboratory Test."
- D. Provide certificate that cement used complies with ASTM C150 and these specifications.
- E. Provide certificates that aggregates comply with ASTM C33 and contain less than 1% asbestos by weight or volume. State weathering region limits of coarse aggregates: severe, moderate, or negligible. State basis of determining that potential reactivity is negligible. Identify certifications and tests to actual materials to be used in the work. Provide additional tests and certifications for each change in material source. Provide an alternate material source of aggregate if tests indicate that aggregates are reactive or possess severe weathering potential. Submit gradation analysis with concrete mix designs.
- F. Provide delivery tickets for ready-mix concrete or weighmasters certificate per ASTM C94, including weights of cement and each size aggregate and amount of water added at the plant and record of pours. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both coarse and fine aggregate.
- G. Provide certificate of compliance with these specifications from the manufacturer of the concrete admixtures.

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- H. Provide epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's certifications as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions.
- I. Provide nonshrink grout manufacturer's certificate of compliance with these specifications and specific instructions for use.
- J. Submit six copies of a report from a testing laboratory verifying that aggregate and gravel material contains less than 1% asbestos by weight or volume and conforms to the specified gradations and characteristics.
- K. Plant Qualification: Submit certification from the National Ready Mixed Concrete Association indicating compliance with the specified qualification requirements.
- L. For potable water, provide certification that materials used in grout, concrete, or the curing and repair of concrete meet the requirements of ANSI/NSF 61 for contact with potable water.
- M. Submit manufacturer's product data, dosage rates, and performance data for waterproofing admixture. Include documentation demonstrating compatibility with other specified admixtures and compliance with ANSI/NSF 61 where used in potable water structures.

1.04 PLANT QUALIFICATION

Meet requirements of the Check List for Certification of Ready Mixed Concrete Production facilities of the National Ready Mixed Concrete Association and ASTM C94.

1.05 STANDARDS

- A. Unless otherwise indicated, materials, workmanship, and practices shall conform to the following standards:
 - 1. IBC.
 - 2. ACI 301, "Structural Concrete for Buildings."
 - 3. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 4. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures."
 - 5. ANSI/NSF 61, "Drinking Water System Components – Health Effects."
- B. Where provisions of pertinent codes and standards conflict with this specification, the more stringent provisions govern.

1.06 SHRINKAGE TESTS

- A. Perform drying shrinkage tests for the trial batch specified in the paragraph in Part 2 entitled "Trial Batch and Laboratory Tests."
- B. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gauge length of 10 inches. Fabricate, cure, dry, and measure specimens in accordance with ASTM C157 modified as follows:
 - 1. Remove specimens from molds at an age of 23 hours $\pm$ 1 hour after trial batching, place immediately in water at $70^{\circ}\text{F} \pm 3^{\circ}\text{F}$ for at least 30 minutes, measure within 30 minutes thereafter to determine original length, then submerge in saturated lime water at $73^{\circ}\text{F} \pm 3^{\circ}\text{F}$. At age seven days, make measurement to determine expansion, expressed as a percentage of original length. This length at age seven days shall be the base length for drying shrinkage calculations (zero days' drying age).
 - 2. Then, store specimens immediately in a humidity-controlled room maintained at $73^{\circ}\text{F} \pm 3^{\circ}\text{F}$ and 50% $\pm$ 4% relative humidity for the remainder of the test. Make and report measurements to determine

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shrinkage expressed as percentage of base length separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

- C. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at zero days' drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of the shrinkage test to the nearest 0.001% of shrinkage. Take compression test specimens in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as specified in Part 2.

PART 2 - MATERIALS

2.01 NONDOMESTIC CEMENT AND ADDITIVES

- A. The use of nondomestic cement and additives in concrete may be permitted only after review of a written request to use such materials. The request to use nondomestic materials shall include a chemical analysis that indicates the material meets the project specifications. Certifications that state the nondomestic materials meet the project requirements will not be accepted.
- B. Test reports for concrete materials shall be current to within three months of inclusion into the project and shall be identifiable to the materials supplied.

2.02 CEMENT

- A. Unless nondomestic cement has been approved, use domestic portland cement that conforms to ASTM C150, Type II or, provide a mixture of 85% Type II portland cement.
- B. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.
- C. Maximum tricalcium aluminate shall not exceed 8%. The maximum percent alkalis shall not exceed 0.6%.

2.03 AGGREGATES

Aggregates shall be natural rock, sand, or crushed natural rock and shall comply with ASTM C33, and shall contain less than 1% asbestos by weight or volume. Aggregates shall be free from any substances that will react with the cement alkalis, as determined by Appendix X-1 of ASTM C33.

2.04 WATER AND ICE

Use water and ice that is clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities that might reduce the strength, durability, or otherwise adversely affect the quality of the concrete. Water shall not contain more than 500 mg/L of chlorides or more than 500 mg/L of sulfate.

2.05 CONCRETE ADMIXTURES

- A. Class A concrete shall contain an air-entraining admixture conforming to ASTM C260. Admixtures shall be Master Builders MB-AE 90, Sika AER, or equal.
- B. Class A concrete shall contain a water-reducing admixture conforming to ASTM C494, Type A. It shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations. Admixtures shall be Master Builders Pozzolith polymer-type normal setting, Plastocrete 161 or Plastiment, Sika Chemical Corporation, or equal.

- C. Class A concrete shall contain a shrinkage-reducing admixture at the rate of 1.5 gallons per cubic yard of concrete. Quantity of shrinkage-reducing admixture used in the mix shall be added to the quantity of water for purposes of determining the water/cement ratio. Admixture shall be Eucon SRA by Euclid Chemical, Tetraguard AS20 by BASF Construction Chemicals, Grace Construction Products "Eclipse," or equal.
- D. Mineral Admixture: Class A concrete shall contain a mineral admixture, fly ash Class F, conforming to ASTM C618, not to exceed or replace more than 15% of the cement material required without the mineral admixture.
- E. Class A concrete shall contain a liquid admixture for mitigation and control of alkali-silica reactivity (ASR). The dosage rate shall be determined in the concrete mix design per manufacturer's formula. The admixture shall contain a 30% lithium nitrate solution. ASR mitigation admixture shall be RASIR™ by W. R. Grace or equal.
- F. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.
- G. Class A concrete for liquid-containing or below-grade structures shall contain a crystalline waterproofing admixture. Waterproofing admixture shall be used in the following elements unless otherwise noted: Liquid-containing structures (tanks, basins, wet wells), below-grade walls and slabs, and structures exposed to groundwater. Admixture shall be added at the batch plant in strict accordance with the manufacturer's recommendations. Admixture shall: reduce permeability and provide integral waterproofing of concrete, be compatible with all other specified admixtures, not contain chlorides, and be suitable for potable water and wastewater exposure where applicable. Acceptable products include: "C-500, C-500NF, C-1000, or C-1000NF" by Xypex, "MasterLife 300 Series" by Master Builders Solutions, "AquaFin IC" by AquaFin "Penetron SB" by Penetron Corporation, "Krystol Internal Membrane (KIM)" by Kryton, "Eucon Vandex AM-10" by Euclid Chemical "Ipanex" by Cement Chemistry Systems or approved equal.

2.06 SUPERPLASTICIZER

Comply with ASTM C1017, Type 1 or 2.

2.07 NONSHRINK GROUT

Nonshrink grout shall conform to the Corps of Engineers Specification for Nonshrink Grout, CRD-621-83, and to these specifications. Use a nongas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be SikagROUT 928, UPCI High Flow, Master Flow 713, or equal. Components shall be inorganic.

2.08 ORDINARY TYPE GROUT (DRY PACK)

One-part portland cement to two parts sand (100% passing a No. 8 sieve). Add sufficient water to form a damp formable consistency.

2.09 EXPANSIVE GROUT

Premixed, cementitious mixture with a minimum 28-day strength of 3,500 psi. Provide air-entraining admixture as recommended by the manufacturer.

2.10 EPOXY GROUT

- A. Mix the two components of epoxy bonding compound in compliance with the manufacturer's instructions.
- B. Use sand that is oven dry and meets the following gradation requirements for epoxy grout.

Sieve Size	No. 8	No. 50	No. 100
% Passing	100	30 ±15	5 ±5

2.11 EPOXY GROUT FOR MACHINERY BASEPLATE INSTALLATION

A. Epoxy grouts shall meet the following minimum requirements:

1. Creep shall be less than 0.005 in./in. when tested per ASTM C1181. The tests shall be at 70°F and 140°F with a load of 400 psi.
2. Linear shrinkage shall be less than 0.080% and thermal expansion less than 17×10^{-6} in./in./°F when tested per ASTM C531.
3. Compressive strength shall be a minimum of 12,000 psi after seven days when tested per ASTM C579, Method B.
4. Bond strength to portland cement concrete shall be greater than 2,000 psi when tested per ASTM C882.
5. Epoxy grout shall pass the thermal compatibility test per ASTM C884 when overlayed on portland cement concrete.
6. Determine tensile strength and modulus of elasticity per ASTM D638. The tensile strength shall not be less than 1,700 psi and the modulus of elasticity shall not be less than 1.8×10^6 psi.
7. Determine gel time and peak exothermic temperature per ASTM D2471. Peak exothermic temperature shall not exceed 110°F when a specimen 6 inches in diameter by 12 inches high is used. Gel time shall be at least 150 minutes.
8. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperature as high as 150°F, with a load of 1,200 psi.
9. Products: Escoweld 7505E, with 7530 aggregate, or equal.

B. Epoxy primer shall be a lead free, chrome free, rust inhibitive, two-component epoxy primer specifically designed for use on metal substrates and in conjunction with epoxy grout products. Products: Escoweld 1014E Rust Inhibitive Epoxy Primer or equal.

C. Nonbonding Filler for Anchor Bolt Sleeves: Escoweld 7506 or equal.

D. Epoxy Grout Liquid: Escoweld 7502E or 7507E or equal.

2.12 JOINT MORTAR BED

Mortar or grout placed on horizontal construction joints shall be a mixture of cement, sand, and water in the same proportions used in the concrete but with coarse aggregate omitted.

2.13 EPOXY BONDING COMPOUND

Bonding compound shall be Sikadur 32 Hi-Mod, Sika Chemical Corporation, Lyndhurst, New Jersey; Concrevice by BASF; Euco Epoxy 452 by Euclid Chemical Company; or equal.

2.14 NONEPOXY BONDING COMPOUND

Use Weldcrete by Larsen Products Corp., Link by Sta-Dry Manufacturing Corp., Euco Weld by Euclid Chemical Co., or equivalent. The compound shall be rewettable for up to two weeks.

2.15 CONCRETE MIX DESIGN

- A. Conform to ASTM C94, except as modified by these specifications. Concrete mix design shall include all specified admixtures, including air-entraining, water-reducing, shrinkage-reducing, and waterproofing admixtures.
- B. Air content as determined by ASTM C231 shall be 5% to 7% $\pm 1.5\%$.
- C. Maximum water-cement ratio for Class A concrete = 0.42 by weight.
- D. Provide concrete with the following compressive strengths at 28 days and proportion it for strength and quality requirements in accordance with ACI 318 and ACI 350, "Proportioning on the Basis of Field Experience," to achieve 28-day compressive strength as follows:

Class	Type of Work	28-Day Minimum Compressive Strength (in psi)	Minimum Cement Content (in lbs per C.Y.)
A	Concrete for all structures and concrete not otherwise specified.	4,500	560

- E. Measure slump in accordance with ASTM C143. Slump shall be as follows:

- 1. Footings, walls, suspended slabs, beams, and columns: 4 inches maximum.

Proportion and produce the concrete to have a maximum slump as shown; slump is prior to addition of superplasticizer. A tolerance of up to 1 inch above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

- F. Aggregate size shall be 3/4 inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1 inch maximum for sections greater than 8 inches and less than 17 inches. Aggregate size shall be 1 1/2 inches maximum for all larger slabs and sections. Aggregate size for floor grout shall be maximum 3/8 inch.
- G. Combined aggregate grading shall be as shown in the following table:

Sieve Sizes	Maximum Aggregate Size		
	1 1/2"	1"	3/4"
	Percent Passing		
2"	100	---	---
1 1/2"	90 to 100	100	---
1"	50 to 86	90 to 100	100
3/4"	45 to 75	55 to 100	90 to 100
3/8"	38 to 55	45 to 75	60 to 80
No. 4	30 to 45	35 to 60	40 to 60
No. 8	23 to 38	27 to 45	30 to 45
No. 16	17 to 33	20 to 35	20 to 35
No. 30	10 to 22	12 to 25	13 to 23
No. 50	4 to 10	5 to 15	5 to 15
No. 100	1 to 3	1 to 5	0 to 5
No. 200	0 to 2	0 to 2	0 to 2

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- H. Mix design for pumped concrete shall produce a plastic and workable mix. The percentage of sand in the mix shall be based on the void content of the coarse aggregate.

2.16 CEMENT GROUT TOPPING

- A. The cement grout topping shall meet the following mix requirements or that mix design specified by the Contractor and his mechanical equipment supplier and reviewed by the Owner's Representative:

Sand:	Three parts by volume
Cement:	One part by volume

- B. Add only enough water to make a workable mixture and allow the mechanical screed to obtain a true and smooth surface.
- C. Make a trial grout batch of not less than 1/2 cubic yard to allow time (minimum of 24 hours) for adjustments in mix design if required.
- D. The cement grout shall obtain a minimum compressive strength of 2,000 psi in 28 days.
- E. The sand gradation shall be such that 100% shall pass the No. 16 sieve and not more than 30% shall be retained on a No. 30 sieve.

2.17 GRANULAR BASE

Use structural backfill material as specified in Section 312300.

2.18 SHRINKAGE LIMITATION

- A. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.036% or 0.042%, respectively. Use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to Class A concrete.
- B. If the trial batch specimens do not meet the shrinkage requirements, revise the mix design and/or materials and retest.

2.19 WORKABILITY

- A. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.
- B. Adjust the proportions to secure a plastic, cohesive mixture, and one that is within the specified slump range.
- C. To avoid unnecessary changes in consistency, obtain the aggregate from a source with uniform quality, moisture content, and grading. Handle materials to minimize variations in moisture content that would interfere with production of concrete of the established degree of uniformity and slump.

PART 3 - EXECUTION

3.01 SITE-MIXED CONCRETE

- A. Conform to ACI 304 as modified by these specifications.

- B. Use a batch-type mixer capable of combining the aggregates, cement, and water within the specified time into a thoroughly mixed and uniform mass and capable of discharging the mixture without segregation.
- C. Use equipment that can accurately proportion cement, coarse and fine aggregates, admixtures, and water. Proportion cement and aggregate by weight.
- D. Discharge each entire batch before recharging. Do not allow any batch to exceed the manufacturer's rated capacity of the mixer.
- E. Mixing time shall be as follows:
 - 1. For mixer of a capacity of 1 cubic yard or less, one and one-half minutes after batching is completed.
 - 2. For mixers of capacities larger than 1 cubic yard, one and one-half minutes plus one-half minute for each additional 1/2-cubic-yard capacity or fraction thereof in excess of 1 cubic yard.
 - 3. The mixer shall revolve at a uniform rate as specified by the manufacturer for the mixing equipment.

3.02 READY-MIXED CONCRETE

- A. Provide ready-mixed concrete conforming to ASTM C94 as modified by these specifications.
- B. Convey concrete from the truck to the place of final deposit as rapidly as practicable by methods that will prevent segregation or loss of ingredients to maintain the quality of the concrete. Place no concrete more than 90 minutes after mixing has begun for that particular batch. If it is necessary to add water to obtain the specified slump, add water per ASTM C94, but do not exceed the water content of the reviewed design mix.
- C. Use dry-batched concrete or jobsite mix only when haul time is excessive. Do not retemper partially hardened concrete.
- D. Keep a record showing time and place of each pour of concrete, together with transit-mix delivery slips certifying the contents of the pour.

3.03 PRIOR TO PLACING CONCRETE

- A. Subgrade: Compact the subgrade and/or bedding. Saturate the subgrade approximately eight hours before placement and sprinkle ahead of the placement of concrete in areas where vapor barrier is not used. Remove all standing water, mud, and foreign matter before concrete is deposited.
- B. Granular Base: When indicated in the drawings, install a granular base beneath the slab on grade or a structural foundation. Place the granular material on a compacted subgrade and compact the granular base to the same density as the subgrade.
- C. Vapor Barrier: Place under structural slabs and buildings and where indicated in the drawings. Lay vapor barrier sheets as described in Section 071119. Stretch and weight edges and laps to maintain their positions until concrete is placed.

3.04 PLACING CONCRETE

- A. Placement shall conform to ACI 304 as modified by these specifications.
- B. Coordinate in advance of concrete placement the sequence of placement to assure that construction joints will occur only as designed. Provide Owner's Representative with a copy of the sequence of placement in advance of placement.
- C. Alternate sections of concrete walls and slabs may be cast simultaneously. Do not place adjacent sections of walls and slabs until seven days after placement of first placed concrete.

- D. Notify the Owner's Representative of readiness, not just intention, to place concrete in any portion of the work. This notification shall be such time in advance of the operation as the Owner's Representative deems necessary to allow observation of the work at the location of the proposed concrete placing. Failure of sufficient advance notification will be cause for delay in placing until observations can be completed. Forms, steel, screeds, anchors, ties, inserts, and other embedded items shall be in place before the Contractor's notification of readiness is given.
- E. Schedule sufficient equipment for continuous concrete placing. Provide for backup equipment and procedures to be taken in case of an interruption in placing. Provide backup concrete vibrators at the project site. Test concrete vibrators the day before placing concrete.
- F. Do not place concrete until all free water has been removed or has been diverted by pipes or other means and carried out of the forms, clear of the work. Do not deposit concrete underwater, and do not allow free water to rise on any concrete until the concrete has attained its initial set. Do not permit free or storm water to flow over surfaces of concrete so as to injure the quality or surface finish.
- G. Where a vapor barrier is installed, do not puncture the vapor barrier by stakes or any other concrete accessory. Repair any holes in the vapor barrier by patching before placing concrete.
- H. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator.
- I. Use mechanical vibration in placing concrete to eliminate rock pockets and voids, to consolidate each layer with that previously placed, to completely embed reinforcing bars and fixtures, and to bring just enough fine material to exposed surfaces to produce a smooth, dense, and even texture. Vibrators shall be of the high-frequency internal type, and the number in use shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least two vibrators shall be available at the site. Use external vibrators for consolidating concrete when the concrete is otherwise inaccessible for adequate consolidating. Construct forms with sufficient strength to resist displacement or damage when external vibrators are used.
- J. Do not place concrete during rainstorms. Protect concrete placed immediately before rainstorms to prevent rainwater from coming in contact with freshly placed or uncured concrete. Keep sufficient protective covering ready at all times for this purpose.
- K. Elephant Trunks: Use hoppers and elephant trunks or drop chutes to prevent the free fall of concrete that results in separation of coarse particles.
- L. Chutes: Use metal or metal-lined chutes with a slope not exceeding one vertical to two horizontal and not less than one vertical to three horizontal. Chutes more than 20 feet long and chutes not meeting the slope requirement may be used only if they discharge into a hopper before distribution.
- M. Deposit concrete continuously and in level layers of such thickness (not exceeding 2 feet in depth) so that no concrete will be deposited on concrete that has hardened sufficiently to cause the formation of seams, planes of weakness, or cold joints.

3.05 TIME BETWEEN POURS

At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise indicated in the drawings.

3.06 MAXIMUM HEIGHT OF CONCRETE POURS AND FREE FALL

Do not drop concrete freely into place from a height greater than 6 feet in unexposed work and 4 feet in exposed work. Use tremies or pumps where the drop exceeds these limits. See Section 03 11 10 also.

3.07 PUMPING CONCRETE

- A. Conform to the recommendations of ACI 304.2R except as modified herein.
- B. Base pump size on rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lift, and slump of concrete.
- C. Minimum inside diameter of pipe or hose shall be based on the maximum aggregate size as follows:
 - 1. 3/4-inch-maximum aggregate: 2 inches minimum inside diameter.
 - 2. 1-1/2-inch-maximum aggregate: 4 inches minimum inside diameter.
- D. Do not use aluminum pipes for delivery of concrete to the forms.
- E. Before pumping is started, prime the delivery pipe or hose by pumping mortar through the line using 5 gallons of mortar for each 50 feet of delivery line. Do not deposit mortar in the forms.

3.08 HOT WEATHER REQUIREMENTS

- A. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305 and the following.
- B. When the weather is such that the temperature of the concrete as placed would exceed 90°F, use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 90°F.
- C. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.
- D. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

3.09 COLD WEATHER REQUIREMENTS

- A. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306 and the following.
- B. When the temperature of the surrounding atmosphere is 40°F or is likely to fall below this temperature, use heated mixing water not to exceed 140°F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.
- C. When placed in the forms during cold weather, maintain concrete temperature at not less than 55°F. All materials shall be free from ice, snow, and frozen lumps before entering the mixer.
- D. Maintain the air and the forms in contact with the concrete at temperatures above 40°F for the first five days after placing, and above 35°F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches inside the concrete surface.
- E. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

3.10 BONDING TO OLD CONCRETE

Coat the contact surfaces with epoxy bonding compound. The method of preparation and application of the bonding compound shall conform to the manufacturer's printed instructions and recommendations for specific application for this project.

3.11 GROUTING MACHINERY FOUNDATIONS

Block out the original concrete or finish off a sufficient distance below the bottom of the machinery base to provide for the thickness of grout shown on the drawings. After the machinery has been set in position and placed at the proper elevation by steel wedges, the space between the bottom of the machinery base and the original pour of concrete shall be filled with a pourable nonshrink grout. Grout and grouting procedure shall be in accordance with API 686, Chapter 4, paragraphs 3.6 and 3.7, and Chapter 5.

3.12 BACKFILL AGAINST WALLS

- A. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.
- B. Do not backfill the walls of structures that will be laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

3.13 CONCRETE TESTS

- A. Concrete quality testing will be performed on the concrete by an independent testing laboratory hired by the Owner as follows:
 - 1. Frequency of Sampling: Cast four concrete test cylinders from each 50 cubic yards, or fraction thereof, of each class of concrete placed in any one day. Sampling and curing of cylinders shall conform to ASTM C31.
 - 2. Strength Testing: Test cylinders in accordance with ASTM C39. Test one cylinder at 7 days for information; test two cylinders at 28 days for acceptance; and hold one cylinder for verification. Strength acceptance will be based on the average of the strengths of the two cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use the fourth cylinder for the test result.
 - 3. Determine concrete slump by ASTM C143 with each strength test sampling and as required to establish consistency.
 - 4. Determine air content of the concrete using ASTM C231 to verify the percentage of air in the concrete immediately prior to depositing in forms.
 - 5. The average value of concrete strength tests shall be equal to or greater than the specified 28-day strength. No test shall be less than 90% of the specified 28-day strength.
 - 6. If the 28-day strength tests fail to meet the specified minimum compressive strength, the concrete will be assumed to be defective and one set of three cores from each area may be taken as selected by the Owner and in accordance with ASTM C42. If the average compressive strength of the set of three concrete cores fails to equal 90% of the specified minimum compressive strength or if any single core is less than 75% of the minimum compressive strength, the concrete will be considered defective. The Owner may require additional coring, nondestructive load testing, or repair of defective concrete. Costs of coring, testing of cores, load testing, and required repairing pertaining thereto shall be paid by the Contractor at no extra cost to the Owner.
 - 7. Concrete acceptance shall be based on the requirements of ACI 318 and ACI 350.
- B. To facilitate concrete sampling and testing, the Contractor shall:

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1. Furnish labor to assist the Owner in obtaining and handling samples at the project site.
2. Advise the Owner in advance of concrete placing operations to allow for scheduling and completion of quality testing.
3. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

END OF SECTION

SECTION 033500 CONCRETE FINISHING

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials and methods of concrete finishes, curing, repair of defects, and surface protection.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Leakage Testing of Hydraulic Structures: 03 05 10.
- B. Concrete Formwork: 03 11 00.
- C. Concrete Joints, Water Stops, and Sealants: 03 15 10.
- D. Concrete Reinforcement: 03 21 00.
- E. Concrete: 03 30 00.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Submit curing compound manufacturer's statement of compliance with these specifications and recommended coverage to meet or exceed the specified tests. Submit manufacturer's application instructions.
- C. For potable water, provide certification that all materials used in the curing and repair of concrete meet the requirements of ANSI/NSF 61 for contact with potable water.

PART 2 - MATERIALS

2.01 EPOXY BONDING COMPOUND

See Section 03 30 00.

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2.02 CURING COMPOUND

- A. Curing compound shall conform to ASTM C309, Type 1, Class A.
- B. Curing compound shall be compatible with required finishes and coatings and shall meet the State of Colorado Clean Air Quality Standards.

2.03 MORTAR FOR REPAIR OF CONCRETE

Mortar used for repair of concrete shall be made of the same materials as used for concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.

2.04 BURLAP MATS

Conform to AASHTO M182.

2.05 SISAL-KRAFT PAPER AND POLYETHYLENE SHEETS FOR CURING

Conform to ASTM C171.

PART 3 - EXECUTION

3.01 CONCRETE FINISHES

- A. Finish concrete surfaces in accordance with the following schedule:

Finish Designation	Area Applied
F-1	Beams, columns, and exterior walls not exposed to water or view.
F-2	Exterior and interior walls, beams, and columns exposed to water, unless such items are to be coated.
F-3	Walls, beams, and columns of structures or buildings exposed to view and to 1 foot below water level or finished grade. Underside of formed floors or slabs. EXCEPTION: surfaces that are to be coated.
F-4	Exterior and interior surfaces to be coated.
S-1	Slabs and floors to be covered with concrete or grout.
S-2	Slabs and floors not water bearing.
S-3	Slab surfaces on which mechanical equipment moves. Slab surfaces to receive hardener.
S-4	Slabs and floors of structures or buildings which are water bearing, or to receive crystalline waterproofing.
S-5	Slabs and floors at slopes greater than 10% and stairs.
E-1	Exposed edges. EXCEPTION: edges normally covered with earth.
E-2	Top of walls, beams, and similar unformed surfaces.

- B. Finish F-1: Repair defective concrete, fill depressions deeper than 1/2 inch, and fill tie holes.

Finish F-2: Repair defective concrete, remove fins, fill depressions 1/4 inch or deeper, and fill tie holes.

Finish F-3: In addition to Finish F-2, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume, over the surface with clean burlap pads or sponge rubber floats. Remove and reslope by scraping and then rubbing with clean burlap.

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Finish F-4: Repair defective concrete, remove fins, fill depressions 1/16 inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16 inch.

Finish S-1: Screed to grade without special finish.

Finish S-2: Smooth steel trowel finish.

Finish S-3: Steel trowel finish free from trowel marks and all irregularities.

Finish S-4: Steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.

Finish S-5: Steel trowel finish without local depressions or high points. Apply a stiff bristle broom finish. Leave broom lines parallel to the direction of slope drainage.

Finish E-1: Provide chamfer or beveled edges per Section 031110.

Finish E-2: Strike smooth and float to an F-3 or F-4 finish.

3.02 FINISHING OF FORMED SURFACES

- A. Water cure surfaces until finishing and repairing are completed.
- B. Perform finish work as soon as possible after forms are removed. Remove fins and irregularities by grinding or rubbing, fill depressions deeper than specified with mortar, and fill tie holes.
- C. Ream tie holes with toothed reamers until surface of hole is rough and clean. Coat surface with epoxy bonding compound and fill with mortar.
- D. Finish tapered tie holes as follows:
 - 1. Sandblast tie rod hole and blow clean prior to filling.
 - 2. Drive rubber plug, with one end open, to the center of the hole. Plug size shall be larger in diameter than the diameter of the hole at the center of the wall.
 - 3. Coat entire annular surface of the hole with epoxy prior to filling with mortar. Apply epoxy in accordance with manufacturer's instructions.
 - 4. Fill each side of hole with mortar. Apply mortar to the "wet" side of the wall first. Consolidate mortar solidly into the hole.
 - 5. Notify Owner's Representative of tie rod filling schedule.

3.03 REPAIR OF DEFECTS

- A. Do not repair defects until concrete has been reviewed by the Owner's Representative.
- B. Surface Defects:
 - 1. Repair surface defects that are smaller than 1 foot across in any direction and are less than 1/2 inch in depth.
 - 2. Repair by removing the honeycombed and other defective concrete down to sound concrete, make the edges perpendicular to the surface and at least 3/8 inch deep, thoroughly dampen the surface, work into the surface a bonding grout (one part cement to one part fine sand), fill the hole with mortar, match the finish on the adjacent concrete, and cure as specified.

C. Severe Defects:

1. Repair severe defects that are larger than surface defects but do not appear to affect the structural integrity of the structure.
 2. Repair by removing the honeycombed and other defective concrete down to sound concrete, make the edges of the hole perpendicular to the surface, sandblast the surface, coat the sandblasted surface with epoxy bonding compound, place nonshrink grout as specified in Section 033000, match the finish on the adjacent concrete, and cure as specified.
- D. Major Defects: If the defects are serious or affect the structural integrity of the structure or if patching does not satisfactorily restore the quality and appearance to the surface, the Owner's Representative may require the concrete to be removed and replaced, complete, in accordance with the provisions of this section.

3.04 REPAIR OF CRACKS IN CONCRETE

- A. Repair concrete cracks in liquid containment structures that are greater than 0.01 inch and less than 0.1 inch in width by epoxy pressure injection.
1. Preparation: Insert and anchor a one-way polyethylene valve or pipe nipple in holes drilled into crack. Position them every 6 inches or 18 inches on center depending on the width of the crack. The injecting operation for vertical cracks shall consist of pumping the epoxy grout into the lowest position first and working vertically up in the cracks. Maintain a slow, steady pressure rather than a rapid buildup of pressure. When grouting material reaches the next tube, stop off the present position and follow the same procedure on the next position.
 2. Upon completion of the epoxy grouting, remove the epoxy gel used to hold the valve or nipple by applying a direct flame to the epoxy and scraping it off. Fill the holes with the same material as used for patching the surface.
 3. While the valves or nipples are installed first, the grouting operation shall not commence until after the patchwork has been completed and has sufficiently cured.
- B. Repair cracks in concrete structures that are wider than 1/10 inch by cutting out a square edged and uniformly aligned joint 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joint, priming the joint, and applying polyurethane joint sealant in accordance with Section 031510.
- C. If the cracks are serious or affect the structural integrity or function of the element, the Owner's Representative may require the concrete to be removed and replaced, complete, in accordance with the provisions of this section.
- D. After leakage testing per Section 030510, dewater the structure, repair leaking concrete cracks from inside the structure, and retest the structure.

3.05 CURING AND PROTECTION

- A. Water cure cast-in-place concrete for liquid containment walls, slabs, channels, and footings by Method 1, 2, or 3 for a period of five days (minimum) prior to applying other curing methods. Do not submerge concrete placed in the dry until it has attained sufficient strength to adequately sustain the stress involved and do not subject it to flowing water across its surface until it has cured four days. Start curing of concrete as soon as possible without damaging surface and not later than two hours after placing.
- B. Cure concrete surfaces in accordance with the methods specified herein for the different parts of the work and described in the following paragraphs. These methods are considered to be minimum for curing. The conditions that exist in the field during placement and curing may require additional curing procedures and efforts to ensure proper protection and curing of the concrete. Select and implement the appropriate method commensurate with climatic conditions.

Curing Method	Area Permitted
1	All surfaces.
2	All surfaces.
3	Slabs and floors.
4	All surfaces when maximum ambient temperature will not exceed 80°F and humidity will not drop below 40% on the day of concrete placement and for the three days following.

- C. Where wooden forms are used, wet forms immediately before concreting and keep moist by sprinkling until removed. Keep exposed surfaces of formed concrete moist until commencement of curing.
- D. Use proper concrete placing and curing methods at all times to limit the amount of crazing and cracking of the structures during initial setting and shrinking of the concrete. Repair cracks and coat with a cementitious crystalline waterproofing system per Section 09 97 40.
- E. Cure concrete for not less than 14 days after placing in accordance with one of the following methods.

1. Method 1, Water Spray Method:

Tightly close off concrete surfaces to be cured by bulkheads or other means or entirely surround by tight enclosures, and keep the concrete surfaces moist by sprinkling, spraying, or other means.

2. Method 2, Wet-Burlap-Mat Method:

Thoroughly wet and cover concrete surfaces to be cured with wet burlap mats as soon as the forms have been stripped or as soon as the concrete has set sufficiently to avoid marring the surface. Keep entire concrete surface and burlap continuously and completely wet during the entire curing period.

3. Method 3, Curing Blanket Method:

Thoroughly wet concrete surfaces to be cured and cover with curing blankets as soon as the concrete has set sufficiently to avoid marring the surface. The curing blankets shall be weighted to maintain close contact with the concrete surface during entire curing period. Should the curing blankets become torn or otherwise ineffective, keep surfaces moist and replace damaged sections. The curing blankets shall consist of one of the following two types:

- a. Sheets of heavy waterproof sisal-kraft paper laid with the edges butted together and with the joints between strips sealed with 2-inch-wide strips of sealing tape or with the edges lapped not less than 3 inches and fastened together with waterproof cement to form continuous watertight joints; or
- b. Sheets of clean polyethylene, having a minimum thickness of 4 mils, laid with edges butted together, and with the joints between sheets sealed with 1-inch-wide strips of acetate tape.

During the curing period, do not permit traffic of any nature or depositing of objects, temporary or otherwise, on the curing blankets.

4. Method 4, Curing Compound Method:

- a. Do not use curing compound on surfaces that are to be coated in accordance with Section 09 97 40 and 09 90 00.
- b. Spray the surface with two coats of liquid curing compound. Apply in accordance with the manufacturer's instructions to cover the surface with a uniform film that will seal thoroughly. Apply second coat at 90 degrees from the first coat.

- c. Apply curing compound immediately after completion of the finish on unformed surfaces and within two hours after removal of forms on formed surfaces. Repair formed surfaces within the said two-hour period; provided, however, that any such repairs which cannot be made within the said two-hour period shall be delayed until after Method 1, 2, or 3 has been applied. When repairs are to be made to an area on which curing compound has been applied, first sandblast the area to remove the compound, then repair.
 - d. Wherever curing compound may have been applied to surfaces against which concrete subsequently is to be placed and to which it is to adhere, remove the curing compound entirely by sandblasting prior to the placing of new concrete.
 - e. Where the curing compound method is used, exercise care to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, repair the damaged portions immediately by the application additional curing compound.
- F. It is the responsibility of the Contractor to select the appropriate curing method in response to climatical and/or site conditions occurring at the time of concrete placement. Take appropriate measures as described in ACI 305 and 306 for protecting and curing concrete during hot and cold weather.

END OF SECTION

DIVISION 5 – METALS

SECTION 050520 BOLTS, WASHERS, AND ANCHORS

PART 1 - GENERAL

1.01 DESCRIPTION

This Section includes materials and installation requirements for anchor bolts, drilled anchors, adhesive anchors, screw anchors, stainless steel fasteners, and miscellaneous bolting not associated with primary structural steel connections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Structural Steel: 05 12 00.
- B. Miscellaneous Structural Steel and Aluminum: 05 12 10.
- C. Welding: Section 05 05 23.
- D. Steel Tank Painting and Coating: Section 09 97 13.

1.03 COORDINATION

- A. High-strength bolting for structural steel connections, including bolt type, installation, and inspection requirements, shall comply with Section 05 12 00 – Structural Steel.

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- B. This Section governs fasteners and anchors not associated with primary structural steel connections.
- C. In the event of conflict, Section 05 12 00 shall govern structural steel connections.

1.04 REFERENCE STANDARDS:

- A. American Institute of Steel Construction (AISC):
 - 1. 360: Specification for Structural Steel Buildings.
- B. American Society for Testing and Materials (ASTM):
 - 1. A307: Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 2. F436: Hardened Steel Washers.
 - 3. F593: Stainless Steel Bolts.
 - 4. F594: Stainless Steel Nuts.
 - 5. F844: Washers, Steel, Plain.
 - 6. F1554: Anchor Bolts.
 - 7. F2329: Zinc Coating, Hot-Dip.
 - 8. F3125: High-Strength Structural Bolts (Grades A325, A490).

1.05 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Submit manufacturer's data for all anchors and fasteners, including: Material type and grade, load capacities, installation requirements, and ICC-ES evaluation reports for post-installed anchors.
- C. Shop Drawings: Indicate anchor locations, sizes, embedment depths, and edge distances.

PART 2 - MATERIALS

2.01 ANCHOR BOLTS

- A. Cast-in-place anchor bolts shall conform to ASTM F1554, Grade 36 or 55 unless otherwise indicated.
- B. Galvanize anchor bolts where exposed or as indicated, in accordance with ASTM F2329.

2.02 POST-INSTALLED ANCHORS

- A. General: All post-installed anchors shall be ICC-ES approved for use in cracked concrete.
- B. Mechanical Anchors:
 - 1. Type: Stainless steel wedge anchors
 - 2. Material: Type 316 stainless steel
 - 3. Acceptable Products:

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- a. Hilti Kwik Bolt TZ2
- b. Simpson Strong-Tie Strong-Bolt 2

C. Adhesive Anchors:

- 1. Type: Threaded rod adhesive anchors
- 2. Material: Type 316 stainless steel threaded rod

D. Adhesive:

1. Hilti HIT-RE 500 V3
2. Simpson Strong-Tie SET-XP

2.03 CONNECTION BOLTS (NON-STRUCTURAL APPLICATIONS)

- A. Bolts for miscellaneous steel connections shall conform to ASTM F3125, Grade A325 unless noted otherwise.
- B. Bolts for light-duty or non-structural applications may conform to ASTM A307.

2.04 STAINLESS STEEL FASTENERS

- A. Bolts: ASTM F593, Type 316
- B. Nuts: ASTM F594, Type 316
- C. Washers: ASTM F844, Type 316
- D. Provide stainless steel fasteners for:
 1. Aluminum components (including roof vent)
 2. Corrosion-prone or exposed locations

2.05 WASHERS

- A. Hardened Washers: ASTM F436
- B. Standard Washers: ASTM F844
- C. Provide washers under all bolt heads and nuts unless noted otherwise.

2.06 GALVANIZING

- A. All carbon steel fasteners exposed to weather or moisture shall be hot-dip galvanized in accordance with ASTM F2329.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install fasteners in accordance with manufacturer's recommendations and applicable ASTM and AISC requirements.
- B. Verify field conditions prior to installation.

3.02 STORAGE OF MATERIALS

Store material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.03 INSTALLING CONNECTION BOLTS

- A. Install bolts in accordance with RCSC Specification where applicable.
- B. Provide standard holes unless otherwise indicated.
- C. Hole diameter shall be 1/16 inch greater than bolt diameter unless noted otherwise
- D. Slotted holes, if required in the drawings, shall conform to AISC Specifications, Chapter J, Section J3, Table J3.1.

3.04 INSTALLING ANCHOR BOLTS

- A. Set cast-in-place anchor bolts using templates to maintain alignment.
- B. Protect exposed threads during construction.
- C. Do not use post-installed anchors where cast-in-place anchors are indicated unless approved by the Engineer.

3.05 INSTALLATION OF POST-INSTALLED ANCHORS

- A. Install anchors in strict accordance with manufacturer's printed instructions and ICC-ES reports.
- B. Clean drilled holes prior to installation.
- C. Observe required edge distances and spacing.
- D. Perform proof testing where required by the Engineer.

3.06 INSTALLATION OF STAINLESS STEEL FASTENERS

- A. Apply anti-seize lubricant to all stainless steel threaded connections prior to installation.
- B. Prevent galling during installation.

3.07 FIELD QUALITY CONTROL

- A. The Engineer may perform inspections of installed anchors and fasteners.
- B. B. Provide access and assistance as required.

END OF SECTION

SECTION 051200 STRUCTURAL STEEL

PART 1 - GENERAL

1.01 COORDINATION OF WORK:

- A. Section 05 12 00 governs all primary structural steel members and connections, including but not limited to roof framing members, primary and secondary framing, connection plates, and all load-resisting elements.
- B. Section 05 12 10 – Miscellaneous Structural Steel and Aluminum governs miscellaneous metals, secondary supports, appurtenances, and aluminum components not defined as primary structural steel.
- C. All structural steel design, materials, fabrication, erection, connections, and quality requirements for load-carrying members shall conform to this Section, regardless of whether such elements are referenced in other sections.
- D. Connections between structural steel and miscellaneous metals or aluminum components shall be designed and detailed in accordance with this Section.
- E. In the event of conflict between this Section and Section 05 12 10, the requirements of this Section shall govern for all structural steel members and connections.

1.02 RELATED WORK

- A. Welding: 05 05 23
- B. Miscellaneous Structural Steel and Aluminum: 05 12 10
- C. Steel Tank Painting and Coating: 09 97 13

1.03 REFERENCE STANDARDS:

- A. American Institute of Steel Construction (AISC):
 - 1. 303: Code of Standard Practice for Steel Buildings and Bridges
 - 2. 325: Manual of Steel Construction, Thirteenth Edition
 - 3. 326: Structural Steel Detailing Manual
 - 4. 348: Specification for Structural Joints using ASTM A 325 or A 490 Bolts
 - 5. 360: Specification for Structural Steel Buildings
- B. American Welding Society (AWS):

1. D1.1: Structural Welding Code – Steel

C. American Society for Testing and Materials (ASTM):

1. A6/A6M: Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. A36/A36M: Specification for Carbon Structural Steel.
3. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
4. A108: Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished
5. A123: Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
6. A143: Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedures for Detecting Embrittlement.
7. A153: Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
8. A194/A194M: Specification for Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
9. A307: Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
10. A325: Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
11. A384: Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
12. A385: Practice for Providing High Quality Zinc Coatings (Hot-Dip).
13. A449: Specification for Quenched and Tempered Steel Bolts and Studs.
14. A500: Standard Specification for Steel for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
15. A563: Specification for Carbon and Alloy Steel Nuts.
16. A572: Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
17. A780: Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
18. A992: Standard Specification for Steel for Structural Shapes for Use in Building Framing.
19. B695: Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

- 20. F436: Specification for Hardened Steel Washers.
- 21. F1554: Standard Specification For Anchor Bolts, Steel, 36, 55, and 105 ksi Yield.
- D. Occupational Safety and Health Administration (OSHA):
 - 1. Safety and Health Standards for the Construction Industry, 29 CFR 1926 Subpart R Safety Standards for Steel Erection.
- E. Governing Building Code:
 - 1. International Building Code (IBC).
- 1.04 SUBMITTALS:
 - A. Submit the following shop drawings in accordance with Section 01 33 00.
 - 1. Submit in advance of fabrication complete information necessary for the fabrication of each component and part of the structural steel framing. Include the following:
 - a. Member size, length and radius of curvature (where applicable).
 - b. Bill of materials.
 - c. Material specifications.
 - d. Bolt hole size and bolt size.
 - e. Cuts, copes, and bevels.
 - f. Piece marks for field assembly.
 - g. Splices.
 - h. Shop applied zinc primer submittal items required by Specification 09 96 50.
 - 2. Submit erection drawings showing complete information necessary for the erection of each component part of the structural steel framing. Include the following:
 - a. Dimensions for alignment and elevations of each member.
 - b. Location of members and attachments by match-marking of piece numbers.
 - c. Type and location of each field connection.
 - d. Number of shear connectors on each member.
 - e. Detail of each field connection or typical connection.
 - f. Anchor bolts and setting plans.

3. Do not develop shop drawings by using reproductions of contract drawings. Identify each shop drawing detail by contract drawing detail title.
4. Indicate both shop and field welding and the required nondestructive testing by welding symbols and nondestructive testing symbols as shown in the latest edition of AWS A2.4.
 - a. Fully explain special conditions with notes or details.
 - b. Welding symbols for groove welds shall indicate the groove depth required to obtain the specified effective throat thickness for the welding process and position of welding to be used.
 - c. The details of groove welds, joints, and preparation of base material shall be referenced to prequalified joints specified in AWS Figures 3.2 through 3.11 and shall clearly distinguish between complete joint penetration and partial joint penetration.
 - d. Fillet weld symbols shall indicate required weld size to obtain the specified effective throat thickness and effective length. For fillet weld lengths not specified provide a continuous weld.
5. Submittal requirements for shop and field welding are outlined in 05 05 23.
6. Submittals for Evidence of Conformity to Specifications: Certified mill test reports containing results of chemical and mechanical test as specified by ASTM A6 for the following material:
 - a. Structural steel shapes.
 - b. Structural steel bars.
 - c. Structural steel plates.
7. In addition to the certified mill test reports, the fabricator shall provide an affidavit stating that the structural steel furnished meets the requirements of ASTM specification for the grade furnished. Test any of the members not represented by certified mill test reports by the testing laboratory in accordance with ASTM specification for chemical and physical properties. The contractor is responsible for the cost of sampling and testing.
8. Submit manufacturer's certification and test data that the following items furnished conform to the following specifications:
 - a. High-strength bolts including nuts and washers. Provide Connection type N per the AISC handbook unless otherwise noted in the drawings.
 - b. Shear Connectors: ASTM A108, stud base qualification requirements in accordance with AWS Code Section 7.6.

9. Proposed Substitutions: Submit for review in sketch form prior to submittal of shop drawings substitutions of members or modifications of details, if proposed by the Contractor. Submit in sketch form for review corrections for inaccuracy that result in a change from the structural drawing or final shop drawing details. Make such substitutions or corrections only when permitted by the Engineer.
10. Qualification test reports bearing witness certification by an independent testing laboratory for each welder, welding operator and tacker to be employed in the work.

1.05 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 45 00.
- B. Test and inspect structural steel in accordance with the International Building Code (IBC) Section 1704.3, and Table 1704.3.
- C. Provide structural steel in accordance with AISC Standard for Structural Steel Buildings and the Code of Standard Practice for Steel Buildings and Bridges, unless otherwise specified herein.
- D. Steel fabricator shall have 5 years' experience minimum in structural steel fabrications.
- E. Steel erector shall have 5 years' experience minimum in structural steel erection.
- F. Welding Qualification and Certification:
 1. Refer to Specification 05 05 23 and the following.
 2. If a welder or welding operator has not been engaged in a specific welding process for a period of six months or more, that individual shall be deemed unqualified and shall not perform work on the project until the individual has been qualified again by testing in conformance with AWS D 1.1.
 3. Maintain duplicate qualification and certification records at the job site readily available for examination.
- G. Tolerances:
 1. Maintain tolerances conforming to AISC Code of Standard Practice.
 2. Permissible variation tolerances conforming to ASTM A6.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Load structural members in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.
- B. Protect structural steel members and packaged materials from corrosion and deterioration. Store material in a dry area.

- C. Support materials stored outdoors above ground surfaces on wood runners and protected with acceptable effective and durable covers.
 - D. Do not place materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as recommended by the Engineer.
- 1.07 FIELD MEASUREMENTS:
- A. Verify dimensions and make any field measurements necessary and be fully responsible for accuracy and layout of the work.
 - B. Review the Contract Drawings and report any discrepancies to the Engineer for clarification prior to starting fabrication.
 - C. Contractor shall revise framing, plates, and connections as directed by the Engineer in order to accommodate actual field conditions, dimensions and geometry at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL:

- A. W shapes in conformance with ASTM A992, Grade 50, unless otherwise indicated or specified.
- B. C, M, S and HP shapes in conformance with ASTM A572, Grade 50, unless otherwise specified or shown on contract drawings.
- C. C, Angles, plates and bars in conformance with ASTM A36, Grade 36.
- D. Round, square and rectangular structural tube members (HSS) in conformance with ASTM A500, Grade B.

2.02 FASTENERS:

- A. High-Strength Structural Bolts: Bolts, nuts, and washers for structural steel connections shall conform to ASTM F3125, Grade A325, Type 1, unless otherwise indicated.
- B. Washers: Hardened steel washers shall conform to ASTM F436.
- C. Nuts: Nuts shall conform to ASTM A563, Grade DH or as required for compatibility with ASTM F3125 bolts.
- D. Coatings: Provide hot-dip galvanized fasteners where indicated on the Contract Drawings or where exposed to exterior or corrosive environments. Galvanizing shall conform to ASTM F2329.
- E. Connection Type: Unless noted otherwise on the Contract Drawings, all bolted connections shall be bearing-type connections (RCSC "snug-tightened" joints).

- F. Related Work: Anchor bolts, post-installed anchors, stainless steel fasteners, and miscellaneous bolting are specified in Section 05 05 20.
- 2.03 WELDING:
- A. Refer to 05 05 23, Welding.
- 2.04 SHOP FABRICATION:
- A. Fabricate each element and connection as indicated on the fabrication shop drawings accepted by the Engineer. Fabricate and shop assemble work to the greatest extent practical in conformance with following publications:
1. AISC Manual of Steel Construction
 2. AISC Specification for Structural Joints
 3. AISC Detailing Manual
 4. AWS Structural Welding Code
- 2.05 CONNECTIONS:
- A. General: Design, detail, fabricate, and install structural steel connections in accordance with:
1. AISC 360
 2. RCSC Specification for Structural Joints Using High-Strength Bolts
 3. Contract Drawings
- B. Bolted Connections:
1. Provide ASTM F3125, Grade A325 high-strength bolts unless otherwise indicated.
 2. Connections shall be bearing-type unless specifically noted as slip-critical on the Contract Drawings.
 3. Provide standard bolt holes unless otherwise indicated. Standard hole diameter shall not exceed bolt diameter plus 1/16 inch.
 4. Provide slotted or oversized holes only where specifically indicated and in accordance with RCSC requirements.
- C. Installation:
1. Install high-strength bolts in accordance with the RCSC Specification.
 2. Unless otherwise indicated, tighten bolts to the snug-tight condition.

3. Snug-tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of an ironworker using a spud wrench.
 4. Marking of bolt rotation for verification is permitted but not required unless specified.
- D. Fit-Up:
1. Bolted parts shall fit solidly together after assembly and shall not be separated by gaskets or compressible materials.
 2. Clean faying surfaces of burrs, dirt, oil, and foreign material.
 3. Do not use drift pins or burning to enlarge holes. Ream holes only when approved by the Engineer.
- E. Coordination with Other Sections:
1. Connections between structural steel and miscellaneous metals or aluminum components shall comply with this Section. Fasteners for aluminum or corrosion-resistant applications shall comply with Section 05 05 20.

PART 3 - EXECUTION

3.01 ERECTION OF STRUCTURAL STEEL:

- A. Conform to the IBC and referenced AISC standards. Brace and secure work until permanent connections are completed. This includes bracing and shoring of the existing tank structure and components during replacement of the internal structural steel frame. Provide accessories and fasteners to secure the work in place whether or not shown or specified. Comply with OSHA requirements.
- B. Erect structural steel with qualified, experienced personnel. Plan and lay out steel to require minimum of cutting. Erect work plumb, square, and true to line and level and in precise positions. Provide temporary bracing and guys to counteract loads and stresses to which structure may be subjected, including those due to erection equipment and its operation. Do not encumber premises with material or equipment.
- C. Splice members only where shown or specified. On exposed welded connections, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds. Do not enlarge holes in members by burning or the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to place bolts. Do not use gas-cutting torches in the field for correcting fabrication errors in the structural framing.
- D. Erect, plumb, level, and align each individual member within the tolerance defined in Section 7 and Commentary of the AISC Code of Standard Practice, allowing for weld shrinkage during

erection for assurance that the end product is within specified tolerance. Establish and maintain the building line for use in plumbing the exterior columns.

3.02 DAMAGED MEMBERS:

- A. During erection, straighten or replace members that are bent, twisted, or damaged. If heating is required in straightening, perform heating by methods that ensure uniform temperature throughout entire member. When required by the Engineer, remove members that are impaired strength and replace with new members at no additional cost to Owner.

3.03 MISFITS AT BOLTED CONNECTIONS:

- A. Immediately notify the Engineer where misfits in erection bolting are encountered. The Submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.
- B. Do not enlarge incorrectly sized or misaligned holes in members by burning or by the use of drift pins. Notify the Engineer immediately and submit a proposed method of remedy for review by the Engineer.

3.04 COLUMNS AND BEARING PLATES:

- A. Field fit and set columns to their proper alignment and elevation by field trimming the top and bottom sections of each column. Weld the column butt joints after members have been positioned and plumbed.

3.05 CONNECTIONS:

- A. Install bolts to maintain structural alignment and resist erection loads, dead loads, and environmental loads.
- B. Tighten high-strength bolts in accordance with the RCSC Specification.
- C. Do not reuse high-strength bolts, nuts, or washers.
- D. Replace improperly installed or damaged fasteners at no additional cost to the Owner.
- E. Where verification of bolt installation is required, testing shall be performed by an independent testing agency using calibrated equipment.

3.06 FIELD QUALITY CONTROL

- A. The Engineer will be performing inspections of the Work associated with this Section. The Contractor is responsible for providing full access to the Work. This includes but is not limited to man lifts and/or scaffolding necessary to visually inspect the elevated Work.

3.07 CLEAN-UP:

- A. Upon completion and before acceptance of the work, remove surplus materials, rubbish, and debris resulting from the operations. This includes disused equipment and implements of

service, and leave the entire structure and site, insofar as the work of this section is concerned, in a neat, clean condition.

END OF SECTION

SECTION 051210 MISCELLANEOUS STRUCTURAL STEEL AND ALUMINUM

PART 1 - GENERAL

1.01 COORDINATION OF WORK

- A. This Section includes miscellaneous metals, secondary structural elements, and aluminum components, including but not limited to roof vents, access appurtenances, supports, and non- primary structural members.
- B. Primary structural steel members, including roof framing and all load-resisting connections, are specified in Section 05 12 00 – Structural Steel and are not included in this Section.
- C. Structural steel materials provided under this Section shall conform to the requirements of Section 05 12 00 unless specifically modified herein.
- D. Connections to structural steel framing shall conform to the requirements of Section 05 12 00, including bolting, welding, and fabrication requirements.
- E. Aluminum members, including the roof vent assembly, shall be designed, fabricated, and installed in accordance with this Section. Interface and attachment to structural steel framing shall be coordinated with Section 05 12 00.
- F. In the event of conflict between this Section and Section 05 12 00, Section 05 12 00 shall govern for structural steel design, materials, fabrication, and connections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Bolts, Washers, and Anchors: 05 05 20.
- B. Welding: 05 05 23.
- C. Structural Steel: 05 12 00.
- D. Access Hatches: 05 53 00.
- E. Steel Tank Painting and Coating: 09 97 13.

1.03 DESIGN CRITERIA

Structural Connections and Framing: AISC Specification for Structural Steel Buildings (latest edition), except connection details are shown in the contract drawings.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Submit placing or erection drawings that indicate locations of fabricated items. Reproductions of contract documents will not be accepted for this purpose.

PART 2 - MATERIALS

2.01 STRUCTURAL STEEL

- A. Structural steel shall conform to Section 05 12 00 unless otherwise noted.

2.02 BOLTS AND WASHERS

- A. See Section 05 05 20.

2.03 STAINLESS STEEL PLATE AND MEMBERS

- A. Except where otherwise specified, stainless steel plate shall be Type 304, ASTM A240.
- B. Stainless steel solid round bar shall conform to ASTM A276.
- C. Stainless steel pipe shall conform to ASTM A312, Grade TP316.
- D. Wrought stainless steel fittings shall conform to ASTM A403, Class WP316.

2.04 ALUMINUM SHEET

Aluminum sheet shall conform to ASTM B209, Alloy 3003, H 14 temper.

2.05 STRUCTURAL ALUMINUM

Aluminum structural members shall conform to ASTM B308, Alloy 6061-T6. Aluminum bars and rods shall conform to ASTM B221, Alloy 6061-T6.

2.06 ALUMINUM TUBING

Aluminum seamless pipe and tubing shall conform to ASTM B241, Alloy 6061-T6. Wall thickness shall be Schedule 80, per ANSI H35.2, unless otherwise shown in the drawings.

2.07 WELDING ELECTRODES

- A. Welding electrodes for structural steel shall conform to AWS A5.1. Use electrodes in the E-70 series.
- B. Filler metal shall have a minimum charpy V-notch toughness of 20 ft-lbs at -20°F.

- C. Welding electrodes for aluminum shall be ER4043 filler metal.
- D. Welding electrodes for stainless steel shall conform to AWS A5.4. Use electrodes as follows:

Stainless Steel Material	Welding Electrode Material
Type 304	E 308
Type 304L	E 347
Type 316	E 316
Type 316L	E 318

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 FABRICATION AND ERECTION

- A. Fabricate miscellaneous metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Continuously weld permanent connections along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated in the drawings, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Conceal fastenings wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded.
- B. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.
- C. Set embedded metalwork accurately in position when concrete is placed and support rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 03 30 00.

3.03 GALVANIZING FOR STEEL PLATES, PIPE, AND TUBING

Zinc coating shall be in accordance with ASTM A123.

3.04 WELDING

- A. Perform welding on steel by the SMAW process. Welding shall conform to the AWS D1.1-2008, except as modified in AISC Section J2.

- B. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to the AWS D1.2-2003.
- C. Perform welding on stainless steel by the TIG process. All welds shall be full penetration and smooth unless otherwise indicated in the drawings. Provide inert gas on the inside of pipe during welding to reduce oxidation.
- D. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.
- E. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

3.05 BOLTING

See Section 05 05 20.

3.06 CONTROL OF FLAME CUTTING

Do not use a gas-cutting torch in the field for correcting fabrication errors on any member in structural framing. Use a gas-cutting torch only on minor members when the member is not under stress.

3.07 REPAIR OF GALVANIZED SURFACES

Repair or replace metal with damaged galvanized surfaces at no additional cost to the Owner. Repair galvanized surfaces per Section 099000, System No. 55.

3.08 CORROSION PROTECTION OF ALUMINUM SURFACES

- A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry, per Section 09 97 13 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.
- B. Where aluminum surfaces come in contact with dissimilar metals, except stainless steel, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

3.09 PAINTING AND COATING OF STRUCTURAL STEEL

Coat nongalvanized structural steel surfaces per Section 09 97 13. Apply prime coat in the shop prior to shipping to the site. Apply intermediate and finish coats after erection, except surfaces that will be inaccessible for coating after erection or assembly shall be finish coated prior to erection or assembly. Color of finish coat shall be selected by Owner. Faying surfaces of connections that are not specified to be slip critical may be primed and need not be further painted.

END OF SECTION

SECTION 055100 LADDERS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, fabrication, and installation of ladders, prefabricated alternating tread stairs, stair nosings, and stair treads.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete: 03 30 00.
- B. Bolts, Washers, Anchors, and Eyebolts: 05 05 20.
- C. Painting and Coating: 09 90 00.

1.03 DESIGN CRITERIA

Handrails, Walkways, Ladders, and Personnel Platforms: OSHA.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Submit drawings of stairs, ladders, and stair nosings. Show dimensions and reference materials of construction by ASTM designation and grade.

PART 2 - MATERIALS

2.01 VERTICAL LADDERS

- A. Fabricate ladders as shown in the drawings. Ladders shall be Type 316 stainless steel. Minimum diameter of rungs shall be 1 inch. The distance between rungs, cleats, and steps shall not exceed 12 inches and shall be uniform throughout the length of the ladder. The minimum clear length of rungs or cleats shall be 16 inches.
- B. All stainless steel materials shall conform to the following:
 - 1. Plate and sheet: ASTM A240, Type 316
 - 2. Bars and shapes: ASTM A276 or ASTM A479, Type 316

2.02 SAFETY CLIMB FOR VERTICAL LADDERS

- A. Provide a cable vertical safety system, 316 stainless steel.
- B. Provide a removable extension kit for each ladder that is equipped with a vertical safety climb system.

2.03 WELDING ELECTRODES

- A. Welding electrodes for stainless steel shall conform to AWS requirements as follows:
 - 1. SMAW: E316L-16 (AWS A5.4)

2. GTAW/GMAW: ER316L (AWS A5.9)

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 INSTALLING LADDERS

Mount ladders to provide clearance in back of ladder so that the distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be not less than 7 inches.

3.03 INSTALLING ANCHOR BOLTS

See Section 05 05 20.

3.04 CORROSION PROTECTION FOR ALUMINUM SURFACES

- A. Stainless steel surfaces shall be cleaned after fabrication to remove contaminants, welding scale, and heat tint.
- B. All welds shall be cleaned and passivated in accordance with ASTM A380 and ASTM A967.
- C. Stainless steel shall not be painted unless specifically indicated.
- D. Prevent contamination from carbon steel during fabrication and installation. Tools used for stainless steel shall not be used on carbon steel.
- E. Where stainless steel comes in contact with dissimilar metals, isolate surfaces using nonconductive materials such as neoprene gaskets or washers to prevent galvanic corrosion

END OF SECTION

DIVISION 6 - WOOD, PLASTICS, AND COMPOSITES

SECTION 066100 FRP GRATING

PART 1 - GENERAL

1.05 DESCRIPTION

CONTRACTOR shall furnish, fabricate (where necessary), and install all fiberglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.

1.06 REFERENCES

- A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:

1. ASTM D 635 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
2. ASTM E 84 Surface Burning Characteristics of Building Materials.

1.07 SUBMITTALS

- A. The Contractor shall furnish shop drawings of all fabricated gratings and accessories in accordance with the provisions of this Section.
- B. The Contractor shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication of and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.
- C. The Contractor shall submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, and design calculations for systems not sized or designed in the contract documents, sealed by a Professional Engineer.
- D. The Contractor shall submit sample pieces of each item specified herein for acceptance by the Engineer as to quality and color. Sample pieces shall be manufactured by the method to be used in the Work.

1.08 QUALITY ASSURANCE

- A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years of experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.
- B. Manufacturer shall offer a 3 year limited warranty on all FRP products against defects in materials and workmanship.

1.09 PRODUCT DELIVERY AND STORAGE

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.
- B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 - PRODUCTS

2.04 MANUFACTURER

- A. Pultruded gratings shall be PROGrate® as manufactured by:
Bedford Reinforced Plastics, Inc.

One Corporate Drive, Suite 106

Bedford, PA 15522. USA

(814) 623-8125 Phone

(814) 623-6032 Fax

Website: <https://bedfordreinforced.com>

2.05 GENERAL

All FRP items furnished under this Section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

- A. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.
- B. Resin shall be Vinyl Ester, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.
- C. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.
- D. All pultruded structural shapes shall be further protected from ultraviolet (UV) light with 1) integral UV inhibitors in the resin and 2) a synthetic surfacing veil to help produce a resin rich surface.
- E. All FRP products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test. Gratings shall not burn past the 25 mm reference mark and will be classified HB per ASTM D635.
- F. All mechanical grating clips shall be manufactured of Type 316SS (stainless steel).

2.06 PULTRUDED FRP GRATING

Manufacture: Grating components shall be high strength and high stiffness pultruded elements having a maximum of 70% and a minimum of 60% glass content (by weight) of continuous roving and continuous strand mat fiberglass reinforcements. The finished surface of the product shall be provided with a surfacing veil to provide a resin rich surface which improves corrosion resistance and resistance to ultraviolet degradation. Bearing bars shall be interlocked and epoxied in place with a cross rod system to provide a mechanical and chemical lock.

- A. Non-slip surfacing: Grating shall be provided with a quartz grit bonded and baked to the top surface of the finished grating product.
- B. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Data gathered only from the resin shall not be acceptable.
- C. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.
- D. Color: {varies by resin - consult your catalog}.
- E. Depth: 1-1/2", " with a tolerance of plus or minus 1/32".
- F. Mesh Configuration: I-15-60.
- G. Load/Deflection: Grating design loads shall be less than manufacturer's published maximum recommended loads. A 100 psf live load plus 300 pound concentrated load is recommended for walkways per ASCE 7. Deflection is typically limited to a L/200 under full live load.

- H. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the engineer for approval.

2.07 GRATING FABRICATION

- A. Measurements: Grating supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. Determine correct size and locations of required holes or coping from field dimensions before grating fabrication.
- B. Layout: Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating supports shall be provided at openings in the grating by contractor where necessary to meet load/deflection requirements specified herein. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
- C. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at a maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

PART 3 - EXECUTION

3.05 INSPECTION

- A. Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor prior to the beginning of any fabrication work so that inspection may be provided. The grating shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits.

3.06 INSTALLATION

- A. Contractor shall install gratings in accordance with manufacturer's assembly drawings. Lock grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Follow manufacturer's instructions when cutting or drilling fiberglass products. Provide adequate ventilation.

END OF SECTION

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

SECTION 071416 COLD FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Application of cold fluid-applied waterproofing.

1.02 DEFINITIONS

- B. MSDS: Material Safety Data Sheets

C. ASTM: American Society for Testing and Materials

D. SDS: Safety Data Sheet

1.2 SUBMITTALS

A. Product and LEED Data:

1. Submit manufacturer's technical bulletins and SDS on each product.

B. Samples:

1. Actual color samples available for each coating scheduled.

C. Miscellaneous:

1. Submit list of project references. Include contact name and phone number of the person charged with oversight of each project.
2. Quality Control Submittals: Provide protection plan of surrounding areas.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Applicator: Minimum of 5 years' experience in application of similar systems and products on projects of similar size and scope.
 - a. Successful completion for a minimum of 5 projects of similar size and complexity to specified Work.
2. Manufacturer Qualifications: Company shall be ISO 9001:2015 Certified.
3. Manufacturer: Minimum 15 years of experience in manufacturing of high build coatings.

B. Field Sample:

1. Install field sample at project site or pre-selected area of structure, minimum 4 feet by 4 feet (1.2 m by 1.2 m), using specified coating system.
2. Apply material in strict accordance with manufacturer's written application instructions.
3. Manufacturer's representative or designated representative will review technical aspects; surface preparation, repair and workmanship.
4. Field sample will be standard for judging workmanship on remainder of project.
5. Maintain field sample during construction for workmanship comparison.
6. Do not alter, move or destroy field sample until work is completed and approved by architect/engineer.
7. Obtain owner/engineer written approval of field sample before start of material application, including approval of aesthetics, color, texture and appearance.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification label intact.
- C. Store tightly sealed coating system materials off ground and away from moisture, direct sunlight, extreme heat and freezing temperatures.
- D. Store in unopened containers in clean, dry conditions at 40 degrees F (4 degrees C) to 80 degrees F (27 degrees C).

1.5 PROJECT / SITE CONDITIONS

A. Environmental Requirements:

1. Ensure that substrate surfaces are dry, and ambient air temperatures are 40 degrees F (4 degrees C) to 90 degrees F (32 degrees C) at application time and remain above 40 degrees F (4 degrees C) for at least 24 hours after application. Ensure that frost or frozen surfaces are thawed and dry.
2. Do not apply coatings if snow, rain, fog, and mist is anticipated within 12 hours after application. Allow surfaces to attain temperature and conditions specified before proceeding with coating application.
3. Do not apply over sealant joints, control joints or other materials that will be affected by solvent.
4. Avoid application when inclement weather is present or imminent.
5. Do not apply membrane to reinforcing bars or to wet or contaminated surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from the following manufacturer:
- B. Sika Corporation St. Louis, 3400 Tree Court Industrial Boulevard, St. Louis, MO 63122.

2.2 MATERIALS

- A. A one-component, moisture-curing, bitumen-modified polyurethane, elastomeric waterproofing membrane for exterior below-grade or between slab applications.
 1. Acceptable Product: Sikalastic® HLM 5000 GC by Sika Corporation.
- B. Performance Requirements: The following properties are based on product's standard system.
 1. Compliances:
 - a. ASTM C836
 - b. National Standard of Canada 37.58 – M86 developed by CGSB.
 2. Minimum Recovery: 90 percent.
 3. Swelling in Water (3 days at room temperature): None.
 4. Service Temperature Range:
 - a. Minimum: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum: 120 degrees F (49 degrees C).
 5. Hardness, Shore OO: 85, ASTM C836.
 6. Tensile Strength: 150 psi (1.0 MPa), ASTM D412.
 7. Average Elongation: 600 percent, ASTM D412.
 8. 100% Modulus: 80 psi (0.6 MPa), ASTM D412.
 9. Moisture-Vapor Permeability (dry perms): < 0.1, ASTM E96.
 10. Crack Bridging Test: Passed 1/16 inch (2 mm), ASTM C836.
 11. Extensibility After Heat Aging: No cracking, ASTM C836.
 12. Weight Loss (20 percent maximum): 16 percent, ASTM C836.
 13. Color: black.

2.3 ACCESSORIES

- A. Protection course: 1-inch foamboard.
- B. Sika Drainage Mat 420: Prefabricated drainage composite with high flow dimpled core and high crush resistant geonet constructions.

PART 3 PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Materials removed and replaced to correct defects due to Work placed on unsuitable surfaces shall be at Contractor's expense.

3.2 SURFACE PREPARATION

- A. Lightly steel trowel concrete deck to flat, uniform surface. Light broom finish is acceptable. Properly cure new concrete for a minimum of 72 hours. Mechanically remove concrete curing compounds.
- B. For extremely porous block, apply parge coat of cementitious block filler or prime with a coat of waterproofing membrane diluted up to 25 percent with reducer recommended by membrane manufacturer. Apply cementitious block filler at a rate of approximately 400 square feet (37 square m) per bag for parge coat. Allow curing minimum of 7 days before applying waterproofing membrane.
- C. Patch voids and deep depressions in substrates with appropriate patching material before applying waterproofing membrane.
- D. Before applying waterproofing membrane, dam drains and drain openings.
- E. Carefully work material over irregular concrete to avoid pinholes and holidays.
- F. Remove dust, dirt and other contaminants just before or during application.
- G. Open air-void pockmarks or honeycombs to allow waterproofing membrane to fill cavities completely. Air entrapment within voids may cause blisters. Extreme cases may require a parge coat.

3.3 PRESTRIPPING

- A. Before applying final membrane, seal joints, cracks, and openings around protrusions by caulking or prestripping (a preliminary coating of waterproofing membrane applied with trowel or stiff bristled brush). Allow drying overnight before applying final membrane.
- B. When final membrane is applied, verify overall thickness over joints and cracks, at coves, and around penetrations of approximately 100 wet mils (2.5 mm) on standard system, or approximately 200 wet mils on high build system.
- C. Static Joints and Cracks: Fill joints and cracks less than 1/16 inch (1.6 mm) by prestripping. Apply material so it both fills and overlaps joint or crack to 4-inch (102 mm) width on each side.
- D. Working or Expansion Joints:
 - 1. Seal joints over 1/8 inch (3 mm) with joint sealant. Rout moving joints less than 1/8-inch (3 mm) to 1/8-inch (3 mm) minimum and fill with joint sealant. Prevent waterproofing membrane from adhering to joint sealant, which could cause sealant or membrane failure, by applying coat of wax or PTFE tape over cured sealant and then prestripping.
- E. Metal:
 - 1. Clean metal to bright metal by wire brush or sandblast. Prime with quality rust-inhibiting metal primer before application of waterproofing membrane.
- F. Vent, Drain Pipe, and Post Penetrations:
 - 1. Clean metal surfaces to bright metal and prime with quality rust-inhibiting metal primer. Remove dust, debris, and other contaminants from voids. Seal with appropriate joint sealant.
 - 2. Seal openings exceeding 1/8 inch (3 mm) with joint sealant. Next, prestripe to 4-inch (102 mm) minimum width on base slab and continue up penetration to height of top-course wearing surface.

3.4 APPLICATION

- A. For horizontal applications, empty contents of pail and spread immediately to ensure workability. Best results are obtained by marking off 125 square foot (11.61 square m) areas and evenly spreading contents of 5-gallon (18.93 L) unit with rubber-edged notched squeegee. Repeat above procedure until entire surface is covered.

- B. For vertical applications, apply roller at rate of 25 square feet per gallon (0.6 square m per L). Best results are obtained by marking off 125 square foot (11.61 square m) areas and evenly applying contents of 5 gallon (18.93 L) pail.

3.5 INSTALLATION OF PROTECTION COURSE

- A. Install protection layer as soon as possible following cure of membrane. Protect membrane from traffic before placement of protection layer. Ensure waterproofing membrane has cured before installation of topping.

3.6 CURING

- A. Appreciable properties develop within 24 to 48 hours at 75 degrees F (24 degrees C) and 50 percent relative humidity. Protect waterproofing membrane from traffic during curing.
- B. Drainage and Protection: For protection during backfill and where hydrostatic pressure is anticipated, use appropriate drain board system.
- C. For protection during backfill only, install protection layer as soon as possible following cure of waterproofing membrane. Protection course shall consist of 1-inch foamboard or approved equal.

3.7 FIELD QUALITY CONTROL

- A. Site tests: Test integrity of cured membrane on horizontal surface by damming entire area and flooding with water to minimum depth of 2 inches (51 mm). Allow water to stand for 24 to 48 hours. Visually inspect bottom surface to check for water penetration. If repairs are necessary, drain area and allow drying before reapplying waterproofing membrane. After reapplication, test area again for membrane integrity. Repeat procedure until no leaks appear in membrane.

3.8 CLEANING AND PROTECTION

- A. Remove temporary coverings and protection from adjacent work areas. Clean up areas not to be coated of over-spray and droppings. Remove construction debris from project site.
- B. Clean tools and equipment immediately after application with manufacturer's recommended cleaning solution.

END OF SECTION

DIVISION 9 – FINISHES

SECTION 099000 PAINTING AND COATING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and application of painting and coating systems for the following surfaces:

- A. Aluminum Insulation from Concrete and Carbon Steel
- B. It does not include coating steel water tanks and reservoirs.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete Finishing: 03 35 00.

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1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Submit manufacturer's data sheets showing the following information:
 - 1. Percent solids by volume.
 - 2. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
 - 3. Recommended surface preparation.
 - 4. Recommended thinners.
 - 5. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
 - 6. Application instructions including recommended equipment and temperature limitations.
 - 7. Curing requirements and instructions.
- C. Submit certificate and supplier's data sheets identifying the type and gradation of abrasives used for surface preparation. The certificate or data sheets shall specifically identify that the abrasives comply with federal and state of Colorado
- D. regulations for materials to be used for abrasive blasting for surface preparation for paints and coatings.
- E. Submit material safety data sheets for each coating.

PART 2 - MATERIALS

2.01 PAINTING AND COATING SYSTEMS

The following index lists the various painting and coating systems by service and generic type:

PAINT COATINGS SYSTEM INDEX

No.	Title	Generic Coating
Coating Systems for Nonferrous Metals		
54.	Aluminum Insulation from Concrete and Carbon Steel	Epoxy

These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses.

2.02 COATING SYSTEMS FOR NONFERROUS METALS

- A. System No. 54--Aluminum Insulation from Concrete and Carbon Steel:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Coat areas of aluminum structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.

Surface Preparation: Solvent or steam cleaning per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Coating System: Apply three or more coats of Tnemec Series 135, Sherwin-Williams Macropoxy B58-600, or approved equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

2.03 ABRASIVES FOR SURFACE PREPARATION

- B. Abrasives used for preparation of ferrous (excluding stainless steel) surfaces shall be one of the following:
 - 1. 16 to 30 or 16 to 40 mesh silica sand or mineral grit.
 - 2. 20 to 40 mesh garnet.
 - 3. Crushed iron slag, 100% retained on No. 80 mesh.
 - 4. SAE Grade G-40 or G-50 iron or steel grit.
- C. Abrasives used for preparation of copper and aluminum surfaces shall be one of the following:
 - 1. Crushed slag, 80 to 100 mesh.
 - 2. Very fine silica sand, 80 to 100 mesh.

PART 3 - EXECUTION

3.01 WEATHER CONDITIONS

- A. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.
- B. Do not apply paint when the relative humidity is above 85%.
- C. Do not paint when temperature of metal to be painted is above 120°F.
- D. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours. Edit paragraph below to match the coatings used in your project.
- E. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

3.02 SURFACE PREPARATION PROCEDURES

- A. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting.
- B. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

- C. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter.
- D. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within two hours of blasting or before any rust bloom forms.
- E. Surface preparation shall conform with the SSPC specifications as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating	SP-12
Surface Preparation of Concrete	SP-13

- F. Wherever the words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning” or similar words are used in these specifications or in paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC (Society for Protective Coatings), surface preparation specifications listed above.
- G. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any contamination or oxide and to provide a surface profile for the coating.
- H. Brush-off blasting of concrete and masonry surfaces is defined as opening subsurface holes and voids and etching the surface for a coating to bond.
- I. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Owner’s Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner’s Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner’s Representative.
- J. Do not apply any part of a coating system before the Owner’s Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner’s Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this specification.

3.03 ABRASIVE BLAST CLEANING

- A. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.
- B. After abrasive blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp

or moist surfaces. Reclean prior to application of primer or touch-up coating any blast cleaned surface not coated within said eight-hour period.

- C. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.
- D. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.04 PREPARATION OF CONCRETE AND MASONRY SURFACES TO BE COATED

- A. Surface preparation of concrete and masonry surfaces shall be in accordance with SSPC SP-13 and the following.
- B. Do not apply coating until concrete has cured at least 30 days. Finish concrete surfaces per Section 03 55 00. Do not use curing compound on surfaces that are to be coated.
- C. Concrete and masonry surfaces on which coatings are to be applied shall be of even color, gray or gray-white. The surface shall have no pits, pockets, holes, or sharp changes of surface elevation. Scrubbing with a stiff-bristle fiber brush shall produce no dusting or dislodging of cement or sand. Sprinkling water on the surface shall produce no water beads or standing droplets. Concrete and masonry shall be free of laitance and slick surfaces.
- D. Detergent clean the concrete or masonry surface with trisodium phosphate per ASTM D4258. Then sandblast surfaces (brush-off blast). Floor slabs may be acid etched per ASTM D4260 in lieu of sandblasting. After sandblasting, wash surfaces with water to remove dust and salts, per ASTM D4258 or D4261. The grain of the concrete surface to touch shall not be rougher than that of No. 10 mesh sand.
- E. Do not apply coatings to concrete when the concrete is outgassing. Apply coatings only when the concrete surface temperature is stable, not rising.

3.05 PROCEDURES FOR ITEMS HAVING SHOP-APPLIED PRIME COATS

- A. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.
- B. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.
- C. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- D. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

3.06 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

- A. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
- B. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces

with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Rinse scrubbed surfaces with clean water.

- C. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
- D. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.
- E. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
- F. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
- G. Surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

3.07 PAINTING SYSTEMS

- A. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.
- B. Deliver paints to the jobsite in the original, unopened containers.

3.08 PAINT STORAGE AND MIXING

- A. Store and mix materials only in areas designated for that purpose by the Owner's Representative. The area shall be well-ventilated, with precautionary measures taken to prevent fire hazards. Post "No Smoking" signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.
- B. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

3.09 PROCEDURES FOR THE APPLICATION OF COATINGS

- A. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.
- B. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.
- C. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating

materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.

- D. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.
- E. Apply coating systems to the specified minimum dry-film thicknesses as determined per SSPC PA-2.
- F. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.
- G. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. Apply the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.
- H. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.
- I. Each coat shall cover the surface of the preceding coat completely, and there shall be a visually perceptible difference in applied shade or tint of colors.
- J. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner's Representative.
- K. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

3.10 SURFACES NOT TO BE COATED

Do not paint the following surfaces unless otherwise noted in the drawings or in other specification sections. Protect during the painting of adjacent areas:

- A. Access hatches.
- B. Handrails.
- C. Ladders.
- D. Vents.
- E. Electrical fixtures except for factory coatings.
- F. Buried pipe, unless specifically required in the piping specifications.

3.11 PROTECTION OF SURFACES NOT TO BE PAINTED

Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

3.12 SURFACES TO BE COATED

The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as "corrosive environment," "buried metal," or "submerged metal." Coat surfaces with the specific coating systems as described below:

- A. Coat aluminum surfaces in contact with concrete per System No. 54.

3.13 DRY-FILM THICKNESS TESTING

- A. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Measure coating thickness specified for stainless steel, aluminum, and copper surfaces with an eddy-current type thickness gauge per ASTM D7091. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.
- B. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, low-voltage, wet-sponge type. Provide measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide detector as manufactured by Tinker and Razor or K-D Bird Dog.
- C. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.
- D. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.
- E. Perform tests in the presence of the Owner's Representative.

3.14 REPAIR OF IMPROPERLY COATED SURFACES

If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.15 CLEANING

- A. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.
- B. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.
- C. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

SECTION 099600 HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field surface preparation and field painting related to high performance coatings used to protect concrete and piping exposed to elevated hydrogen sulfide (H₂S) environments in wastewater applications. Work includes surface preparation, application, curing, and inspection of the coating and lining system.

1.2 REFERENCES

- A. This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.
 - 1. AAMA – American Architectural Manufacturers Association
 - a. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
 - 2. ASTM – American Society for Testing and Materials
 - a. ASTM B 117 - Salt Spray (Fog)
 - b. ASTM D 149 - Dielectric Strength
 - c. ASTM D 4060 - Abrasion
 - d. ASTM D 4417 - Standard Test Methods for Indicating Moisture in Concrete by the Plastic Sheet Method
 - e. ASTM D 4417 - Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
 - f. ASTM D 4541 - Adhesion
 - g. ASTM D 4585 - Humidity
 - h. ASTM D 4787 - Standard Practice for Continuity (Holiday) Testing of Coatings on Concrete
 - i. ASTM D 5894 - Cyclic Salt Fog/UV
 - j. ASTM D 4587 - QUV Exposure
 - k. ASTM D 4141 - EMMAQUA (Equatorial Mount with Mirrors for Acceleration with Water) Outdoor Accelerated Weathering Test Method
 - l. ASTM G 8 - Cathodic Disbondment
 - m. ASTM G 85 – Prohesion
 - 3. ICRI International Concrete Repair Institute
 - a. CSP 1 - Acid Etching, Light Grinding
 - b. CSP 2 - Grinding, Light Shotblasting
 - c. CSP 3 - Shotblasting, Light Scarifying
 - d. CSP 4 - Shotblasting
 - e. CSP 5 - Medium Shotblasting, Scarifying
 - f. CSP 6 - Aggressive Shotblasting, Scarifying
 - g. CSP 7 - Heavy Scarifying, Milling
 - h. CSP 8 - Heavy Scarifying, Milling, Abrasive Blasting
 - i. CSP 9 - Milling, Bush Hammering
 - j. CSP 10 - Heavy Milling, Hydro-Demolition, Scarifying
 - 4. NACE International
 - a. NACE SP0188 - Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
 - 5. National Association of Pipe Fabricators (NAPF)
 - a. NAPF 500-03 - Surface Preparation Standards for Ductile Iron Pipe & Fittings

6. NSF International

- a. NSF/ANSI/CAN Std. 61 Drinking Water System Components
- b. NSF/ANSI/CAN Std. 600 Health Effects Evaluation and Criteria for Chemicals in Drinking Water

7. SSPC – The Society for Protective Coatings

- a. SSPC-SP 1 Solvent Cleaning
- b. SSPC-SP 2 Hand Tool Cleaning
- c. SSPC-SP 3 Power Tool Cleaning
- d. SSPC-SP 6 Commercial Blast Cleaning
- e. SSPC-SP 7 Brush-off Blast Cleaning
- f. SSPC-SP 10 Near White Metal Blast Cleaning
- g. SSPC-SP 11 Power Tool Cleaning to Bare Metal
- h. SSPC-SP 13 Surface Preparation of Concrete
- i. SSPC-SP 16 Brush-off Blast Cleaning of Non-Ferrous Metals
- j. SSPC-SP WJ-4 Waterjet Cleaning of Metals – Light Cleaning
- k. SSPC Paint 20 Zinc-Rich Coating
- l. SSPC Paint 22 Epoxy Polyamide Paints
- m. SSPC Paint 36 Two Component Weatherable Aliphatic Polyurethane Topcoat
- n. SSPC PA 2 Measurement of Dry Coating Thickness with Magnetic Gauges

1.3 DEFINITIONS

- A. Definitions of Painting Terms: ASTM D16, unless otherwise specified.
- B. Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch).
- C. Low VOC: All interior and exterior field applied coatings shall have minimal VOC content as listed in OTC Draft Model Rule for Architectural and Industrial Maintenance of Coatings.
- D. Wet Film Thickness (WFT): Thickness of a coat of paint in an uncured state measured in mils (1/1000 inch).

1.4 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1 Interior Substrates: Concrete, Immersion
 - 2 Interior Submerged: Ductile Iron Pipe

1.5 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Manufacturer's data sheets on each product to be used, including:
 - 1 Preparation instructions and recommendations.
 - 2 Storage and handling requirements and recommendations.
 - 3 Installation methods.
 - 4 Operation and maintenance data.
 - 5 Provide material analysis, including vehicle type and percentage by weight and by volume of vehicle, resin, and pigment.
- C. Manufacturer's Safety Data Sheets (SDS) and other safety requirements.
- D. Manufacturer's Certificates:
 - 1 Certify products meet or exceed specified requirements documented with certified test reports detailing any proposed substitute product(s) performance as outlined herein.
 - 2 Submitted products shall be compared to the specified performance criteria for each product, along with case histories, for review by the Engineer.
- E. Submittals shall detail work methodology including but not limited to surface preparation, cleanup, environmental control, coating application, and timeline.
- F. Color Samples

1 Submittal of color swatches for the specified finish colors shall be included for approval by the Owner.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Quality Assurance:
 - 1 Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.
 - 2 Performance criteria must be included for comparison with specified products.
- B. Manufacturer's Qualifications
 - 1 Specialized in manufacture of the submitted coatings for a minimum of five (5) years on the projects of similar nature.
- C. Applicator's Quality Assurance: Submit list of a minimum of 5 completed projects of similar size and complexity to this Work. Include for each project:
 - 1 Project name and location.
 - 2 Name and contact information for Owner.
 - 3 Name and contact information for Contractor.
 - 4 Name and contact information for Engineer.
 - 5 Name of coating manufacturer.
 - 6 Approximate area of coatings applied.
 - 7 Date of completion.
 - 8 Estimate of remaining useful service life.
- D. Pre-application Meeting: Convene a pre-application meeting before start of application of coating systems. Require attendance of parties directly affecting work of this section, including Contractor, Engineer, applicator, and manufacturer's representative. Review the following:
 - 1 Approved coating submittal.
 - 2 Environmental requirements.
 - 3 Protection of surfaces not scheduled to be coated.
 - 4 Surface preparation.
 - 5 Application methods.
 - 6 Repair.
 - 7 Field quality control.
 - 8 Cleaning.
 - 9 Protection of coating systems.
 - 10 One-year inspection.
 - 11 Coordination with other work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
 - 1 Coating or material name
 - 2 Manufacturer
 - 3 Color name and number
 - 4 Batch or lot number
 - 5 Date of manufacture
 - 6 Mixing and thinning instructions
- B. Storage:
 - 1 Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions.
 - 2 Keep containers sealed until ready for use.
 - 3 Do not use materials beyond manufacturer's shelf-life limits.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.

- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 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.
- B. Weather:
 - 1 Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
 - 2 Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
 - 3 Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
 - 4 Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
 - 5 Wind: Do not spray coatings if wind velocity is above manufacturer's recommended limit.
- C. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer's instructions.
- D. Dust and Contaminants:
 - 1 Schedule coating work to avoid excessive dust and airborne contaminants.
 - 2 Protect work areas from excessive dust and airborne contaminants during coating application and curing.

PART 2 PRODUCTS

2.1 HIGH PERFORMANCE COATINGS GENERAL

- A. Materials Compatibility:
 - 1 Provide shop and field primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 2 Provide products of same manufacturer for each coat in a coating system.

2.2 MANUFACTURERS

- A. Tnemec Company, Incorporated
 - 1 Product Distribution and Technical Representation:
 - a. Elevation Product Representatives (Tnemec) 303-431-7334-SWilliamson@eprsals.com- Steve Williamson
- B. Sherwin Williams
 - 1 Product Distribution and Technical Representation:
 - a. Russell MacDonald 720-879-2795 russell.S.macdonald@sherwin.com
- C. Environmental Coatings, LLC

2.3 INTERIOR SUBSTRATES – CONCRETE IMMERSION

- A. Epoxy Modified Cementitious Mortar
 - 1 Tnemec Series N218 Mortarclad
 - 2 Sherwin Williams Dura-Plate 2300
 - 3 Environmental Coatings C-120
 - 4 Performance Criteria:
 - Submit results for each of the following:
 - a. Bond Strength (Slant Shear): ASTM C 882 – 28 Days
 - b. Surface Tensile Strength: ASTM C 1583 – 28 Days
 - c. Rapid Chloride Permeability: ASTM C 1202
 - d. Compressive Strength: ASTM C 39
 - e. Compressive Strength: ASTM C 579
 - f. Drying Shrinkage: ASTM C 596
 - g. Modulus of Elasticity: ASTM C 469
 - h. Setting Time: ASTM C 191

- i. Tensile Strength: ASTM C 307
- j. Tensile Strength, Elongation, Modulus of Elasticity: ASTM D 2370
- k. Water Absorption: ASTM C 413

B. Intermediate and Finish Coats

- 1 Tnemec Series 435 Perma-Glaze
 - a. Solids by Volume: 100.0%
 - b. Dry Film Thickness (DFT): 2 coats - 20.0 mils (intermediate), 20.0 mils (final)
- 2 Sherwin Williams Dura-Plate 6100
 - a. Solids by Volume: 100.0%
 - b. Dry Film Thickness (DFT): 1 coats- 80.0 – 100.00 mils
- 3 Environmental Coatings Sewer Shield 100
 - a. Solids by Volume: 100.0%
 - b. Apply by trowel to a thickness of 1/8" (up to 1/4")

2.4 IMMERSION DUCTILE IRON PIPE

A. Prime and Finish Coats

- 1 Tnemec Series V69 Epoxy
 - a. Solids by Volume: 100.0%
 - b. Dry Film Thickness (DFT): 2 coats – 4.0 to 6.0 mils (prime), 4.0 to 6.0 mils (final)
- 2 Sherwin Williams Dura-Plate 6100
 - a. Solids by Volume: 100.0%
 - b. Dry Film Thickness (DFT): 1 coat – 12.0 to 50.0 mils

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared and inspected by a third party coating inspector.
- B. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.2 SURFACE PREPARATION

- A. Prepare surfaces in accordance with manufacturer's instructions.
 - 1 Interior Surfaces
 - a. Allow new concrete to cure for a minimum of 28 days.
 - b. Blast Cleaning: In accordance with SSPC-SP13/NACE No. 6 – Surface Preparation of Concrete. ICRI CSP 3-4 – Shotblasting, light scarifying.
 - c. Angular Profile: Minimum of a 2.0 mil angular profile.
 - 2 Submerged Ductile Iron Pipe
 - a. Abrasive Blast Cleaning: In accordance with NAPF-500-03-04.

3.3 APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions.
 - 1 Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
 - 2 Keep containers closed when not in use to avoid contamination.
 - 3 Do not use mixed coatings beyond pot life limits.

- 4 Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
 - B. Uniformly apply coatings at spreading rate required to achieve specified DFT.
 - C. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- 3.4 HOLIDAY DETECTION
- A. Upon full cure, Contractor shall perform high voltage spark detection of the installed lining system in accordance with NACE SP0188 and the Manufacturer's printed application guide to verify a pinhole-free surface. Areas which do not pass the spark detection test shall be corrected at no cost to the Owner.
- 3.5 REPAIR
- A. Materials and Surfaces Not Scheduled to Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.
 - B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
 - C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.
- 3.6 FIELD QUALITY CONTROL
- A. Inspector's Services:
 - 1 Verify coatings and other materials are as specified.
 - 2 Verify surface preparation and application are as specified.
 - a. Blast profile shall be measured using rubber comparator chips in accordance with ICRI Guideline 310.2R.
 - 3 Verify DFT of each coat and total DFT of each coating system specified using wet film and dry film gauges.
 - a. DFT measurements shall be measured using a Type 1 or Type 2 magnetic gauge according to the requirements of SSPC-PA2.
 - 4 Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
 - 5 Report:
 - a. Submit written reports describing inspections made and actions taken to correct nonconforming work.
 - b. Report nonconforming work not corrected.
 - c. Submit copies of report to Engineer and Contractor.
 - B. Manufacturer's Technical Services: Coordinate with coating manufacturer's technical service department or independent sales representative for current technical data and instructions.
- 3.7 SITE CLEANING AND PROTECTION
- A. Remove temporary coverings and protection of surrounding areas and surfaces.
 - B. Protect surfaces of coating systems from damage during construction.
 - C. Touch-up, or repair damaged products before Substantial Completion.
- 3.8 ONE-YEAR INSPECTION
- A. Owner will set date for one-year inspection of coating systems.
 - B. Inspection shall be attended by Owner, Contractor, Engineer, and manufacturer's representative.
 - C. Repair deficiencies in coating systems as determined by Engineer in accordance with manufacturer's instructions.
- 3.9 HIGH PERFORMANCE COATING SCHEDULE
- A. Concrete (Immersion; wastewater)
 - 1 Verify Concrete Dryness:
 - a. Verify concrete dryness in accordance with ASTM F 2170 "Standard Test Method for Determining Relative Humidity in Concrete using In Situ Probes", relative humidity

shall not exceed 80% or per ASTM D 4263 "Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method", no moisture present.

2 Epoxy/Epoxy System:

a. Surface Preparation:

1. Abrasive blast referencing SSPC-SP 13 to provide a uniform surface profile referencing ICRI CSP -3-4 or greater. Prepared substrate must be clean, dry, and free of contaminants.

b. Concrete Repairs (Spalls, Voids, Bugholes)

1. Concrete Spall Repair:

- a. Prepare areas of damaged concrete referencing ICRI Technical Guideline No. 310.1R
- b. Select repair mortar application methods referencing ICRI Technical Guideline No. 320.1R
- c. Repair spalls using SikaTop 123 or approved equal.

c. Resurfacer/Filler:

1. Tnemec Series N218 Mortarclad applied to entire surface at 1/16" nominal DFT.
2. Sherwin Williams Dura-Plate 2300 applied to entire surface at 1/16" nominal DFT.

d. Primer:

1. Tnemec Series G435 Perma-Glaze applied at 20.0 mils DFT
2. Sherwin Williams Dura-Plate 6100 applied at 80.0 to 100.0 mils DFT.
3. Environmental Coatings Sewer Shield applied by trowel to a thickness of 1/8" (up to 1/4")

e. Finish:

1. Tnemec Series G435 Perma-Glaze applied at 20.0 mils DFT

B. Immersion Ductile Iron Pipe

1 Verify surface preparation and surface profile.

2 Epoxy System

- a. Tnemec Series V69 applied at 4.0 to 6.0 mils DFT (primer) and 4.0 to 6.0 mils DFT (final coat).
- b. Sherwin Williams Dura-Plate 6100 applied at 12.0 to 50.0 mils DFT (single coat).

END OF SECTION

DIVISION 22 – PLUMBING

SECTION 220523 PROCESS VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

Valves indicated on the drawings, specified, or required for proper operation of equipment or systems

1.2 RELATED SECTIONS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples

Section 01 60 00 – Materials and Equipment

Section 01 78 23 – Operation and Maintenance Data

Section 26 05 00 – Basic Electrical Materials and Methods

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - B16.1 – Cast Iron Pipe Flanges and Flanged Fittings
- B. American Society for Testing and Materials (ASTM):
 - A48 – Standard Specification for Gray Iron Castings
 - A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - A216 – Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
 - A536 – Standard Specification for Ductile Iron Castings
 - B62 – Standard Specification for Composition Bronze or Ounce Metal Castings
- C. American Water Works Association (AWWA):
 - C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - C207 – Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In.
 - C500 – Metal-Seated Gate Valves for Water Supply Service
 - C502 – Dry-Barrel Fire Hydrants
 - C503 – Wet-Barrel Fire Hydrants
 - C504 – Rubber Seated Butterfly Valves
 - C508 – Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS
 - C509 – Resilient-Seated Gate Valves for Water Supply Service
 - C510 – Double Check Valve Backflow Prevention Assembly
 - C511 – Reduced-Pressure Principal Backflow Prevention Assembly
 - C512 – Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
 - C514 – Air Valve and Vent Inflow Preventer Assemblies for Potable Water Distribution System and Storage Facilities
 - C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
 - C517 – Resilient-Seated Cast-Iron Eccentric Plug Valves
 - C518 – Dual-Disc Swing-Check Valves for Waterworks Service
 - C520 – Knife Gate Valves, Sizes 2 In. (50 mm) Through 96 In. (2,400 mm)
 - C530 – Pilot-Operated Control Valves
 - C541 – Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates
 - C542 – Electric Motor Actuators for Valves and Slide Gates
 - C550 – Protective Interior Coatings for Valves and Hydrants
 - C560 – Cast-Iron Slide Gates
 - C561 – Fabricated Stainless-Steel Slide Gates
 - C562 – Fabricated Aluminum Slide Gates
 - C563 – Fabricated Composite Slide Gates

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 23.
- B. Product Data: Provide data on valves and accessories. Provide manufacturer's catalog information with dimensions, materials, and assembled weight. Indicate valve data and pressure ratings.
- C. Manufacturer's Instructions: Provide complete manufacturer's installation instruction.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual size, type and locations of valves.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 78 23.

- B. Maintenance Data: Include installation instructions, spare parts list, exploded assembly views, maintenance requirements.

1.7 QUALITY ASSURANCE

- A. Manufacturer's name and pressure rating marked on valve body.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

1.9 REGULATORY REQUIREMENTS

- A. Conform to all municipal codes and ordinances, laws and regulations of the State.
- B. In case of apparent conflict, State and local requirements govern over these specifications.
- C. In absence of State and local regulations, International Plumbing Code will apply.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
- B. Prepare valves and accessories for shipment according to AWWA C500.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- D. Provide temporary protective coating on cast iron and steel valves.
- E. Seal valve ends to prevent entry of foreign matter into valve body.
- F. Drain valves and pilotry of water prior to shipping and storage.

PART 2 PRODUCTS

2.1 GENERAL

- A. Construction
 - Actual valve length within $\pm 1/16"$ of specified or theoretical length
 - Ends, except as otherwise specified
 - a. 3" and smaller, threaded or soldered ends
 - b. 4" and larger, flanges, ANSI 125 lb
- B. Actuators
 - Manual actuators:
 - a. Provide manual actuators for all valves not specified to be power actuated or designed for automatic operation
 - i) General use: Handwheel
 - ii) Seven feet or more above the floor or grade unless otherwise indicated: Chain wheel with operating chain
 - a) Equipped with chain guide to permit rapid chain handling of the chain without "gagging" the wheel and to permit reasonable side pull on the chain
 - b) With extensions as required to prevent interference with adjacent piping or equipment
 - c) Chain heavily zinc or cadmium-plated and looped to extend between 3' and 4' off the floor or grade below valve
 - b. Rotation

- i) Counter clockwise (to the left) to open
- ii) The word "OPEN" and an arrow indicating the direction to open cast on each valve body or operator
- iii) Position indicator clearly visible from operating floor

2.2 ECCENTRIC PLUG VALVES

A. Manufacturers/Models

- 1. Valves
 - a. DeZurik - PEC Eccentric Plug Valve (basis-of design)
 - b. Milliken
 - c. Val-Matic Valve and Manufacturing Corporation
 - d. Or Engineer accepted substitution

B. Valve Design

- 1. Valves shall conform to design specified herein and in Valve Schedule provided in this section
- 2. Quarter-turn non-lubricated eccentric plug valves
- 3. Resilient faced plug
- 4. Tight shut-off up to scheduled rating with pressure in reverse direction where scheduled
- 5. Valves with vane type seat rings are not acceptable
- 6. Valve port shall be at least 80% of full pipe area for valves through 20-inch in diameter
- 7. Valve ends to match connecting piping
 - a. Buried: Mechanical joint, ANSI A21.11/AWWA C111
 - b. Flanged: Class 125/150 lb, ANSI B16.1
 - c. Screwed valve ends shall be to the NPT standard
 - d. Grooved ends shall conform to AWWA C606 rigid joint specifications
- 8. Minimum Working Pressure Rating:
 - a. 175 psig, 4 inch through 12 inch
- 9. Opening motion eccentric, lifting plug away from body seat
- 10. Valve Alignment
 - a. In horizontal pipelines, valve shall be installed so that the plug is horizontal and rotates upward as the valve opens
 - b. In vertical pipelines, valve shall be installed with the end marked "seat" at the top of valve
 - c. Valve shall be installed with seat on high pressure side of valve
 - d. Confer with specific manufacturer installation instructions on valve alignment.
- 11. Provided with fully adjustable plug position stops
- 12. Plugs shall be eccentric type with no backing ring or frame
- 13. Valve body cavity shall be smooth without protrusions or baffles
- 14. Electric actuators shall conform to AWWA C542
- 15. Valve bonnet stuffing box sufficiently deep for 4 packing rings on 4" and larger valves
- 16. Valve body plainly marked to indicate seat end
- 17. Actual length within 1/16" $\pm$ of specified or theoretical length
- 18. Valve packing adjustment accessible without removing actuator from valve

C. Valve Materials

- 1. Plug and body: Cast iron, ASTM A126, Class B, or Ductile iron, ASTM A536, Grade 65-45-12
- 2. Resilient plug facing or replaceable style body seats shall be synthetic rubber, neoprene, or Buna N compound suitable for use with water and wastewater applications.
- 3. Seat rings shall be threaded, or welded of corrosion-resistant stainless steel (18-8), nickel, or Monel conforming to AWWA C517
- 4. Sprayed or plated mating seat surfaces are not acceptable
- 5. Bearings shall be replaceable. Sleeve type and thrust bearings in the upper and lower journals shall be corrosion-resistant stainless steel or bronze
- 6. Shaft seals shall be multiple O-ring, self-adjusting U-cup or chevron type packing conforming to AWWA C517
- 7. Pull-down packing is not acceptable
- 8. Shaft seals shall be field adjustable or replaceable without valve disassembly
- 9. Plug seat: Chloroprene (Neoprene)
- 10. Packing: Acrylonitrile Butadiene V-Type Cup

- a. Dual U-cup
- 11. Upper thrust bearing: TFE
- 12. Body seat: Welded-in overlay seat of no less than 90% nickel
- 13. Upper and lower trunnion bearings: Sleeve type, 18-8 stainless steel
- 14. Valves complete with epoxy coating on the interior and exterior per manufacturer's recommendations.

D. Testing

- 1. Each valve shall be in accordance with AWWA C517 subjected to cycle life and pressure leak test (1,034 kPa)(150 psi) and a valve body hydrostatic test (2,068 kPa)(300 psi) by the manufacturer at their facilities prior to shipping
- 2. Valves shall be capable of drip-tight shut-off up to the full leak test rating
 - a. Test and certify pressure capacity in the reverse direction

2.3 BUTTERFLY VALVES

A. Manufacturers:

- 1. Bray Series 35/36 or 30/31
- 2. Dezurik - BOS-US
- 3. Val-Matic – American BFV
- 4. Or Engineer accepted substitution

B. Valve Design and Conditions

- 1. Bi-directional pressure rating: 150 psi for 3 inch through 24 inch valves
- 2. Temperature rating: 250°F
- 3. Bi-directional and tested to 110% of full rating
- 4. Shall be in conformance with AWWA C504 and C542
- 5. Conform to Valve Schedule in this section
- 6. Valve ends:
 - a. Shall be ANSI B16.1 Class 125 for cast-iron body valves Class 25A through Class 150B
 - b. Shall be ANSI B16.1 Class 125 for ductile iron body Class 250 valves
 - c. Shall be AWWA C207 Class D with ANSI B16.1 Class 125 drilling for steel body Class 25A through Class 150B valves
 - d. Shall be AWWA C207 Class E for steel body Class 250 valves
- 7. Joints:
 - a. Shall be mechanical or push-on type rubber-gasket joint ends
 - b. Shall conform to AWWA C111
- 8. The use of a stop or lug cast integrally with or mechanically secured to the body for the purpose of limiting disc travel by means of direct contact or interference with the valve disc (in either the open or closed position) will not be acceptable

C. Materials

- 1. Body:
 - a. Cast iron for Class 25A through Class 150B valves
 - b. Ductile iron for Class 250
- 2. Disc:
 - a. Cast iron or ductile iron for Class 25A through Class 150B valves
 - b. Ductile iron for Class 250
- 3. Seats:
 - a. NBR for services up to 180 Deg F
 - b. Shall be body mounted
 - c. Shall be resilient type
 - d. Mating seat surface shall be stainless steel or Monel
 - i) Sprayed or plated mating surfaces are not acceptable
- 4. Shaft: 316 stainless steel
- 5. Shaft seals:
 - a. Shall be designed for use of standard self-adjusting split-V-type packing or Viton O-ring seals
 - b. Pull down packing is not acceptable
 - c. Material shall be compatible with wastewater process fluids.

- D. Valve position indicators
 - 1. Provide position indicators on all exposed operators
 - 2. Provide handwheel with an arrow with the word open on handwheel rim specifying opening direction
 - a. Arrow shall be cast on rim and raised
 - 3. Identify open position of valve, 0 - 100%
- E. Operator locking devices
 - 1. Modulating service: Infinitely variable locking device or a totally enclosed geared operator as indicated

2.4 GATE VALVES

- A. Gate valves above grade
 - 1. Valves 3 inches in size and larger
 - a. Resilient wedge type in accordance with AWWA C515
 - b. Flange, iron body, and bonnet rated for 200 psi working pressure. Provide O-ring seal between valve body and bonnet
 - c. Ductile or cast iron wedge encapsulated in nitrile rubber and capable of sealing in either flow direction
 - d. Bronze stem with double or triple O-ring or braided packing stem seals
 - e. Rising stem configuration with handwheel diameter sized to allow opening of valve with no more than a 40-pound pull
 - f. Coat interior and exterior surfaces of valve body and bonnet with fusion-bonded epoxy in accordance with AWWA C550
- B. Manufacturers:
 - 1. Kennedy Valve Company, Model KS-RW
 - 2. Mueller, 2300 Series
 - 3. American Flow Control, Series 2500
 - 4. Or Engineer accepted substitution

2.5 BALL CHECK VALVE

- A. Manufacturers
 - 1. Flomatic Valves, Type 408
 - 2. Flygt Corporation, Type 5087
 - 3. AVK, Series 53
 - 4. Or Engineer accepted substitution
- B. Design
 - 1. Ball check valves shall be designed to be non-clog, fully automatic, maintenance free, and specifically suited for operation in wastewater where solids, fibers, grit or highly viscous materials are encountered
 - 2. Ball check valves are designed to be maintenance-free and suited for installation in the horizontal or vertical position
 - 3. Ball check valves will have one moving part, the ball, which automatically rolls out of the path of flow, thus providing an unobstructed and "full flow" equal to nominal size. Upon discontinuation of flow, the ball shall automatically roll back to the closed position providing a positive seal against back pressure or backflow
 - 4. Ball shall have an exterior coating of vulcanized nitrile rubber resistant to grease, petroleum products, animal and vegetable fats, dilute concentrations of acids and alkalines, tearing and abrasion
 - 5. Valve shall be constructed so that by unbolting and lifting off the cover, the ball may be removed and replaced without removing the valve from the line
 - 6. Ball check valves will be available with either a floating or sinking ball.
 - 7. Suitable for 150 psi working pressure (all sizes)
 - 8. Conform to Valve Schedule criteria in this section
 - 9. Body and Cover: Flanged iron body shall be nodular cast iron type
 - 10. Flanges: Shall be ANSI B16.1 Class 125

2.6 SWING CHECK VALVES – REQUIRED FOR ALL SOLIDS APPLICATIONS

- A. Gorman Rupp shall supply all check valves for project. Specification below listed as alternative.
- B. Manufacturers
 - 1. FNW Stainless Steel Figure 471A
 - 2. Or Engineer accepted substitution
- C. Design
 - 1. 175 psi working pressure (general). 250 psi working pressure (special case).
 - 2. Conform to AWWA C508
 - 3. Conform to Valve Schedule criteria in this section
 - 4. Unobstructed waterway, quick-closing, spring-loaded, horizontal swing
 - 5. Stainless steel shaft with both ends extending through bronze bushed bearings and outside stuffing boxes
 - 6. Body and Cover: Shall be stainless steel
 - 7. Flanges: Shall be ANSI B16.1 Class 125
 - 8. Furnish with extended stainless steel hinge with outside lever and weight
 - 9. For vertical installations, adjust lever angle accordingly

2.7 ELASTOMERIC CHECK VALVE

- A. Manufacturers:
 - 1. Red Valve Co Inc, Tideflex Series 35-1
 - 2. Or Engineer accepted substitution
- B. Check valves shall be constructed of elastomeric rubber and be flow operated check type with a flanged end connection. Port area shall contour down to a duckbill which shall allow passage of flow in one direction and prevent reverse flow.
 - 1. Flange and flexible duckbill sleeve shall be one-piece rubber construction with nylon reinforcement.
 - 2. Bill portion shall be thinner and more flexible than valve body and formed into a curve of 180°.
 - 3. Bill slit height must be 1.6 times nominal pipe diameter (12" pipe), minimum.
- C. Flange drilling – conform to ANSI B16.1 Class 125/ANSI B16.5, Class 150
 - 1. Furnish with galvanized or stainless steel retainer rings for installation

2.8 BALL VALVES (BRONZE OR STAINLESS STEEL)

- A. Manufacturers for air and water service 2-inches and larger:
 - Jamesbury (Metso)
 - Jenkins (Crane)
 - Crane
 - Nibco
 - Or Engineer accepted substitution
- B. Manufacturers for air and water service 2-inches and smaller:
 - Crane
 - Jamesbury (Metso)
 - Jenkins (Crane)
 - Nibco
 - Or Engineer accepted substitution
- C. Application
 - Except as otherwise indicated or specified, provide ball valves for all 2-1/2" or smaller shutoff valves
 - Provide additional ball valves as indicated on Drawings or as specified
 - All Ball valves shall be NSF 61 certified.
- D. Fabrication
 - Handles showing direction of opening

Ball design which does not allow media contact with stem
Balancing stop for all applications

2.9 AIR RELEASE AND VACUUM RELIEF VALVES (COMBO VALVE)

- A. All combination air release valves in this project shall be provided by Gorman Rupp. Specifications below apply for alternatives should they be required in project.
- B. Note that all venting orifices shall be routed back to wetwell for a corrosive free environment. Contractor shall routing with tubing and sealed penetration into the wetwell using pipe link seal detail or cast in place tubing.
- C. Manufacturer
APCO (DeZurik) Series 401
Or Engineer accepted substitution
- D. General
Provide on both pump suction lines.
Size shall be 2 inch inlet and outlet
Buna-N seat
Include option for quick connect flushing and venting back to the wetwell. Use 1-inch flexible tubing or Sch. 80 PVC to route to wetwell. Each line shall have an independent ball valve.
All venting shall be routed back to the wetwell for a corrosive free environment.
Floats shall be stainless steel
Working pressure: 75-125 psi
Size as indicated on drawings
2-inch Combo Valve inside lift station
Provide a shutoff valve: Ball valve, gate valve, butterfly valve, eccentric action handle (Refer to standard detail.
 - a. Manufacturers:
 - i) Nibco
 - ii) Dyna-Quip
 - iii) Or Engineer accepted substitution

2.10 BALL AND BUTTERFLY VALVES (PVC OR CPVC BODY)

- A. Use ball and butterfly valves for low pressure small diameter pipe locations
3" and less in size
Type as shown on Drawings
PVC or CPVC, as indicated on the valve schedule
Valve ends as required by piping with ability to remove valve with unions or flanges
Handle or lever operator, quarter turn
- B. Manufacturers
NIBCO
Asahi
Or Engineer accepted substitution

2.11 SLIDE GATES

- A. Slide gates shall be installed inside splitter manhole and inside wetwell.
Model: Series 8200 Fabricated Slide Gates 18"x18"
Materials: Stainless Steel
Seating head: 8" – 11" as shown on drawings
Self contained construction
UHMW Poly Liner
J-Seals
Stainless steel stem

Gear operated lift specific to site conditions shown on drawings with a removable handwheel located inside Lift Station.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General:
Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly
Install valves and accessories in accordance with the manufacturer's recommendation and in accordance with referenced standards and specifications and shown on Drawings
Provide a union or flanged connection within 2 feet of each threaded end valve unless the valve can otherwise be easily removed from piping
Set valve level and plumb. Actuator to be set plumb or actuator can be set at 90 degrees to valve body if required for proper actuation
Install valve in proper orientation for flow and disc seating
Test valves installed with piping for hydrostatic testing, ensure each valve is operated and able to maintain test pressure and seal tight to isolate each piping section
- B. Check valves: Install ball check valves in vertical piping
- C. Air release and Vacuum-Relief Valves:
Provide exhaust piping to a suitable disposal point

3.2 ADJUSTMENT

- A. Check and adjust valves, actuators, pilotry, and accessories for smooth operation in accordance with manufacturer's instructions

3.3 TRAINING

- A. Provide manufacturer certified training on-site for valves and actuators
- B. Training to consist of field training and classroom training for valves and actuators as required
- Minimum of 4 hours training for valves with pilotry and/or electric/pneu actuators
 - Minimum of 4 hours training for valves with replaceable seats and seals, or are testable backflow preventers

3.4 VALVE SCHEDULE, VALVES LARGER THAN 4-INCHES

- A. Install valves as scheduled in the Valve Schedule provided below. All valves on appurtenances (taps, PIT, drain lines, gages, etc.) are not shown below. Drawings take precedence for quantity of valves.

VALVE SCHEDULE						
Type	Valve ID	Size	Area Location	Type of Installation	Valve End Connection	Actuation
BFV	BFV-1	8-inch	Lift Station	Indoor	Lugged	Manual Handwheel
PV	PV-1	8-inch	Lift Station	Indoor	FLGxFLG	Manual Handwheel
PV	PV-2	8-inch	Lift Station	Indoor	FLGxFLG	Manual Handwheel
PV	PV-3	8-inch	Lift Station	Indoor	FLGxFLG	Manual Handwheel
SG	SG-1	18x18 inch	Wetwell	Indoor	Contained Frame	Manual Handwheel
SG	SG-2	18x18 inch	Wetwell	Indoor	Contained Frame	Manual Handwheel
SG	SG-3	18x18 inch	Manhole	Indoor	Contained Frame	Manual Handwheel
SG	SG-4	18x18 inch	Manhole	Indoor	Contained Frame	Manual Handwheel

SAV	SAV-1	8-inch	Lift Station	Indoor	Threaded	Automatic (provided by lift station supplier)
SAV	SAV-2	8-inch	Lift Station	Indoor	Threaded	Automatic (provided by lift station supplier)

- B. Valves smaller than 4-inches are not indicated in the Valve Schedule and are the responsibility of the Contractor to purchase and install.
- C. Install valves as scheduled in the Valve Schedule provided below
 - ARV: Air Release Valve
 - ASHP: Aerated Sludge Holding Pond
 - BFV: Butterfly Valve
 - C: Contractor to provide valve
 - CARVB: Combination Air Release and Vacuum Breaker Valve
 - CV: Check Valve
 - DAP: Diffuser Air Purge Valve
 - DC: Double Check Valve
 - DV: Diaphragm Valve
 - EA: Electrically Actuated
 - FLG: Flanged Joints
 - GV: Gate Valve
 - HW: Hand Wheel
 - MJ: Mechanical Joints
 - NPT: National Pipe Thread
 - NPW: Non-Potable Water Line
 - PSE: Pre-Selected Equipment to be included in Xylem scope of supply
 - PV: Plug Valve
 - PRV: Pressure Reducing Valve
 - RAS: Refrigerated Automatic Sampler
 - RPZ: Reduced Pressure Backflow Preventer
 - S: Solenoid
 - SAV: Pressure Relief and Surge Anticipator Valve
 - VBNO: Valve Box and Nut Operation

END OF SECTION

SECTION 220529 SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers and supports
- B. Equipment bases and supports
- C. Flashing and sealing equipment

1.2 RELATED SECTIONS

- A. Section 03 00 00 – Concrete

- B. Section 22 11 00 – Pipe and Pipe Fittings

1.3 REFERENCES

- A. American Society of Testing and Materials (ASTM)
 - 1. F708 – Design and Installation of Rigid Pipe Hangers
- B. International Building Code (IBC)
- C. Manufacturers Standardization Society (MSS)
 - 1. SP58 – Pipe Hangers and Supports – Materials, Design and Manufacturer
 - 2. SP69 – Pipe Hangers and Supports – Selection and Application
 - 3. SP89 – Pipe Hangers and Supports – Fabrication and Installation Practices

1.4 SYSTEM DESCRIPTION

- A. Provide complete system of pipe supports and anchors for all piping
- B. Support all piping to prevent undue strain on any valve, fitting or piece of equipment
- C. Provide support and anchors at changes in direction, change in elevation, adjacent to flexible couplings, and where valve actuators/positioners add additional weight and stresses
- D. Do not install in equipment access areas

1.5 PERFORMANCE REQUIREMENTS

- A. Pipe support system components to withstand total dead load
 - 1. Dead load: Weight of pipe filled with water plus any insulation
 - a. Dead load defined as weight of pipe filled with water plus any insulation
 - 2. Factor of safety: 5 minimum
- B. Pipe restraint system components to withstand thrusts created by fluid pressure within pipes
 - 1. Factor of safety: 5 minimum
- C. Do not exceed manufacturers' recommended loads
- D. Brace all piping 2½ inch and larger for Seismic Zone B forces in accordance with International Building Code

1.6 SUBMITTALS

- A. Submit under provisions of Section 01340
- B. Shop drawings: Indicate system layout with location and detail of trapeze hangers. Include location of pipe supports
- C. Product data: Provide manufacturers catalog data including load capacity
- D. Design data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers
- E. Manufacturer's installation instructions: Indicate special procedures and assembly of components

PART 2 PRODUCTS

2.1 MATERIALS

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- A. Not submerged: Galvanized steel except where otherwise indicated or specified
- B. Submerged: Stainless steel, 304L
- C. Use stainless steel materials for stainless steel pipe or galvanized steel with non-conductive isolation gaskets to prevent electrolytic corrosion

2.2 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Anvil International
 - 2. Unistrut Corporation
 - 3. Elcen Metal Products Co.
 - 4. PHD Manufacturing, Inc
 - 5. Or accepted substitution
- B. Plumbing piping – water:
 - 1. Conform to requirements of Section 15060
 - 2. Hangers for pipe sizes ½ to 1½ inch: Stainless steel, adjustable swivel, split ring
 - 3. Multiple or trapeze hangers: Steel channels with welded spacers and hanger rods
 - 4. Wall support for pipe sizes to 3 inches: Cast iron hook
 - 5. Vertical support: Stainless steel riser clamp
 - 6. Copper pipe support: Stainless steel ring, adjustable, copper plated

2.3 ACCESSORIES

- A. Hanger rods: ASTM A307, Grade R. Mild steel threaded both ends, threaded one end, or continuous threaded
- B. Isolation pads: neoprene waffle type
 - 1. Manufacturers: Mason Industries "Type W", Fabreka Production Company "Fabcel", or accepted substitution
- C. Insulation protection shield: ANSI/MSS SP-58

2.4 FLASHING

- A. Metal flashing: 26 gauge galvanized steel
- B. Metal counter flashing: 22 gauge galvanized steel
- C. Flexible flashing: 0.125 inch thick sheet butyl-isoprene; compatible with roofing
- D. Caps: Steel, 22 gauge minimum

2.5 SLEEVES

- A. Sleeves for round ductwork: Galvanized steel
- B. Sleeves for rectangular ductwork: Galvanized steel or wood
- C. Sealant: Refer to Section 07900

2.6 FINISHING

- A. All hangers, rods, clamps, protective shields, metal framing support components, and hanger accessories: Galvanized Steel unless otherwise indicated or specified
- B. For stainless steel components: none required

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions
- B. Pipe supports and anchors are not indicated on drawings in all locations; supports are indicated for most larger pipes
- C. Provide system of pipe supports and anchors for all piping
- D. Provide additional supports as required adjacent to couplings
- E. Pipe supports shall be provided at all changes in direction and adjacent to flexible couplings

3.2 PIPE HANGERS AND SUPPORTS

- A. For designated pipe supports located adjacent to equipment and other locations requiring vibration isolation, provide isolation pad
- B. Support horizontal piping as scheduled

- C. Install hangers to provide minimum ½ inch space between finished covering and adjacent work
- D. Brace all piping 2-1/2 inch and larger for Seismic Zone B forces in accordance with local building codes
- E. Place hangers within 12 inches of each horizontal elbow
- F. Use hangers with 1½ inch minimum vertical adjustment
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers
- H. Support riser piping independently of connected horizontal piping
- I. Design hangers for pipe movement without disengagement of supported pipe
- J. Piping connections to equipment: Provide pipe support adjacent to equipment. Pipes shall not be supported on equipment
- K. Do not support lower pipe from pipe above
- L. Support pipe 1½ inch minimum from walls and 3 inch minimum below ceilings
- M. From framing strut systems, cut ends and paint exposed metal with galvanized paint
- N. Prime coat exposed steel hangers and supports. Refer to Section 09900. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed
- O. Do not install pipe supports in equipment access areas

3.3 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Drawings for location of pads
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure
- D. Provide rigid anchors for pipes after vibration isolation components are installed

3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs
- B. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb

3.5 SCHEDULES

- A. Maximum hanger spacing and rod size for cast iron, ductile iron, steel and PVC:

Pipe size (inches)	Max. hanger spacing (feet)	Hanger rod diameter (inches)
1½ and smaller	6	3/8
1 ½ to 2	8	3/8 to 1/2
2 ½ to 3	10	1/2 to 5/8
4	10	5/8
6 and 8	12	3/4
10 and 12	14	7/8
14 and 16	16	1
18	16	1-1/8
20 and larger	18	1-1/4
PVC (all sizes)	6	Same as for steel

- B. Maximum hanger spacing and rod size for copper and stainless steel piping
1. Spacing:
 - a. 1 inch and smaller: 5 feet maximum
 - b. 1¼ inch and larger: 2 feet less than maximum spacing for steel pipe of same size
 2. Hanger rod size: Same as for steel

END OF SECTION

DIVISION 26 - ELECTRICAL

SECTION 260500 BASIC ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes basic electrical requirements for materials and methods applicable to electrical equipment specified under this section and other related sections.
1. Conduit
 2. Boxes
 3. Duct Bank
 4. Wire and Cable
 5. Wiring Devices and Device Plates
 6. Maintenance Materials
 7. Grounding Materials
 8. Luminaries
 9. Power Panels
- B. Related Sections:
1. Section 01340 – Shop Drawings and Product Data
 2. Section 01500 – Construction Facilities and Temporary Controls
 3. Section 01730 – Operation & Maintenance Data
 4. Section 02300 – Earthwork

- 5. Section 03300 – Cast-In-Place Concrete
- 6. Section 09900 – Coatings

1.2 REFERENCES

- A. UL – All applicable standards
- B. IEEE – All applicable standards
- C. IPCEA – All applicable standards
- D. NEMA – All applicable standards
- E. ANSI/NFPA 70 – National Electrical Code
- F. ANSI C2 – National Electrical Safety Code
- G. ANSI/NEMA FB 1 – Fittings and Supports for Conduit and Cable Assemblies
- H. ANSI/NEMA OS 1 – Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- I. ANSI/NEMA OS 2 – Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- J. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 SUBMITTALS

- A. Information covering all material that is to be used on this project shall be submitted.
- B. Each sheet of descriptive literature shall be clearly marked to identify the material or equipment for which it pertains.
- C. Equipment on submitted sheets that is not for this project shall be crossed out.
- D. As a minimum the following information shall be submitted:
 - 1. Lamp fixture descriptive sheets identified by the fixture schedule letter
 - 2. Equipment sheets shall identify what the equipment refers to by calling out the name of the equipment on the sheet.
 - 3. Schematics and connection diagrams for all electrical equipment shall be submitted.
 - 4. Submit all types of conduit and cables with manufacturer and sizes as well as all appurtenances.

1.4 QUALITY ASSURANCE

- A. Supplier's qualifications
 - 1. The entire system shall be designed, coordinated, and supplied by a qualified Electrical Contractor who is regularly engaged in the business of building electrical systems for water and wastewater projects. The Electrical Contractor shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.
- B. Coordination
 - 1. The electrical equipment shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufacturer and the manufacturer of related equipment.

2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
3. The Contractor shall provide coordination with other contractors and supervision of installation as required during construction.
4. All service entrance work shall be in accordance with the local utility standards.
5. The electrical contractor shall coordinate all service entrance work with the local utility. The local utility is Xcel Energy.
6. The electrical contractor shall NOT pay for the utility's work. That shall be billed directly to the owner.
7. Accurately record actual locations of conduit, duct banks, panels, and accessories.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable Building Code.
- B. Electrical: Conform to latest version of NFPA 70.
- C. Coordinate, obtain and pay for all permits, inspections and approvals of authority having jurisdiction.
- D. Comply with local electrical codes in force or in the absence of local electrical code, the latest edition of the National Electrical Code, ANSI C1.

1.6 WARRANTY

- A. The electrical contractor shall warrant the supplied equipment and labor for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The work for this project is for a functioning city building. All new work shall be done in a way that allows the existing facility to maintain its operation.
- B. All equipment furnished under this Section shall be selected by the Contractor for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged, and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
 1. Conduit
 - a. Minimum Size: $\frac{3}{4}$ inch unless otherwise specified, or $\frac{1}{2}$ inch for luminaries pendants.
 - b. Underground Installations:
 - i) Over 100V: More than five feet from foundation wall: Use thick wall nonmetallic conduit.
 - ii) Within five feet from foundation wall: Use rigid steel conduit
 - iii) Under 100V: Use rigid steel conduit
 - iv) Minimum size: 1 inch.
 - c. Outdoor Locations, Above Grade: Use rigid steel conduit.
 - d. In Slab Above Grade:
 - i) Use rigid steel conduit for circuits that are 24V or less.
 - ii) Use rigid thick wall non-metallic conduit for 120V to 480V circuits.
 - iii) Maximum Size Conduit in Slab: 2 inch, 1 inch for conduits that cross over each other, or with structural engineer's approval.
 - iv) Conduits shall not be spaced closer than 3 conduit widths on center.
 - v) Aluminum conduit shall not be embedded in concrete.

- vi) Conduits shall not pass through a structural concrete beam without the structural engineer's approval.
- e. In or under slab on grade:
 - i) Use rigid steel conduit for circuits that are 24V or less.
 - ii) Use rigid thick wall non-metallic conduit.
- f. Wet and damp locations: Use PVC coated rigid steel conduit.
- g. Dry locations:
 - i) Concealed: In walls or above ceilings, use rigid steel or aluminum conduit.
 - ii) Exposed: Use rigid steel conduit or aluminum conduit.
- h. Rigid Steel Conduit.
 - i) Rigid steel conduit shall be heavy wall, hot-dipped galvanized, and shall conform to Fed Spec WW-C-581 and ANSI C80.1, and shall be manufactured in accordance with UL 6.
- i. Rigid Nonmetallic Conduit (PVC).
 - i) PVC conduit shall be heavy wall, schedule 40, shall be UL labeled for aboveground and underground uses.
- j. PVC-Coated Rigid Steel Conduit.
 - i) The conduit shall be rigid steel and before the PVC coating is applied, the hot-dipped galvanized surfaces shall be coated with a primer to ensure a bond between the steel substrate and the coating. The PVC coating shall be bonded to the primed outer surface of the conduit at a thickness of at least 40 mils. A two part urethane chemically cured coating shall be applied at a nominal 2 mil thickness to the interior of all conduit and fittings.
 - ii) Manufacturers: Ocal, PermaCote, or Robroy Industries.
- k. Rigid Aluminum Conduit.
 - i) Rigid aluminum conduit shall be heavy wall and shall conform to Fed Spec WW-C-581 and ANSI C80.1, and shall be manufactured in accordance with UL 6.
- l. Flexible connections
 - i) Conduit: Moisture proof vinyl jacketed, liquid-tight, hot-dipped galvanized flexible steel and shall be UL labeled.
 - ii) Connectors: Watertight, Appleton Type ST or STB, Crouse-Hinds Type LT or LTC, or equal.
- 2. Outlet Boxes
 - a. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, Galvanized.
 - i) Luminaries and equipment supporting boxes: rated for weight of equipment supported.
 - ii) Concealed installations.
 - b. Nonmetallic outlet boxes: ANSI/NEMA OS 2.
 - c. Cast Boxes: NEMA FB 1, Type FD, Cast Ferroalloy.
 - i) Provide gasketed cover by box manufacturer.
 - ii) Provide threaded hubs.
 - iii) Models VXF, GRFX as manufactured by Crouse-Hinds.
 - iv) Models SEH, JBDX, with mounting lugs as manufactured by Appleton.
- 3. Pull and Junction
 - a. Sheet Metal Boxes: NEMA OS 1, Galvanized Steel.
 - b. Surface-Mounted Cast Metal Box: NEMA 250, Type 4 flat-flanged, surface-mounted junction box.
 - i) Material: Galvanized cast iron Cast aluminum in corrosive areas.
 - ii) Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
 - iii) Model: WCB as manufactured by Crouse-Hinds.
 - c. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting.
 - i) Material: Galvanized cast iron.
 - ii) Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 - iii) Cover Legend: ELECTRIC.
 - iv) Model: WPD as manufactured by Crouse-Hinds.
- 4. Large Junction Boxes and Wiring Gutters
 - a. Indoor Locations:
 - i) Steel, NEMA 12.
 - b. Outdoors:

- i) Stainless steel.
 - ii) Weather-tight NEMA 4.
 - c. Construction.
 - i) Provide rigid handles for box covers larger than 9 sq. ft. or heavier than 25 lbs.
 - ii) Provide split covers for covers larger than 12 sq. ft.
 - iii) Aluminum boxes in concrete not allowed.
- 5. Seal Fittings
 - a. Model ESU with Apelco sealing cement and fiber, as manufactured by Appleton.
 - b. Model EZS with Chico X Fiber and Chico A compound as manufactured by Crouse-Hinds.
- 6. Deflection Fittings
 - a. Locations:
 - i) Underground conduit runs.
 - ii) Runs between concrete sections subject to relative movement.
 - b. Material:
 - i) Ferroalloy hubs.
 - ii) Neoprene outer jacket.
 - iii) Stainless steel jacket clamps.
 - iv) Molded plastic inner sleeve.
 - v) Tinned copper braid grounding strap.
 - c. Model XD as Manufactured by Crouse-Hinds.
- 7. Expansion Fittings
 - a. Locations:
 - i) In long conduit runs, to permit linear movement caused by thermal expansion and contraction.
 - ii) In long conduit runs to prevent conduit from buckling.
 - iii) Indoors and outdoors, where conduit expansion occurs or where there is a wide temperature range.
 - iv) At structural expansion joints.
 - b. Material:
 - i) End fittings: Ferroalloy.
 - ii) Body: Steel conduit.
 - c. Provide Bonding Strap When Used Outdoors.
 - d. Model XJ, as Manufactured by Appleton and Crouse-Hinds.
- 8. Flexible Sealing Compound
 - a. "Duxseal" as Manufactured by Johns-Manville.
 - b. "Permagum" as Manufactured by In mount.
- 9. Coal Tar Epoxy Paint
- 10. Wire and Cable
 - a. 600 Volt Power Cable
 - i) General Use:
 - a) Conductors: Single, copper, 12 AWG minimum.
 - b) All conductors shall be stranded.
 - c) Insulation: 600V thermoplastic, UL Type THWN/THHN.
 - d) Suitability: Wet or dry locations at 75° C and 90° C copper temperature.
 - e) Or as specified for service entrances.
 - ii) Service entrance and 4 AWG and above:
 - a) Conductors: Single, stranded, copper.
 - b) Insulation: 600V cross-linked polyethylene, UL Type XHHW/USE or THHN.
 - c) Suitability: Wet or dry locations at 75° C and 90° C copper temperature.
 - iii) Terminations
 - a) Lugs, cup washers or pressure type; do not use wire nuts on stranded cable or wrap standard cable around screw type terminals
 - b. Lighting Circuits
 - i) General Use:
 - a) Conductors: Single, copper, 12 AWG minimum.
 - b) Conductors may be solid or stranded.
 - c) Insulation: 600V thermoplastic, UL Type THWN/THHN.
 - d) Suitability: Wet or dry locations at 75° C and 90° C copper temperature.

- ii) Terminations:
 - a) Lugs, cup washers or pressure type; do not use wire nuts on stranded cable or wrap stranded cable around screw type terminals.
 - c. Control circuits
 - i) General Use:
 - a) Conductors: Single, tinned copper, 14 AWG
 - b) All conductors shall be stranded
 - c) Insulation: 600V thermoplastic, UL Type THWN/THHN.
 - ii) Millivolt or Milliampere Instrumentation and Control.
 - a) Conductors: 18 AWG stranded copper, 2 or 3 as required.
 - b) Insulation: 15 mils, minimum, 90°C PVC.
 - c) Shield: Mylar aluminum tape with 20 AWG copper drain wire, fully covering conductors.
 - d) Jacket: 20 mils, minimum, 80°C PVC.
 - e) Suitability: Wet or dry steel conduit.
 - iii) Manufacturers: Belden "UL Instrumentation Cable – 1032A", Samuel Moore "Dekoron ICMX" No. 1852-686 and 1862-686, or equal.
- 11. Wiring Devices
 - a. General:
 - i) Industrial Specification grade.
 - ii) White.
 - b. Receptacles:
 - i) 120 V duplex outlets: NEMA 5-20R, 3 wire, grounding, 20A, 125 V, Leviton 5362, or approved equal.
 - ii) 120 V duplex GFCI outlets: NEMA 5-20R, 3 wire, grounding, 20A, 125 V, Leviton 7899, or approved equal.
 - iii) 240 V duplex outlets: NEMA 6-20R, 3 wire, grounding, 20A, 250 V, Leviton 5462, or approved equal.
 - iv) Welding outlets: 50A, 125/250V, 3 pole, 4 wire, grounding, NEMA 14-50R, Leviton 55050, or approved equal.
 - c. Light Switches:
 - i) 277 V lighting circuits: 20 amp, 120/277 V, Leviton 1221-2W to 1224-2W, or approved equal.
- 12. Device Plates
 - a. General:
 - i) Mounting hardware countersunk and finished to match plate.
 - ii) Provide over-sized plates where standard plates do not cover wall opening.
 - iii) Provide engraving as indicated on drawings.
 - b. Indoors:
 - i) Surface mounted devices: Galvanized or cadmium-plated steel.
 - ii) Flush mounted devices in other finished areas: Phenolic plastic, white.
 - iii) All other flush mounted devices: Type 302 stainless steel.
 - c. Outdoors and Indoors when identified on Drawings as Weatherproof:
 - i) Weatherproof with spring doors for receptacles and with provisions for padlocking switches on and off.
 - ii) Provide an adaptor plate for flush mounted device plates, Crouse-Hinds FS031, or equal.
- 13. Grounding and Bonding
 - a. Provide rod electrodes, exothermic connections and mechanical connections.
 - b. Building perimeter ground cable shall be minimum of 4/0 AWG bare copper.
 - c. Duct bank ground cable shall be minimum of 4/0 AWG bare copper.
 - d. Other ground cable shall be as noted on the drawings.
- 14. Luminaries
 - a. Furnish products as specified on drawings.
 - b. Install ballasts, lamps, and specified accessories at factory.
 - c. Accessories:
 - i) Provide swivel-type box covers.
 - ii) Provide threaded conduit pendants.

- d. Provide all lamps and required mounting hardware.
- 15. Power Panels
 - a. General:
 - i) Circuit breaker panel board.
 - ii) With neutral.
 - iii) Dead front.
 - b. Enclosure:
 - i) NEMA 12, surface in unfinished areas, NEMA 1 flush in finished areas or as indicated on the drawings.
 - ii) Door with latch and lock.
 - iii) Typewritten circuit directory.
 - iv) Ground stud bolt through cabinet with removable 1/0 AWG bond to the panel ground bus and an external clamp connector for a station ground conductor.
 - c. Circuit Breakers:
 - i) Molded case thermal magnetic.
 - ii) Multiple pole breakers shall be common trip.
 - iii) Bolt-in.
 - iv) Individually front replaceable.
 - v) Indicating "On", "Off", and "Tripped".
 - vi) RMS symmetrical interrupting capacity shall be as indicated on the drawings.
 - vii) Breakers, trip ratings, and number of poles as indicated on the drawings.
 - d. Buses:
 - i) Three phase and neutral bus insulated from cabinet.
 - ii) Ground bus.
 - a) Connected to cabinet.
 - b) Clamp type lug for supply circuit and each load circuit.
 - c) Removable bond to neutral bus.
 - iii) Copper bussing.
 - iv) Ampere and voltage ratings as indicated on the drawings.
 - v) Bracing coordinated with circuit breakers interrupting capacity.
- 16. Lighting Panels
 - a. General:
 - i) Circuit breaker panel board.
 - ii) With neutral.
 - iii) Dead front.
 - b. Enclosure:
 - i) NEMA 1 or as indicated on the drawings.
 - ii) Door with latch and lock.
 - iii) Typewritten circuit directory.
 - iv) Ground stud bolt through cabinet with removable 1/0 AWG bond to the panel ground bus and an external clamp connector for a station ground conductor.
 - c. Circuit Breakers:
 - i) Molded case thermal magnetic.
 - ii) Multiple pole breakers shall be common trip.
 - iii) Bolt-in or plug-in.
 - iv) Individually front replaceable.
 - v) Indicating "On", "Off", and "Tripped".
 - vi) 10,000 amp RMS symmetrical interrupting capacity at 240 V.
 - vii) Handle clips to prevent casual operation for circuit breakers indicated on drawings.
 - viii) Ground fault interrupting breakers with a sensitivity of 5mA for receptacle branch circuit and where indicated on drawings.
 - ix) Breakers, trip ratings, and number of poles as indicated on the drawings.
 - d. Buses:
 - i) Two phase and neutral bus insulated from cabinet.
 - ii) Ground bus.
 - a) Connected to cabinet.
 - b) Clamp type lug for supply circuit and each load circuit.

- c) Removable bond to neutral bus.
 - iii) Copper.
 - iv) Ampere and voltage ratings as indicated on the drawings.
 - v) Bracing coordinated with circuit breakers interrupting capacity.
- 17. Dry-Type Specialty Transformers.
 - a. Phase, voltage current ratings as indicated on drawings.
 - b. Two 2½% full capacity taps below normal voltage.
 - c. Dry type, wall floor or MCC mounted as indicated on the drawings, enclosed for wiring in conduit.
 - d. Self air-cooled.
 - e. Suitable for indoor NEMA 4.
 - f. Insulation system and average winding temperature rise for rated KVA as follows:
 - i) 1-15 KVA: Class 185 with 115°C rise.
 - ii) 16-500 KVA: Class 220 with 115°C rise.
 - g. Sound Levels: NEMA ST20.
 - h. Ground core and coil assembly to enclose by means of a visible flexible copper grounding strap.
 - i. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise
- 18. Surge Protective Device (SPD).
 - a. General:
 - i) SPD units shall be installed as shown on the drawings.
 - ii) SPD units shall be appropriate for the voltages indicated on the drawings.
 - iii) Approved manufacturers: Cutler Hammer, Square D, LEA, or equal.
 - iv) SPD units shall comply with UL 1449 and 1283.
 - v) SPD units shall comply with IEEE C62.41 and IEEE C62.45.
 - vi) SPD units shall have a 30 amp disconnect directly before the TVSS unit.
 - vii) SPD units shall have indication for trouble alarms and surge count.
 - viii) For assembled equipment the SPD unit shall be of the same manufacturer as the assembled equipment.
 - b. Ratings:
 - i) Maximum let through voltage shall be:

Mode	120/208	277/480
L-N or L-G	400V	800V
L-L	800V	1800V
 - ii) Minimum total surge current capability:

Location	Per Phase	Per Mode
Switchgear	250 KA	125KA
MCC	160KA	80KA
Panelboards	120KA	60KA

2.2 SPARE PARTS

- A. The Supplier shall furnish and deliver the following spare parts.
- B. The following spare parts to be furnished as a minimum:
 - 1. 25% replacement lamps for lighting fixtures.
 - 2. 25% replacement lamps for pilot light.
 - 3. Two (2) sets of each type of fuse used in the project.
 - 4. Two (2) spare ballast of each type specified.

- C. All of the above parts shall be provided as spare parts and shall be packaged new in the original manufacturer's packaging. A list of spare parts shall be provided.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. General Requirements
 - 1. The instrumentation equipment shall be installed by the Contractor or his subcontractors in accordance with the manufacturers' instructions. The services of the system supplier's technical representative shall be provided as necessary to calibrate, test, and advise others of procedures for adjustment and operation.
- B. Inspection
 - 1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
 - a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.
- C. Equipment Installation
 - 1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
 - a. Separate sheet metal junction boxes, equipment enclosures, sheet metal raceways, etc., mounted on water or earth-bearing walls or wall-mounted outdoors 1/4" from wall be corrosion resistant spacer.
 - b. Seal the base of all outdoor switchgear, motor control center, and similar equipment with grout.
 - c. Screen or seal with flexible sealing compound all openings into outdoor equipment to prevent the entrance of rodents, wasps, and mud-daubers.
 - d. Electrical work shall conform to the construction schedule and progress of other trades.
 - e. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
 - f. Perform all work in accordance with manufacturer's instructions.
 - i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
 - ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
 - g. Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.
- D. Identification:
 - 1. Conduit. All conduits shall be provided with identification tags. Tags shall be brass nameplates with 3/8" high lettering and attached to the conduits by means of stainless steel wire. Conduits shall be identified at both ends with the same identification number.
 - 2. Cable. Except for lighting and receptacle circuits, each individual wire in power, control, indication, and instrumentation circuits shall be provided with identification markers at the point of termination. Power wires without individualized identification numbers shall be color coded with electrical tape or colored wire jacket. The wire markers shall be of the heat-shrinkable tube type.
 - 3. Control Stations. Control stations shall be provided with nameplates identifying the related equipment. Pilot controls and indicating lights shall have engraved or etched legends ("start", "stop", etc.) as indicated on the drawings. Nameplates shall be laminated plastic, with 1/8 inch engraved letters, and shall be securely fastened to the control stations.
 - 4. Circuit Breakers. Circuit breakers shall be provided with nameplates identifying related equipment. Nameplates shall be laminated plastic, with 1/8 inch engraved letters, and shall be securely fastened to the circuit breakers.
- E. Raceways:

1. General:
 - a. Except as otherwise indicated on drawings, conduit shall be concealed in finished areas and exposed in unfinished areas.
 - b. Rigid steel conduit and aluminum conduit connections and terminations shall be reamed, deburred, threaded and provided with bushings.
 - c. Securely fasten conduit connections to sheet metal enclosures with locknuts inside and out. Conduit hubs outdoors and in wet locations.
 - d. Provide deflection fittings across structural joints where structural movement is allowed.
 - e. Keep conduit clear of structural openings and indicated future openings.
 - f. Provide flashing and seal watertight conduits through roofs and metal walls.
 - g. Neatly grout conduit into any opening cut into structure.
 - h. Cap or plug conduits during construction to prevent the entrance of trash, dirt and water.
 - i. Minimum conduit size shall be $\frac{3}{4}$ ", except $\frac{1}{2}$ " for luminaries pendants or as noted on drawings.
 - j. Seal conduits with flexible sealing compound forced to a minimum depth equal to the conduit diameter after cable is installed.
 - i) At handholes, manholes, and vaults.
 - ii) Building entrance junction boxes.
 - iii) One inch or larger connections to equipment.
 - k. Provide flexible conduit where flexible connections are necessary, including each motor without flexible cord.
 - i) Keep length to a minimum, not to exceed 6' maximum.
 - ii) No sharp bends.
 - l. Provide suitable pull string in each empty or spare conduit.
2. Conduit exposed in structures:
 - a. Install parallel to structural members and surface.
 - b. Install conduits of the same general routing parallel with symmetrical bends.
 - c. Arrange supports to prevent misalignment during wiring installation.
 - d. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
 - e. Group related conduits; support using conduit rack. Construct rack using steel channel provide space on each for 25 percent additional conduits.
 - f. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch size.
 - g. Provide suitable pull string in each empty conduit except sleeves and nipples.
 - h. Maintain 6" clearance to ducts, piping and flues.
 - i. Support rigidly with galvanized or cadmium-plated hardware and framing materials, including nuts and bolts.
 - j. Provide expansion fittings at 100' centers outdoors, 200' centers indoors; in each conduit run longer than 100' outdoors, 200' indoors.
 - k. Provide galvanized pipe caps on conduit stubs for future use.
 - l. Allow 7' headroom for horizontal conduit runs, except along structures, piping equipment or where not possible.
 - m. Except as otherwise indicated, do not install exposed conduit in water chambers.
 - n. Where allowed, coat conduit exposed in water chambers with 2 coats of coal tar paint with paint injuries repaired or use PVC coated conduit.
3. Conduit concealed in structure:
 - a. Install between reinforcing steel in slabs with reinforcing in both faces.
 - b. Install under reinforcing steel in slabs where only a single layer is provided.
 - c. Terminate conduit for future use in equipment or by galvanized couplings and conduit plugs flush with structural surfaces. Seal plugs with self-leveling caulk.
 - d. Maximum of two conduits crossing each other in slab.
4. Underground:
 - a. One inch minimum.
 - b. Encased in concrete.
 - i) Two inches between conduits.
 - ii) Three inches over conduit where not reinforced.

- iii) Three inches over reinforcing.
- iv) Reinforced at and 5' past portion on disturbed earth or subject to traffic.
- v) Reinforced within 5' of a structure, manhole or vault.
- vi) Reinforced for entire length and 2' beyond each adapter to steel conduit if non-metallic is used in duct bank.
- vii) Where capped underground, reinforce the last 2' and extend steel and conduit 2' past end of duct bank. Paint all un-encased metal with 2 coats of coal tar paint.
- viii) Continue encasement on outdoor risers to 3" above grade and crown and chamfer top.
- c. Two foot minimum bend radius at vertical risers, 3 foot elsewhere.
- d. Install underground conduit so that it does not drain to cable pulling access in buildings; where necessary, provide a handhole or manhole near or adjacent to building.
- e. Provide 3 foot minimum earth cover.
- f. Install underground conduits through buildings, manhole, handhole and vault walls in box outs as indicated on the drawings.
- g. All steel inside manholes, handholes and vaults shall be galvanized with bared spots treated with zinc rich paint.
- h. Provide ¾" galvanized steel pulling eyes on opposite walls below the centerline of each duct bank.
- i. Provide end bells at wall terminations and adapters for steel conduit continuations for non-metallic duct systems.
- j. Isolate intercommunication and milliamperage level instrumentation circuits from all power wiring raceways, conduits, boxes, vaults, manhole and handhole.
- k. Provide a full-size extension for each underground conduit entering a building.
- l. Rigid nonmetallic conduit (PVC) shall be fastened no less than every 4 feet.
- 5. Junction boxes and wiring gutters:
 - a. Install electrical boxes as shown on drawings and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
 - b. Install pull boxes and junction boxes to maintain headroom and to present neat mechanical appearance.
 - c. Install level and plumb.
 - d. Where indicated, provide a removable side opposite underground duct banks.
 - e. At least code size including space for full size continuation of any conduit not originally continued.
 - f. Arrange conduit for maximum space for future conduits.
 - g. Support boxes independently of conduit except cast box that is connected to rigid metal conduits both supported within 12 inches of box.

F. Wire and Cable

- 1. General:
 - a. Protect the cable and avoid kinking conductors, cutting or puncturing jackets, contaminating by oil or grease or damaging in any manner.
 - b. Terminate stranded cable with lugs, cup washers, or pressure type connectors; do not wrap stranded cable around screw type terminals.
 - c. Splice stranded cable with pressure type connectors; do not use wire nut type connectors on stranded cable.
 - d. Splice cables only at readily accessible locations.
 - e. Do not pull cable tight against bushings or press heavily against enclosures.
 - f. Use cable pulling lubricants as recommended by the cable manufacturer.
 - g. Use swab to clean conduits and ducts before pulling cables.
 - h. Install cable and accessories in accordance with manufacturer's instructions.
 - i. Where necessary to prevent heavy loading of cable connectors due to cable weight, support cables in vertical risers with woven cable grips.
 - j. Coil and tape spare cable ends.
 - k. Support each 250 MCM or larger cable, and each conduit group of smaller cables from manholes, handholes or vault walls.
 - l. Use Stranded conductor for feeders and branch circuits.
 - m. Use stranded conductors for control circuits.
 - n. Use conductor not smaller than 12 AWG for power and lighting circuits.

- o. Use conductor not smaller than 16 AWG for control circuits.
 - p. Use 10 AWG conductors for 20 ampere, 120 Volt branch circuits longer than 100 feet.
 - q. Pull all conductors into raceway at same time.
 - r. Use suitable wire pulling lubricant for building wire 8 AWG and larger.
 - s. Protect exposed cable from damage.
 - t. Neatly train and lace wiring inside boxes, equipment, and panel boards.
 - u. Clean conductor surfaces before installing lugs and connectors.
 - v. Make splices, taps, and terminations to carry full ampacity of conductors.
2. Special cables:
- a. Isolate networking and milliampere level instrumentation cables from all power circuits.
 - b. Isolate telephone cables from all other circuits.
3. Conductor identification:
- a. Color code all service, feeder, and branch circuit conductors, 277/480 VAC and above as follow:
 - i) Phase A: Brown
 - ii) Phase B: Orange
 - iii) Phase C: Yellow
 - iv) Neutral: White
 - v) Ground: Bare or Green
 - b. Color code all feeder, and branch circuit conductors, 120/208 VAC as follows:
 - i) Phase A: Red.
 - ii) Phase B: Black.
 - iii) Phase C: Blue.
 - iv) Neutral: White.
 - v) Ground: Bare or Green.
 - c. Identify single control conductors by color coding orange and by labeling each end of conductors by color coding orange and by labeling each end of conductor with heat shrink-tube type wire markers.
 - d. Identify multi-conductor instrumentation and control cables with heat shrink-tube type wire markers.
 - e. Contractor shall establish a control and instrumentation conductor and cable identification system acceptable to Engineer.
- G. Wiring Devices:
- 1. Flush mount wiring devices in concealed conduit system.
 - 2. Surface mount wiring devices in exposed conduit systems.
 - 3. Provide extension rings to bring outlet boxes flush with finished surface.
 - 4. Clean debris from outlet boxes.
 - 5. Install products in accordance with manufacturer's instructions.
 - 6. Install devices plumb and level.
 - 7. Install switches with OFF position down.
 - 8. Install receptacles with grounding pole on bottom.
 - 9. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
 - 10. Connect wiring devices by wrapping conductor around screw terminal.
 - 11. Use jumbo size plates for outlets installed in masonry walls.
 - 12. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
 - 13. Install wall switch 48 inches above finished floor.
 - 14. Install convenience receptacle 24 inches above finished floor.
 - 15. Inspect each wiring device for defects.
 - 16. Operate each wall switch with circuit energized and verify proper operation.
 - 17. Verify that each receptacle device is energized.
 - 18. Test each receptacle device for proper polarity.
 - 19. Test each GFCI receptacle device for proper operation.
 - 20. Adjust devices and wall plates to be flush and level.
- H. Grounding Materials:
- 1. Coordinate installation with other disciplines.

2. Verify that final backfill and compaction has been completed before driving rod electrodes.
 3. Install Products in accordance with manufacturer's instructions.
 4. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
 5. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing.
 6. Provide bonding to meet Regulatory Requirements.
 7. Install ground cable through building walls within 3' below finish grade and prepare a water stop.
 8. Install ground rods and cables as deep in earth as possible and as far from structure as possible, not closer than 6".
 9. All branch circuit and feeder circuits to include a copper ground conductor in addition to the conduit ground connection.
 10. Connect ground conductors to equipment by ground lugs or clamps.
 - a. If no ground bus or terminal is provided and enclosure is not explosion-proof or submersible provide a clamp type lug under a permanent assembly bolt or by grounding locknuts or bushings.
 - b. If an explosion-proof or submersible enclosure is not provided with grounding means, provide an adjacent junction box with a ground lug.
 - c. Bond grounding system to station piping by connection to the first flange inside the building on either a suction or discharge pipe which will form a good ground connection:
 - i) Drill and tap the flange.
 - ii) Provide a bolted connection.
 - iii) Bond with a copper bar or strap.
 - d. Form ground conductors on equipment to the contours of the equipment.
 - e. Install main ground cables with encased underground conduit banks in earth at least 3" below 1 corner of the duct bank.
 - f. Bond ground cables in underground circuits to main ground cables at each manhole, handhole, and vault.
- I. Luminaries
1. Install in the general locations and arrangement indicated on drawings.
 2. Align luminaries in rows vertically and horizontally except as otherwise required.
 3. Install clear of pipes, mechanical equipment, structural openings, indicated future equipment and structural openings, and other obstructions.
 4. Adjust luminaries location as required by field conditions.
 5. Examine each luminaries to determine suitability for lamps specified.
 6. Install in accordance with manufacturer's instructions.
 7. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminaries at indicated height.
 8. Support luminaries larger than 2x4 foot size independent of ceiling framing.
 9. Locate recessed ceiling luminaries as indicated on reflected ceiling plan.
 10. Install surface mounted luminaries and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
 11. Install recessed luminaries to permit removal from below.
 12. Install accessories furnished with each luminaire.
 13. Bond products and metal accessories to branch circuit equipment grounding conductor.
 14. Install specified lamps in each luminaire emergency lighting unit and exit sign.
 15. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
 16. Aim and adjust luminaries as directed.
 17. Relamp luminaries that have failed lamps at Substantial Completion.
 18. Clean electrical parts to remove conductive and deleterious materials.
 19. Remove dirt and debris from enclosure.
 20. Clean photometric control surfaces as recommended by manufacturer.
 21. Clean finishes and touch-up damage.
- J. Lighting Panel
1. Wall mount in unfinished areas, flush mount in finished areas.
 2. Install lighting panel in accordance with NEMA PB 1.1.

3. Install lighting panel plumb. Provide supports. Height: 6 ft. to top of lighting panel; install lighting panel taller than 6 ft. (2M) with bottom no more than 4 in. above floor.
4. Provide filler plates for unused spaces in lighting panels.
5. Provide typed circuit directory for each branch circuit in lighting panel. Revise directory to reflect circuiting changes required to balance phase loads.
6. Measure steady state load currents at each lighting panel feeder; rearrange circuits in the lighting panel to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
7. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

3.2 FIELD QUALITY CONTROL

- A. Low Voltage Cable Testing
 1. Test 600 V power cables for continuity and freedom from short circuits and ground, except where grounding is intentional immediately after installation.
 2. Test all circuits with a 500 V megger or its equivalent.
 3. Replace conductors which read less than 1.5 Megohms between conductors and ground.

3.3 PROTECTION AND STORAGE

- A. Protection of equipment during storage:
 1. During construction, all electrical equipment shall be protected against absorption of moisture, and metallic components shall be protected against corrosion. This protection shall be provided immediately upon receipt of the equipment and shall be maintained continuously. Any means necessary shall be used to protect the equipment at the Contractor's expense.

END OF SECTION

SECTION 262500 ENGINE GENERATORS: DIESEL

PART 1 – GENERAL

1.1. Section Includes:

- A. Engine-generator set
 1. City Of Rifle South Lift Station Backup Generator
- B. Provide engine generator set including but not necessarily limited to the following:
 1. Engine.
 2. Cooling system.
 3. Exhaust system.
 4. Starting system.
 5. Generator.
 6. Fuel tank and associated fuel system
 7. Control equipment and accessories.
 8. Housing.

9. Output circuit breaker.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. National Electrical Manufacturer's Association (NEMA).
2. National Fire Protection Association (NFPA)
3. Underwriter's Laboratories, Inc. (UL).

B. Testing:

1. Prototype Test: The manufacturer shall have successfully tested a prototype of each engine/generator set series offered. The tests performed shall include the following:
 - a. Maximum power test.
 - b. Maximum motor starting kVA.
 - c. Transient response, steady state governing, and voltage regulation.
 - d. Single step load pick-up per NFPA 110.
 - e. Three-phase short circuit test for mechanical and electrical strength.
 - f. Fuel consumption.
 - g. Cooling system test.
 - h. Endurance run test.
2. Factory Tests: Prior to shipment, each unit shall be factory performance tested under load. Test results shall be certified and documented on a strip chart recorder. The tests shall be performed in accordance with the Manufacturer's standards and NFPA Standard 110. The following tests shall be performed:
 - a. Stepped load test at 1/2, 3/4, and full load for 5 minutes each step.
 - b. Full single step block load.
 - c. Results documented shall include steady-state voltage and frequency analysis, transient response, maximum power analysis, and fuel consumption.
3. Field Tests: Each complete installation shall be tested for compliance with the plans and specifications following completion of all site work. Testing shall be conducted by a representative of the supplier. The Contractor shall supply fuel, and other equipment required for the test. The Owner and Engineer shall be notified in advance and shall have the option to witness the tests. The tests shall be repeated until the equipment performs as specified. The tests to be conducted on site shall be as follows:
 - a. Cold Start Test: Perform a cold start test on the generator using the generator's actual load as a test load. A power failure shall be simulated by opening the normal power disconnect and the following information shall be recorded:
 - 1) Cranking on time.
 - 2) Time required to come up to speed.
 - 3) Voltage and frequency overshoot.

- 4) Time to achieve steady state.
- 5) Voltage, frequency, and amps at standby state.
- 6) Oil pressure, water temperature, and battery charge rate at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter for 2 hours.
- b. Crank Cycle Test: Disable the generator from starting by a method approved by the Manufacturer and test the crank cycle by switching the generator to run.
- c. Safety Shutdowns: Test all the generator safety shutdowns.

1.3 SUBMITTALS

- A. Verify dimensions, coordination and applicability of equipment furnished.
- B. Full detail for performing of engine testing required. Upon completion of engine testing prepare and submit final results along with all new data.
- C. Upon satisfactory completion of startup, secure a written statement from manufacturer that each engine generator is installed in accordance with manufacturer's recommendations, properly started up and is ready for operation by the Owner's personnel. Also certify that required operation and maintenance training has been fully satisfied.
- D. Wiring diagrams for each engine-generator set. Indicate clearly factory versus field wiring connections.
- E. Generator fault current at full rpm and main circuit breaker trip curves and fault interrupting rating.
- F. Operation and Maintenance Manuals

1.4 WARRANTY

- A. Minimum of one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. CAT Wagner
 - 2. Or approved equals.
- B. Assure engine, generator and accessories are provided by the engine manufacturer and its authorized dealer.
- C. Assure local availability of service and replacement parts.

2.2 PERFORMANCE AND OPERATING REQUIREMENTS

- A. Operating Conditions: Provide complete generator sets, controls and accessories rated for the following conditions:
 - 1. Location: Rifle, CO
 - 2. Altitude: 5,520 FT AMSL.

3. Fuel: Diesel.
 4. Enclosure rating: Outdoors.
 5. Ambient Temperature: 51 degF
- B. Performance: Establish net rating of each generator set under operating conditions specified when equipped and fully loaded with all necessary operating accessories. Substantiate ratings with manufacturer's standard published curves and data.
1. Minimum ratings:
 - a. Standby rating (at 0.8 PF): 80 kW
 - b. Frequency: 60 Hz
 - c. Voltage and phase: 480/3
 - d. Engine speed, max (rpm): 1800
 - e. Maximum voltage dip: 10%
 2. The unit shall be required to maintain the above noted parameters while starting and running the loads listed at the end of this section. The loads will not be started simultaneously.
- C. Fuel: Engines requiring special or premium fuel will not be acceptable.

2.3 ENGINE

- A. Engine Construction: Provide diesel-type engine of heavy-duty construction, full compression ignition diesel, radiator and fan cooled.
1. Engines solid-state designed for cold quick start, capable of delivering full load output in 30 seconds.
 2. Engine must meet scheduled performance without turbo-charging or after- cooling.
 3. Provide exhaust manifolds.
- B. Lubrication:
1. Provide pressure-type lubrication system with gear-type oil pump and full flow filters fitted to engines. Provide level indicator or dipstick.
 2. Locate filter for convenient servicing.
 3. Oil drain piped to edge of skid with valve or cap.
- C. Air Cleaner:
1. Provide one or more dry-type replaceable element air cleaners suitable for high dust load operation.
 2. Equip each air cleaner with service indicator.
- D. Governor:
1. Provide a fully enclosed electronic governor.
 2. Frequency at any constant load shall not deviate more than plus or minus 0.5 percent of rated frequency.
 3. The governor to provide adjustable frequency regulation from isochronous to 5 percent drop.

- E. Fuel System: Dual replaceable element filter, engine supply and return line, solenoid, shut off valve, and engine driven fuel pump.

2.4 GENERATOR

- A. Construction: Provide brushless, revolving field type, synchronous generator coupled directly to engine flywheel through a flexible driving disc for positive alignment.
 - 1. Bolt generator housing directly to engine flywheel housing.
 - 2. Provide volts-per type voltage regulator of solid state 3-phase sensing, construction matching characteristics of each unit. Provide no load to full load regulation within ± 0.5 percent at rated voltage during steady state conditions.
 - 3. Provide permanent magnet generator to provide excitation power to the automatic voltage regulator.
 - 4. Provide shock-resistant mounting of regulators.

2.5 COOLING SYSTEM

- A. Provide unit-mounted radiator cooling system with sufficient capacity for cooling generator set at full rated load and operating conditions specified.
 - 1. Equip engine with engine-driven centrifugal-type water circulating pumps and thermostatic valve to maintain coolant temperature below 200 DegF.
- B. Coolant:
 - 1. Flush and drain cooling system.
 - 2. Fill with minimum 50 percent ethylene glycol and water solution.
 - 3. Assure radiator, engine block and related items protected to minus 50 DegF.
 - 4. Coolant drain piped to edge of skid with valve or cap.
- C. Jacket Water Heaters: Furnish one or more engine mounted thermal circulation type water heaters to maintain engine jacket water at 70 DegF at minimum ambient temperature specified.
 - 1. Include integral thermostatic controls to maintain desired temperatures.
 - 2. Rate heaters for 240 V, 1 PH, 60 HZ.

2.6 EXHAUST SYSTEM

- A. Exhaust Silencer. Provide a Critical-grade silencer and related hardware to include side inlet, standard 125-150 LB flange connections, companion-flanges, cleanouts, Type E support arrangement, and stainless steel bellows type flexible exhaust connectors at least 24 IN long.
 - 1. Ensure silencers and related hardware are properly sized and installed according to the manufacturer's recommendation.
 - 2. The silencer shall be mounted horizontally such that its weight is NOT supported by the engine.
 - 3. Furnish and install exhaust pipe constructed of schedule 40 steel pipe with standard 125-150 LB flange connections as shown on the Drawings. Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed 20 IN of water.

- B. Install insulation so that it does not interfere with the functioning of the flexible exhaust fitting.
- C. Provide a 20 foot flexible connection hose for connecting the generator exhaust to on outside port when the generator is running in a building.

2.7 STARTING SYSTEMS

- A. Starting Motors: Provide 24 V DC starting system with solenoid operated positive engagement drive.
- B. Batteries: Furnish lead acid batteries with each engine generator with sufficient capacity to crank engines for three 20-second cranking periods with a 30-second rest period between cranks without recharging.
 - 1. Provide battery rack appropriately sized for the batteries furnished, painted with alkaline-resistant paint.
 - 2. Provide constant voltage, current limiting, full wave rectifier type battery chargers using silicon controlled rectifiers as the power controlling elements.
 - 3. Provide float and equalize charge rates. Rate charger for 120 V, 1 PH, 60 HZ with output current rating to recharge the battery from a 70 percent discharged condition to 95 percent charged condition in 12 HRS.
 - 4. Battery charger shall be 120V and shall be hardwired.
 - 5. Provide malfunction alarm contacts for actuation of alarm in the event of malfunction in the battery charging system.
 - 6. Provide DC voltmeter and ammeter, ac input and dc output circuit breakers.
 - 7. Provide cables, clamps and all other necessary connections.
 - 8. Size main cables to exhibit total circuit resistant of 0.005 ohm or less.
 - 9. Batteries and charger located in generator enclosure.
 - 10. Starting shall be initiated by a normally open, dry contact closure.

2.8 CONTROLS

- A. Control Panel:
 - 1. Provide NEMA 1 enclosed control panel mounted on each generator terminal box with vibration isolators.
 - 2. Construct dead front panel with 14 GA steel.
 - 3. Include the following devices in panel:
 - a. Engine coolant temperature gage.
 - b. Engine lube oil pressure gage.
 - c. Engine lube oil temperature gage.
 - d. Engine running hour meter.
 - e. Battery charging indicators.
 - f. Voltmeter.
 - g. Ammeter with true RMS output, supplied by 3 CT's at generator output leads.

- h. Ammeter and voltmeter phase selector switch or switches.
- i. Frequency meter.
- j. Manual and automatic starting controls.
- k. Panel illumination lights and switch.
- l. Voltage level adjustment rheostat.
- m. Fault indicators including low oil pressure, high water temperature, overspeed and overcrank. Provide dry contacts for common annunciation of fault conditions.
- 4. Multifunction digital device incorporating all above functions will be acceptable.
- B. Main Line Circuit Breaker: Provide main circuit breaker for generator set, sized for appropriately to protect the generator.
 - 1. Breakers are to operate both manually for normal switching function and automatically during overload and short circuit conditions.
 - 2. The trip unit for each pole of each breaker is to have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection.
 - 3. Provide breakers to interrupt bolted 3 PH fault from generator at full rpm at load terminals.
 - 4. Provide a NEMA 1 enclosure for circuit breakers and mount on generator using suitable vibration isolators.

2.10 SPARE PARTS

- A. Furnish Owner the following extra parts and supplies for each generator set:
 - 1. One set of filters, i.e., fuel, oil, and air for each unit.
 - 3. Oil for one complete oil change for each unit.
 - 4. Complete replacement set of all fuses.
- B. Spare parts shall be packaged with labels indicating contents of each package.

PART 3 - EXECUTION

3.1 MOUNTING, FUEL TANK AND ENCLOSURE

- A. Base: Mount engine, generator and cooling system on a common structural steel subbase capable of maintaining unit alignment suitable for mounting unit on a base fuel tank. Equip subbase with spring-type vibration isolators between subbase and fuel tank.
- B. Fuel Tank: Provide double-wall welded steel UL listed base tank assembly designed and supplied by the generator manufacturer.
 - 1. Size tank for minimum 24 HRS of continuous engine operation at 3/4 load.
 - 2. Provide mounting and anchoring means suitable for installation on the trailer
 - 3. Provide double wall construction with leak detection and alarm contact.
 - 4. Provide low fuel level alarm contact.
 - 5. Provide fuel fill spill containment box.

6. Provide overfill prevention valve.
 7. Provide liquid tight fill connection system.
 8. Provide fuel fill drop tube.
- C. Flexible Connections: Provide stainless steel flexible fittings on all engine piping and electrical conduits.
1. Engine control conduit.
 2. Fuel connection: Braided metallic.
 3. Exhaust connector bellows: Stainless steel.
 4. Coolant water pipes: Braided metallic.
- D. Enclosure:
1. Equip engine generator set with a factory assembled ventilated sheet steel enclosure.
 2. Provide weatherproof enclosure with an external critical grade silencer with rain cap.
 - a. Provide housing with hinged side-access doors and a rear control door.
 - b. All access doors to be lockable.
 - c. Treat entire enclosure and skid tank assembly with an electro deposition primer process prior to finish painting for maximum durability.
 - d. Equip the set with lifting eye.
 - e. Enclosure shall be a sound attenuating enclosure and shall reduce the sound to a Level 1 sound attenuation. The level 1 sound attenuation shall reduce the sound to a maximum of 89dB at 7 meters distance with the generator fully loaded.

3.2 FIELD QUALITY CONTROL

- A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by these Specifications.
 2. Supervise any adjustments and installation checks.
 3. Conduct initial start up of equipment and perform operational checks at jobsite. Conduct field tests as specified.
 4. Provide instruction to Owner's personnel on training in operation and maintenance of equipment for a 4 hours period.

Load List:

City of Rifle				
South Lift Station Upgrades				
3-PHASE LOAD LIST				
Description	HP/KW	Volts	Amperes	KVA

				0.0
Influent Pump #1 - VFD	40	480	52.00	43.2
Influent Pump #2 - VFD	40	480	0.00	0.0
Only one pump will run at a time				
Heater	5 kw	480	6.00	5.0
G-R Lighting Panel (1 phase)	3kva	480	3.00	1.4
				0.0
Building Lighting Panel (3-phase)	10kva	480	3.00	2.5
Totals			64.0	52.1

END OF SECTION

SECTION 16280 480 VOLT AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the furnishing and installation of a 480 volt automatic transfer switch (ATS) for use with the generator. The ATS shall be provided by the contractor. The ATS enclosure shall be rated NEMA 3R for installation outside. The ATS current rating shall be as noted on the drawings.

1.2 SYSTEM DESCRIPTION

- A. This equipment will be connected to a 240 volt, 1 phase, 3 wire, solidly grounded system. A fully rated neutral lug shall be included in the ATS enclosure for connection of all the neutral conductors.

1.3 REFERENCES

- A. All equipment to be furnished under this section shall be designed, constructed, and tested in accordance with the latest applicable requirements of the standard specifications and codes of ANSI, NEMA, IEEE, and other such regularly published and accepted standards, as well as state and local codes and the USERC standards required by the local utility.

1.4 SUBMITTALS

- A. Submittals shall be required as noted in section 16050 and 16900.

1.5 QUALITY ASSURANCE

- A. Supplier's qualifications
 - 1. The entire system shall be designed, coordinated, and supplied by a qualified Supplier who is regularly engaged in the business of ATS equipment. The Supplier shall meet the following qualifications.

- a. The Supplier shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
- b. The Supplier shall have the physical plant and fabricating personnel to complete the work specified.
- c. The Supplier shall employ competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
- d. The Supplier shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.

1.6 WARRANTY

- A. The Supplier shall warrant the hardware for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment furnished under this section shall be selected by the Supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
 - 1. Acceptable Manufacturers. Subject to compliance with Contract Documents, the following manufacturers are acceptable.
 - a. Generac Power Systems.
 - b. Cummins Power Generation.
 - c. Or accepted substitution
 - 2. The ATS shall be supplied by the engine generator supplier who shall be responsible for the design, manufacture, coordination, and proper installation and operation of the automatic transfer switch.

2.2 MATERIALS AND EQUIPMENT

- A. Automatic Transfer Switch
 - 1. Each automatic transfer switch shall consist of a power transfer module and a control module, interconnected to provide complete automatic operation. The ATS shall be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double throw. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
 - 2. The automatic transfer switch shall conform to the requirements of NEMA Standard ICS 2-447 and UL's UL 1008 and shall be UL listed for use in standby systems in accordance with Articles 517, 700, 701, and 702 of the NEC.
 - 3. The automatic transfer switch shall be rated as shown on the drawings.
 - 4. All main contacts shall be of silver composition. They shall be protected by arcing contacts. The operating transfer time in either direction shall not exceed 1/6 of a second.
- B. Control.
 - 1. The automatic transfer switch shall be controlled by a microprocessor-based programmable controller specifically designed for this function to provide rapid, reliable transfer of power between emergency and normal power conditions. The programmable controller shall be programmable from buttons on the front of the unit with an alphanumeric display for indication of entered values and any fault conditions.
 - 2. Manual operation of the switch shall also be possible, as well as manual lockout.
 - 3. The following control shall be incorporated into the transfer switch:
 - a. Voltage sensing shall be provided on all phases. The pickup voltage shall be adjustable from 85% to 100% of nominal, and the dropout voltage shall be adjustable from 75% to 90% of the pickup

value. The transfer to the emergency power supply will be initiated upon reduction of normal source to 85% of nominal voltage, and the retransfer to normal shall occur when normal source restores to 90% of nominal.

- b. A time delay shall be provided to override momentary normal source outages to delay all transfer switch and engine starting signals. The time delay shall be field adjustable from 0.5 to 30 seconds and factory set at 10 seconds.
 - c. A time delay on retransfer to normal source shall be provided. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 30 minutes and factory set at 10 minutes.
 - d. A timer shall be provided for the unloaded running time delay for emergency generator cool down. The time delay shall be field adjustable from 0 to 10 minutes and factory set at 5 minutes.
 - e. A contact shall be provided that closes when the normal source fails. This contact is for initiating the engine starting sequence. The contact shall be rated 10 amperes at 32 volts dc.
 - f. A white signal light shall be provided to indicate when the automatic transfer switch is connected to the normal source. A red signal light shall be provided to indicate when the automatic transfer switch is connected to the emergency source.
 - g. Two auxiliary contacts shall be provided that are closed when the automatic transfer switch is connected to normal and two auxiliary contacts shall be provided that are closed when the automatic transfer switch is connected to emergency. Contacts shall be rated 1 ampere, 240 volts, 60 Hz.
 - h. In phase monitoring to allow for in-phase switching controls shall be provided to delay transfer from one active power source to another until the transfer can be done without causing nuisance tripping of circuit breakers and damage to the equipment.
 - i. A selector switch shall be provided for selecting manual or automatic retransfer to normal.
 - j. An engine generator automatic exercising timer shall be provided with the option of selecting to exercise under load or no-load conditions.
- C. Switching Components. The automatic transfer switch shall be rated to withstand 30,000 RMS symmetrical short circuit current at the automatic transfer switch terminals with the type of overcurrent protection and voltage as shown on the drawings.
- 1. Automatic transfer switches utilizing components of molded case circuit breakers, contactors, or parts thereof are not acceptable.
- D. Control Pad Cover. The ATS control display shall be covered with a stainless steel box that is hinged on one side to prevent the sun from deteriorating the display and protect from unapproved access to display. The box shall be lockable and easily opened with the lock removed.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. General Requirements
 - 1. It shall be the Contractor's responsibility to ensure that the entire electrical equipment is installed in a satisfactory condition per these specifications and the manufacturer's requirements.
- B. Inspection.
 - 1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
 - a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.
- C. Equipment Installation.
 - 1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.

- a. Separate sheet metal junction boxes, equipment enclosures, sheet metal raceways, etc., mounted on water or earth-bearing walls or wall-mounted outdoors ¼" from wall be corrosion resistant spacer.
- b. Seal the base of all outdoor switchgear, motor control center, and similar equipment with grout.
- c. Screen or seal with flexible sealing compound all openings into outdoor equipment to prevent the entrance of rodents, wasps, and mud-daubers.
- d. Electrical work shall conform to the construction schedule and progress of other trades.
- e. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
- f. Perform all work in accordance with manufacturer's instructions.
 - i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
 - ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
 - iii) Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.

3.2 OPERATION AND TRAINING

- A. Step-by-step detailed instructions shall be furnished by the ATS supplier for the operation of the transfer switch. A minimum of 2 hours of training on the operation and maintenance of the ATS shall be provided at the site at a time mutually agreeable to the owner's personnel and the manufacturer during normal business hours.

3.3 FIELD SUPERVISION AND TESTS

- A. The Contractor shall furnish the services of a competent manufacturer's technical representative to check the installation, make all necessary adjustments, and in the presence of the Owner's representative, test the transfer switch to determine whether the equipment conforms to specified requirements and properly controls the engine generator.

END OF SECTION

SECTION 16300 SWITCHBOARDS

PART 1 GENERAL

A. DESCRIPTION

- 1. Provide service distribution switchboards in accordance with the Contract Documents.

B. STANDARDS

- 1. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the approved manufacturer:

C. SUBMITTALS

- 1. Include fully detailed and dimensioned plans, section and elevations. Include information on type and size of structural supports, metal thicknesses, surface finishes, bus cross sections, provisions for lifting as well as single line diagram of switch, fuse, circuit breakers, bus arrangements, etc.
- 2. All fuse sizes and types must be indicated.
- 3. All nameplate information must be complete.

4. All mimic bus arrangements must be illustrated.
5. All concrete housekeeping pads must be sized and illustrated.

D. QUALITY ASSURANCE

PART 2 PRODUCTS

E. APPROVED MANUFACTURERS

1. Acceptable manufacturers are: Westinghouse, General Electric, Square D., Siemens.

F. GENERAL

1. Provide switchboards of the free standing, totally enclosed dead-front safety type, consisting of an assembly of pressure switch and self-contained switch units of the number, size and arrangement shown on the Drawings.
2. Each switchboard shall be of rear accessible type where all connections are accessible from the rear. Where indicated on the Drawings as being positioned such that a rear accessible switchboard would have limited or no access provided from accessible equipment where all connections are accessible from the front.
3. Carefully check the physical space limitations for each switchboard and furnish switchboards to match those conditions. Nothing in these Specifications shall preclude the use of a custom designed switchboard (as approved by the Engineer) to meet those limitations. Custom equipment must meet UL and NEMA Standards.
4. Provide service entrance label where required.
5. Provide short circuit rating as shown on the one line diagram(s).

G. CONSTRUCTION

1. Completely enclose on back, front, and sides with removable panels. All closure plates shall be small enough for easy handling by operator.
2. All sections same height, 90 inches except as otherwise required due to physical space limitations. All sections of the same depth. Align all sections front and rear.
3. The switchboard shall be installed on a 4" housekeeping pad. Additional equipment shall be included to ensure the breaker disconnect heights comply with the NEC.

H. PULLBOX OVER SWITCHBOARD

1. Where required for conduit terminations, provide pullbox of same type of construction and finish as the switchboard.
2. Provide (if pullbox is utilized) cable supports for horizontal support of cables. Construct supports of 3/4 inch conduit loosely enclosed by strong fiber tubes. Space supports no more than 24 inches horizontally and 6 inches vertically.

I. BUSES

1. Bus bars shall be arranged throughout A-B-C left to right, top to bottom, and front to rear. Where special circuiting precludes this arrangement (as accepted by the Architect/Engineer) bus bars shall be permanently labeled.
2. Conductor material shall be copper having a silver plating or aluminum.
3. Bus shall be sized at 1,000 amperes per square inch, but in no case less than of sufficient cross section to limit temperature rise to 65 degrees Celsius above an ambient temperature rise of 40 degrees Celsius.

J. FEEDER INSTALLATION AND TERMINATION

1. Group cables paralleling one another and arranged so as to permit easy insertion of a clamp-on ammeter on each cable.

K. SELF-CONTAINED SWITCH UNITS

1. Application: Switches 800 amperes and below.
2. Quick-make, quick-break, dead-front type. Each switch a self-contained unit, externally operated from the front.
3. Fuse and switch compartment interlocked to prevent access to the fuse compartment until switch is thrown to "OFF" position. Interlock intentionally releasable by externally applied tool to permit checking switch and fuses under load.
4. Switches shall be equipped with rejection type clips suitable for Class R fuses.
5. Handle shall be capable of being padlocked in the "OFF" position.
6. Suitable for 80% load.

L. GROUNDING

1. Provide ground bus of at least 33 percent of capacity of switchboard extending along the full length of the switchboard.

M. UTILITY METERING

1. Provide utility metering cubicle in accordance with the requirements of the serving utility.
2. Utility meters shall not be mounted in or on the switchboard.

PART 3 EXECUTION

- A. Install switchboards when the area is free and clear of dust and debris. Protect switchboards at the time from dust and moisture.
- B. Install switchboards on 4 inch high reinforced concrete housekeeping pads which shall follow the contour of switchboards with 4 inch clear all around. The contractor shall provide and install the housekeeping pads.

END OF SECTION

SECTION 16900 INSTRUMENTATION

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the furnishing and installation of metering which shall include the following principal items:
 - 1. Principal components of the metering and control systems shall be as listed on the "Instrument List" at the end of this section.
 - 2. Miscellaneous. One lot of test equipment, spare parts, and miscellaneous devices as set forth herein. Supplementing this section, the drawings indicate locations and arrangement of instruments and provide functional diagrams and schematics regarding connection and interaction with other equipment.
- B. Related Sections
 - 1. Section 16050 – Electrical

1.2 REFERENCES

- A. Codes & Permits
 - 1. All work and materials shall comply with the National Electrical Code, the National Electrical Safety Code, and applicable local regulations and ordinances. All panels shall be listed by Underwriters Laboratories or other testing organizations acceptable to the governing authority. The Contractor shall, at his own expense, arrange for and obtain all necessary permits, inspections, and approval by the proper authorities in local jurisdiction of such work.

1.3 SUBMITTALS

- A. Complete fabrication, assembly, and installation drawings; wiring and schematic diagrams; and details, specifications, and data covering the materials used and the parts, devices, and accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. Submittal data shall be grouped and submitted in two separate stages. The submittal for each stage shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Instrument tag numbers indicated on the contract drawings shall be referenced where applicable. Submittal data for multifunctional instruments shall include complete descriptions of the intended functions and configurations of the instruments.
 - 1. First-stage Submittal. The first-stage submittal shall include the following items.
 - a. Product catalog cut sheets clearly marked to show the applicable model number, operational features, and intended service of the device.
 - b. A detailed list of any exceptions, functional differences, or discrepancies between the Supplier's proposed system and the contract requirements.
 - c. Complete panel fabrication drawings and details of panel wiring, piping, and painting. Panel and subpanel drawings shall include overall dimensions, metal thickness, door swing, mounting details, and front of panel arrangement to show general appearance, with spacing and mounting height of instruments and control devices.
 - d. System wiring and installation drawings for all interconnecting wiring between components of the systems furnished and for all interconnecting wiring between the related equipment and the equipment furnished under this section. Wiring diagrams shall show complete circuits and indicate all connections.
 - e. If panel terminal designations, inter-device connections, device features and options, or other features are modified as a result of the fabrication process or factory testing, revised drawings shall be resubmitted.
 - f. A total of seven (7) copies for the submittal shall be provided.

2. Second-stage Submittal. Complete system documentation, in the form of operation and maintenance manuals, shall be provided. Manuals shall include complete product instruction books for each item of equipment furnished.
 - a. Where instruction booklets cover more than one specific model or range of instrument, product data sheets shall be included which indicate the instrument model number, calibrated range, and all other special features. A complete set of "as-built" wiring, fabrication, and interconnection drawings, calibration and startup sheets shall be included with the manuals.
 - b. A copy of all final O&M manuals shall be provided in PDF format on a USB Thumb drive. All AutoCAD drawings shall be provided in PDF and DWG formats.
 - c. A total of two (2) printed copies, and two (2) softcopies of final O&M manuals shall be provided.

1.4 QUALITY ASSURANCE

A. Supplier's qualifications

1. The entire system shall be designed, coordinated, and supplied by a qualified system integrator (Integrator) who is regularly engaged in the business of designing and building instrument and control systems for water and wastewater projects. The Contractor's intended Integrator shall meet the following qualifications.
 - a. The Integrator shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
 - b. The Integrator shall have the physical plant and fabricating personnel to complete the work specified. The Integrator's fabrication capabilities and arrangements shall be acceptable to the Engineer.
 - c. The Integrator shall employ competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
 - d. The Integrator shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.

B. Coordination.

1. Instrument and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All instruments and control devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufactured and the manufacturer of related equipment.
2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
3. The Integrator shall provide coordination with other contractors and supervision of installation as required during construction.
4. Coordination shall be provided between the Integrator and the process system supplier.
5. Instrument and control systems shall be designed and coordinated for proper operation with other sections of these specifications. These shall include but not be limited to Electrical – Section 16050, Variable Frequency Drives – Section 16150, and Programmable Logic Controllers – Section 16950.

1.5 WARRANTY

- A. All suppliers shall warrant their hardware for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged, and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and

installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.

1. Power and Instrument Signals. Unless specified otherwise, electrical power supply to the instrumentation equipment will be unregulated 120 VAC at the locations noted on the one-line and functional diagrams. All transmitted electronic analog instrument signals shall be 4-20 mA DC and shall be linear with the measured variable.
2. Metering Accuracy. System metering accuracy, as compared to the actual process value, shall be determined from the value read at the principal readout device such as the recorder or totalizer. System requirements shall not preclude any requirements specified herein for individual devices.
 - a. For systems where the primary measuring device, transmitter, and receiver are furnished under this section, the accuracies shall be within the following limits:
 - i) Level: 1.0% of measured span.
 - ii) Flow Rate: magnetic or transit time ultrasonic metering: 0.5% of full scale between 1.0 and 100% of scale.
3. Appurtenances. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation requirements shall be furnished and installed as required for proper performance of the equipment.
4. Interchangeability and Appearance. Instruments used for the same types of functions and services shall be of the same brand and model line insofar as possible. Similar components of different instruments shall be from the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished. Recorders, process indicators, control stations, and similar panel-mounted instruments shall be of the same style and shall be products of the same major instrument manufacturer.
5. Programming Devices. A programming or system configuring device shall be provided for systems that contain any equipment which required such a device for routine calibration, maintenance, and troubleshooting. The programming device shall be complete and in like-new condition and shall be turned over to the Owner at completion of the startup.
6. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the instrument device schedules and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanels, and rack-mounted devices shall have laminated plastic identification tags securely fastened to the device. Hand lettered labels or tape labels will not be acceptable.
7. Special Tools and Accessories. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.
8. Provide sunshade for outdoor installations.
9. Provide stainless steel tags for each instrument.

2.2 PANEL FABRICATION

- A. General Fabrication Requirements. All panels furnished hereunder shall conform to the requirements of NEMA ICS-6-1988. The following paragraphs describe general fabrication requirements for the instrument panels, consoles, enclosures, and subpanels:
 1. All completed panels shall be UL 508A or UL 698 listed (as appropriate).
 2. Wiring.
 - a. All internal instrument and component device wiring shall be as normally furnished by the manufacturer. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded tinned copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90°C.
 - b. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 VAC. Surge protectors shall be of a non-faulting and non-interrupting design, with a response time of not more than 5 nanoseconds. Surge protectors shall be Cutler Hammer AEGIS Powerline Filters, or equal.
 - c. Panels that are over 15 cubic feet in total volume shall have panel lighting above each door of the panel.

- d. Power distribution wiring on the line side of the panel's protective devices shall be minimum 12 AWG. Secondary power distribution wiring shall be minimum 16 AWG. Wiring for control circuits shall be minimum 16 AWG. Electronic analog circuits shall be 18 AWG twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Wiring for ac power distribution, DC power distribution, and control circuits shall have different colors and shall agree with the color-coding legend on the system supplier's panel wiring diagrams.
- e. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with a marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal circuits, plus one ground for each shielded cable. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 20% spare terminals shall be provided. Each control loop or system shall be individually fused, and all fused or circuit breakers shall be clearly labeled and located for easy maintenance. Terminal block shall be Phoenix Contact UT 4-MTD series.
- f. All wiring shall be grouped and firmly supported inside the panel. Wiring shall be routed in nonmetallic slotted wire duct or similar. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40% of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables. Wire duct shall be Thomas & Betts Ty Duct or approved equal.
- g. Where signal or loop wiring must be routed to more than one panel or device, the required circuit routing shall be as indicated on the one-line diagrams.
- h. All analog input signals coming from external from the building where the panel is located shall have surge protection.
- i. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.
- j. All wires in the panel shall be identified at both ends of the wire. These labels shall agree with the labels shown on the wiring diagrams. The wire labels shall be of the heat-shrink tube type of wire marker as manufactured by Brady thermal labels.
- k. All instruments that require 120 VAC power that have the signal from the instrument going to a panel, shall be provided 120 VAC from that panel. The 120 VAC circuit to these instruments shall be individually fused.
- 3. Uninterruptable Power Supply (UPS)
 - a. Any panels that have PLCs or are shown to have a UPS on the drawings shall have a UPS.
 - b. The PLC and all associated equipment shall be powered by a UPS.
 - c. The UPS shall be sized to provide power to all devices connected to it for a minimum of 30 minutes.
 - d. The UPS shall be wired so that in the event of the UPS failure, the PLC panel will be powered by utility power and an alarm will be generated.
- 4. Nameplates. Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions and legends, as indicated on the drawings, letters approximately 3/16-inch-high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel. Panel face nameplates do not replace the requirement for device identification tags as specified herein under the Device Tag Numbering System paragraph.
- 5. Painting. Interior and exterior surfaces of all panels shall be thoroughly cleaned and painted with rust-inhibitive primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be painted with one or more finish coats of the manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils.
- 6. Factory test. Panels shall be factory tested electrically by the panel fabricator before shipment.

2.3 METERING & CONTROL SYSTEMS

- A. Principal components for the metering and control systems are indicated on the "Instrument List" at the end of this specification.

2.4 CONTROL COMPONENTS

A. Panel Front-Mounted Devices

1. **SELECTOR SWITCHES.** Selector switches shall be a minimum 30 mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 VAC. Contact configuration shall be as indicated on the drawings or as required for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Eaton "Series 10250T", Square D "Class 9001", or approved equal.
2. **INDICATING LIGHTS.** Indicating lights shall be a minimum 30 mm, heavy-duty, oil-tight type, Push-to-Test, which uses a low voltage lamp. A built-in transformer shall be used for AC service. Legends shall be engraved on the lens or on a legend faceplate. Lamps shall be easily replaceable from the front of the indicating light. Indicating lights shall be Eaton "Series 10250T", Square D "Class 9001", or approved equal.
3. **PUSH BUTTONS.** Push buttons shall be a minimum 30 mm, heavy-duty, oil-tight type. Legends shall be engraved on push button faceplate. Contacts shall be rated 10 amperes continuous at 120 VAC. Push buttons shall be Eaton "Series 10250T", Square D "Class 9001", or approved equal.
4. **TOTALIZERS.** Totalizers shall have miniature, rectangular, semi-flush counters, designed for use in conjunction with miniature indicators and recorders, and shall be of such a design that only the counter is flush-mounted, and the associated integrating mechanism is located in the rear of the panel. The counter shall contain not less than seven digits; with a multiplier of a power of 10 plainly engrave on the face of the counter, or on a nameplate below the counter, so that a full range of 9,999,999 is reached before repeating. Totalizers actuated by DC powered coils shall be equipped with a reverse voltage protection device. Totalizers shall not reset upon power failure. Totalizers shall be as manufactured by Red Lion CUB7T series or Action Instruments.
5. **RUN TIME METERS.** Run time meters shall have miniature, rectangular, semi-flush counters. The counter shall contain not less than seven digits, with a nameplate plainly engraved on the face of the counter, or below the counter identifying it as a run time meter. Run time meters shall not reset upon power failure. Run time meters shall be as manufactured by Red Lion "CUB7" series or Action Instruments.

B. Panel Interior-Mounted Devices

1. **POWER SUPPLIES.** Regulated DC power supplies for instrument loops shall be provided as needed. Power supplies shall be suitable for input voltage variation of plus or minus 10%. The DC power supplies shall be Idec "PS5R Slim line", or Phoenix Contact "UNO".
2. **RELAYS.** Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be UL listed. Relays shall have a minimum rating of 10 amperes at 120 VAC. Time-delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of $\pm 2.0\%$ of setting. Latching and special purpose relays shall be as required for the specific application. Relays shall have a light to indicate when coil is energized. Relays shall be Idec "RH or RTE Series" or approved equal.
3. **ELECTRONIC SIGNAL BOOSTERS AND ISOLATORS.** Electronic Signal Boosters and Isolators shall have all solid-state circuitry and complete electrical isolation between the power supply and the input and output signals. Accuracy shall be $\pm 0.15\%$ of span. Isolators shall be manufactured by Acromag, Moore, or Phoenix Contact.

2.5 INSTRUMENTATION

A. Flow Instrumentation

1. **Magnetic Flow Meters**
 - a. The Magnetic Flow Meter shall be a completely obstruction less, in-line flow meter with no constrictions in the flow of fluid through the meter. The meter shall consist of a metallic tube with flanged ends and with grounding rings. Flange diameter and bolt drilling pattern shall comply with ANSI/ASME B16.5, Class 150 for 24" and smaller, and AWWA Class D for 28" and larger. Meters shall be suitable for the maximum range of working pressures of the adjacent piping. Electrode and liner materials shall be fully compatible with the process fluid and shall comply

with the requirements specified in the instrument device schedules. Each meter shall be factory calibrated, and a copy of the calibration report shall be submitted as part of the operation and maintenance manual submittal.

- b. In vaults, wet wells and all other below grade locations the flow meter shall be IP68/NEMA 6P Protection.
 - c. The meter shall be capable of standing empty for extended periods of time without damage to any components. The meter housing shall be of a splash-proof and drip-proof design.
 - d. Power supply to the meter shall be 120 VAC, 60 Hz, single phase.
 - e. Provide NSF61 Drinking Water approval for Water Applications.
 - f. Meters shall be Rosemount Type 8750W, Endress+Hauser Promag W 400 or approved equal.
2. Area Velocity Flow Meter
- a. Each flow meter shall be a microprocessor-based electronic unit consisting of a signal converter/transmitter, a sensor assembly, and an interconnecting cable
 - b. Meter shall measure flow stream area velocity using ultrasonic sound waves to produce a Doppler effect and measures liquid level using an internal differential pressure transducer.
 - c. Sensor:
 - i) Body Material: PDVF
 - ii) Cable Material: UV-Rated PVC
 - iii) Temperature Range: 0 to 60 degrees C
 - iv) Power Input: 7 to 13.2 VDC
 - v) Level Measurement:
 - a) Differential linear pressure transducer with integral digital temperature compensation coefficients
 - b) Pressure rating: 5 PSI
 - c) Accuracy: +/- 0.10%
 - vi) Velocity Measurement:
 - a) Continuous wave doppler ultrasonic
 - b) Frequency: 500kHz
 - c) Minimum depth for velocity measurement: 1.0 inch
 - d) Range: -5 to +20 ft/s
 - e) Accuracy: +/- 2%
 - vii) Sensor shall be Teledyne ISCO TieNET 350 Area Velocity Sensor, or engineer approved equal.
 - d. Transmitter:
 - i) Shall be 120VAC powered and able to be mounted on the wall. Transmitter shall be provided with all necessary accessories to properly function in given application with specified sensor.
 - ii) Transmitter shall be Teledyne ISCO Signature Flow Meter, or engineer approved equal.
- B. Pressure and Level Instrumentation
1. Gauge Pressure Transmitters.
- a. Transmitters used to measure process pressure or inferred level from process pressure such as a bubbler system or other source, shall include diaphragm type piezo resistive pressure transducer and microprocessor-based electronics. Transmitters shall be 24VDC loop power. Transmitters shall have self-diagnostics and electronically adjustable span, zero, and damping.
 - b. Transmitters shall be enclosed in a NEMA Type 4X housing and shall be suitable for operation at temperatures from 0 to 180°F. All transmitter parts shall be of a corrosion-resistant material.
 - c. Vents shall be provided on the sides of the diaphragm housing body. Transmitter shall have over-range protection to 1.5 times the upper range limit.
 - d. Accuracy shall be plus or minus 0.5% of calibrated span, with repeatability of 0.1%.
 - e. Transmitter output shall be 4-20mA DC without the need for external load adjustments and shall have an elevated or suppressed zero as required by the application.
 - f. Display shall be integrally mounted 2-Line LCD display scaled with engineering units.
 - g. Each transmitter shall be provided with a process shutoff valve and a bracket for mounting as required.
- OPTIONAL: Bluetooth Enabled

- h. Transmitters shall be Rosemount "Model 2088", Endress+Hauser "Model PMP51", Vega "VEGABAR 83" or, approved equal.
- 2. Hydrostatic Level Transducers
 - a. Each transducer shall be a hydrostatic pressure sensor for submerged level measurement of fresh water and wastewater applications. The sensor shall be a permanently sealed submersible probe and cable combination with waterproof 316 Stainless Steel Housing. The transducer shall be a of the two-wire type which requires no direct power connection to the transducer. Transducer output shall be 4-20mA DC. The transducer shall be capable of the ranges and pressures for which the application will require. The transducer shall have an operating temperature range of 0 to 140°F. Accuracy shall be +/- 0.35%. Transducer should be protected from moisture intrusion with a vent filter. The transducer shall be mounted as shown on drawings or as required for application. The transducer shall be an Endress-Hauser "Waterpilot FMX21", GE Sensing (Druck) "PDCR/PTX-1730", Mercoïd SBLT2, or approved equal.
- 3. Conductance Relay Level Switch
 - a. Each level switch shall consist of a single-pole, double-throw relay with contacts rated not less than 5 amperes ac at 120 VAC. The relay primary power shall be 120 VAC. The electrodes shall be flexible wire suspension type with shielded stainless steel electrode tips. The electrode holder shall be the manufacturer's standard holder appropriate for the application.
 - b. Electrodes and conductance relay shall be as manufactured by Gems Sensors (Warrick Controls) or Ametek (BW Controls) or approved equal.
- C. Miscellaneous Instrumentation
 - 1. Magnetic Door Switch
 - a. The magnetic door switch shall be a two-piece switch rated 100V AC/DC.
 - i) Mandoor use: Switch shall be Edwards 60 Series or approved equal.
 - ii) Overhead Door use: Switch shall be Edwards 2200 Series or approved equal.
 - 2. Room Temperature Transmitter
 - a. Platinum 100 ohm or 1,000 ohm RTD. 10-30 VDC loop powered. Sensing range of 32-158 degrees Fahrenheit. Output shall be 4-20 mA. Accuracy shall be ±0.1% of span. Enclosure shall be NEMA 4X (IP65).
 - b. Room Temperature Transmitter shall be Omega Engineering model "EWSE-PT100-TX", or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. General Requirements
 - 1. The instrumentation equipment shall be installed by the Contractor or his subcontractors in accordance with the manufacturers' instructions. The services of the system Supplier's technical representative shall be provided as necessary to calibrate, test, and advise others of procedures for adjustment and operation.
- B. Inspection.
 - 1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
 - a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.
- C. Equipment Installation.
 - 1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.

- a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
 - b. Perform all work in accordance with manufacturer's instructions.
 - i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
 - ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
 - c. Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.
 - d. Field Piping. Field piping materials and installation shall conform to the requirements of the miscellaneous piping section.
 - e. Field-Mounted Instruments. Instruments shall be mounted so they may be easily read and serviced and all appurtenant devices are easily operated. Installation details for some instruments are indicated on the drawings. Unless otherwise indicated on the drawings, instruments which include local indicators shall be mounted approximately 5 feet above the floor and shall be oriented for ease of viewing. Transmitters shall be mounted on corrosion-resistant pipe supports suitable for floor, wall, or bracket mounting.
- D. Field Calibration. A technical representative of the system supplier shall calibrate each instrument and shall provide a written calibration report for each instrument, indicating the results and final tuning adjustment settings. The adjustment of each calibrated instrument shall be sealed or marked, insofar as possible, to discourage tampering. Instruments shall be calibrated before checkout of the operation of the system.
- E. Systems Check. A technical representative of the system supplier shall participate in the checkout of metering and control systems. If interrelated devices furnished by other suppliers, such as valve actuators, motor controls, chemical feeders, or primary measuring devices, do not perform properly when placed in service, the technical representative shall use suitable test equipment to introduce simulated signals to verify or measure signals from such devices as required to locate the source of trouble or malfunction. A written report stating the results of such tests shall be furnished, if requested by the Engineer, to assign responsibility for corrective measures.
- 1. Installation Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by the Contractor for the duration of the testing work. Unless specified otherwise, test equipment will remain the property of the Contractor or the system Supplier.
- F. Adjustment and Cleaning
- 1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
 - 2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

3.2 CUSTOMER TRAINING

- A. The coordinating supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training session shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of one 4-hour session, and the schedule shall be arranged and coordinated with the Engineer.

3.3 INSTRUMENT LIST

Rifle LS

Instrument List

(This list does not include instruments provided by the packaged systems)

<u>Tag #</u>	<u>Description</u>	<u>Service</u>	<u>Scale</u>	<u>Provided Under Specification</u>
LSH 010	PUMP ROOM WATER ON FLOOR	CONDUCTANCE RELAY LEVEL SWITCH		16900
TT 015	PUMP ROOM TEMPERATURE	TEMPERATURE TRANSMITTER		16900
FIT 095	INFLUENT CHANNEL FLOW	AREA VELOCITY FLOW METER		16900
FIT 150	DISCHARGE FLOW	MAGNETIC FLOW METER		16900
LIT 110	WET WELL #1 LEVEL	HYDROSTATIC LEVEL TRANSDUCER		16900
LIT 120	WET WELL #2 LEVEL	HYDROSTATIC LEVEL TRANSDUCER		16900
PIT 150	DISCHARGE PRESSURE	GAUGE PRESSURE TRANSMITTER		16900
ZS 010	PUMP ROOM MAN DOOR INTRUSION	MAGNETIC DOOR SWITCH	24VDC	16900
ZS 011	PUMP ROOM OVERHEAD DOOR INTRUSION	MAGNETIC DOOR SWITCH	24VDC	16900

END OF SECTION

SECTION 16950 PROGRAMABLE LOGIC CONTROLLERS

PART 4 GENERAL

4.1 SUMMARY

- A. This section includes the items listed below and all other components necessary for a complete system as noted herein and indicated on the drawings
 - 1. Programmable Logic Controllers (PLCs)
 - 2. Communication equipment
 - 3. HMI software
 - 4. Programming
 - 5. Spare parts
- B. Related Sections
 - 1. Section 16050 – Electrical
 - 2. Section 16900 – Instrumentation & Controls
 - 3. I/O list

4.2 REFERENCES

- A. ISA 5.1 – Instrumentation Symbols and Identification
- B. NEMA ICS 1 – General Requirements for Industrial Control and Systems

- C. NEMA ICS 2 – Standards for Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated 600 Volts
- D. DEMA ICS 3 – Industrial Control and Systems: Factory Built Assemblies
- E. NEMA ICS 6 – Industrial Controls and Systems: Enclosures

4.3 DESIGN REQUIREMENTS

- A. Discrete input/output signals shall all be 24VDC
- B. Analog input/output signals shall all be 4-20mA
- C. Analog signal isolators shall be independently powered units capable of driving two 4-20mA signals
- D. All required buffers, isolators, signal converter, and amplifiers for coordination with other equipment furnished under other sections, and between items of equipment needed for a complete system shall be furnished under this section of the specifications whether indicated on the Drawings or not or detailed in these specifications or not

4.4 SYSTEM DESCRIPTION

- A. Equipment furnished and installed 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, unless exceptions are noted by Engineer.
 - 1. I/O List. An I/O list is attached at the end of this section

4.5 SUBMITTALS

- A. Submittals shall be required as noted in Section 16900.

4.6 QUALITY ASSURANCE

- A. Supplier's qualifications
 - 1. The entire system shall be designed, coordinated, and supplied by the system integrator supplier.
- B. Coordination
 - 1. The PLCs and PLC system shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufacturer and the manufacturer of related equipment.
 - 2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
 - 3. The Contractor shall provide coordination with other contractors and supervision of installation as required during construction.

4.7 WARRANTY

- A. The Supplier shall warrant the hardware, software, and configuration related to the operational performance of the facility for a period of two years from the date of system acceptance. The Supplier shall provide a two-year software service agreement to include any and all minor and/or major releases and upgrades and shall correct any problems or "bugs" which prohibit the SCADA system from performing process operations in accordance with these specifications.

PART 5 PRODUCTS

5.1 GENERAL REQUIREMENTS

- A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
 - 1. Interchangeability. All PLC systems shall be products of the same manufacturer and of the same series or product line. Processors, local and remote input/output hardware, communications modules, and specialty modules shall be interchangeable among all I/O panels and systems.
 - 2. Installed I/O requirements. Each PLC shall have I/O modules installed to accommodate requirements shown on drawings and the I/O List at the end of this section and with a minimum of 20% spares installed.
 - 3. Acceptable Manufacturers.
 - a. PLC – Allen Bradley CompactLogix 5069 Series and no equal.
 - 4. Modules shall be added as needed to provide for all the I/O required on the project plus the spares.
 - 5. All Analog signals shall be logged in the Historian Software

5.2 MATERIALS AND EQUIPMENT

- A. Programmable Logic Controller (PLC)
 - 1. The additions to the PLC system shall include, but are not limited to, the following components:
 - a. Input Modules
 - i) Digital Input Modules
 - a) Number of Inputs: 25
 - b) Voltage Category: 120VAC
 - c) Module shall be: 5069-IA16
 - ii) Digital Output Modules
 - a) Number of Outputs: 7
 - b) Voltage Category: 120VAC
 - c) Module shall be: 5069-OA16
 - iii) Analog Input Modules
 - a) Number of Inputs: 8
 - b) Signal Range: 4-20mA
 - c) Module shall be: 5069-IF8
 - iv) Analog Output Modules
 - a) Number of Inputs: 2
 - b) Signal Range: 4-20mA
 - c) Module shall be: 5069-OF8
- B. PLC Programming Software
 - 1. The PLC programming software shall be Allen Bradley Studio 5000, and no equal.
- C. Remote Access Equipment
 - i) Reuse existing Freewave Radio & Yagi Antenna for signal to Rifle Regional WWTF.

PART 6 EXECUTION

6.1 INSTALLATION REQUIREMENTS

- A. General Requirements
 - 1. It shall be the Supplier's responsibility to ensure that the entire PLC system and HMI system is installed in a satisfactory condition per these specifications and the manufacturer's requirements.

B. Inspection

1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
 - a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation

1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
 - a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
 - b. Perform all work in accordance with manufacturer's instructions.
 - i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
 - ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.

D. Adjustment and Cleaning

1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

E. PLC Programming.

1. The Contractor shall be responsible for all PLC programming.

6.2 CUSTOMER TRAINING

1. The system supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training sessions shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of two consecutive 4-hour working days, and the schedule shall be arranged and coordinated with the Engineer.

6.3

LIST RIFLE LS
I/O List

<u>Tag #</u>	<u>Description</u>	<u>DI</u>	<u>DO</u>	<u>AI</u>	<u>AO</u>	<u>Scale</u>	<u>Notes</u>
LIT 110	WET WELL 1 LEVEL			1			
LIT 120	WET WELL 2 LEVEL			1			
FIT 095	INFLUENT CHANNEL FLOW			1			
FIT 150	DISCHARGE FLOW			1			
PIT 150	DISCHARGE PRESSURE			1			
M 110	PUMP #1 RUNNING	1					From GR Panel
HS 110	PUMP #1 IN AUTO	1					From GR Panel

MA 110	PUMP #1 FAULT	1					From GR Panel
TSH 110	PUMP #1 HIGH TEMPERATURE	1					From GR Panel
LSHH 110	WET WELL #1 LEVEL HIGH HIGH	1					From GR Panel
MC 120	PUMP #1 START/STOP COMMAND		1				From GR Panel
SI 120	PUMP #1 SPEED INDICATION			1			From GR Panel
SC 120	PUMP #1 SPEED COMMAND				1		From GR Panel
M 120	PUMP #2 RUNNING	1					From GR Panel
HS 120	PUMP #2 IN AUTO	1					From GR Panel
MA 120	PUMP #2 FAULT	1					From GR Panel
TSH 120	PUMP #2 HIGH TEMPERATURE	1					From GR Panel
LSHH 120	WET WELL #2 LEVEL HIGH HIGH	1					From GR Panel
MC 120	PUMP #2 START/STOP COMMAND		1				From GR Panel
SI 120	PUMP #2 SPEED INDICATION			1			From GR Panel
SC 120	PUMP #2 SPEED COMMAND				1		From GR Panel
M 070	FLEXRAKE SCREEN RUNNING	1					
HS 070	FLEXRAKE SCREEN IN AUTO	1					
MA 070	FLEXRAKE SCREEN NO FAULT	1					
LSHH 070	FLEXRAKE SCREEN CHANNEL HI HI	1					
HC 070	FLEXRAKE SCREEN REMOTE S/S CMD		1				
HC 111	MIXER #1 S/S COMMAND		1				
HC 121	MIXER #2 S/S COMMAND		1				
HC 131	MIXER #3 S/S COMMAND		1				FUTURE SIGNAL
HC 141	MIXER #4 S/S COMMAND		1				FUTURE SIGNAL
LSH 010	LS WATER ON FLOOR	1					
TIT 010	LS ROOM TEMPERATURE			1			
ZS 010	LS MAN DOOR INTRUSION	1					
ZS 011	LS ROLLUP DOOR INTRUSION	1					
J 020	UTILITY POWER FAIL	1					
JA 020	UPS POWER FAIL	1					
M 026	GENERATOR RUN	1					

HS 026	GENERATOR IN AUTO	1					
MS 026	GENERATOR FAULT	1					
LSL 026	GENERATOR LOW FUEL LEVEL	1					
YA 026	GENERATOR BATTERY LOW	1					
YA 025	ATS POSITION	1					
		25	7	8	2		

END OF SECTION

DIVISION 31 - EARTHWORK

SECTION 312300 EARTHWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, and Division One and other related specification sections apply to work of this section.

1.2 SECTION INCLUDES

- A. Clearing, grubbing and site preparation
- B. Removal and disposal of debris (refer to Demolition Spec for detailed removal of structures, trees, and infrastructure)
- C. Handling, storage, transportation, and disposal of excavated material
- D. Sheeting, shoring, bracing and protection work
- E. Pumping and dewatering as required or necessary
- F. Backfilling
- G. Pipe embedment
- H. Construction of fills and embankments
- I. Excavation for buildings & structures
- J. Pavement Subgrade preparation
- K. Trench Stabilization
- L. Final grading

M. Slope Stabilization

N. Appurtenant work

1.3 RELATED SECTIONS

A. Section 02 40 00 - Demolition

B. Section 31 25 00 – Erosion Control and Protection

C. Section 32 92 19 - Seeding

1.4 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

B. American Society for Testing and Materials (ASTM):

1. C33 – Concrete Aggregates
2. C136 – Sieve Analysis of Fine and Coarse Aggregates
3. D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-Inch Drop
4. D1241 – Material for Soil Aggregate Subbase, Base and Surface Courses
5. D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
6. D4253 – Test Methods for Maximum Index Density of Soils and Unit Weight of Soils Using a Vibratory Table
7. D4254 – Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
8. D4318 – Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
9. D6938 – Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)

C. American Concrete Institute (ACI):

1. 229 – Controlled Low-Strength Materials

D. Council of American Building Officials/American National Standards Institute (CABO/ANSI):

1. A117.1 – Accessible and Useable Buildings and Facilities Standards

E. Colorado Department of Transportation (CDOT)

F. Occupational Safety and Health Administration (OSHA):

1. Part 1926 – Safety and Health Regulations for Construction

1.5 SUBMITTALS

A. Submit under provisions of Division One specifications.

B. Product Data: Submit on all products or materials supplied herein

C. Test Reports: Indicate supplier, sieve analysis, optimum moisture content and density in accordance with ASTM D698 if appropriate for crushed rock or gravel, pipe embedment and material for fills and embankment

1.6 REGULATORY REQUIREMENTS

A. Burning will not be allowed on-site. Comply with all applicable codes, regulations, and laws.

- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- C. Obtain and comply with all requirements of Basalt Sanitation District and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.
- D. For public improvements only, in the event of a conflict between municipal standards and this specification, municipal standards for products and installation will govern.
- E. Excavation work will be performed in compliance with Basalt Sanitation District and current OSHA requirements.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Protect adjacent structures and surrounding areas from damage during excavation, filling, and backfilling
- B. Protect work from erosion or other similar types of damage until the project has been accepted. Leave protection in place for subsequent contractors' use.
- C. Do not backfill or construct fills during freezing weather. Backfill or construct fills only when temperature is 35°F and rising
- D. Do not use frozen materials, snow, or ice in any backfill or fill area
- E. Do not backfill or construct fill on frozen surfaces
- F. Protect excavated material from becoming frozen
- G. Do not backfill or construct fills or embankments during periods of heavy rainfall or precipitation when soil moisture conditions will not allow proper compaction to be achieved
- H. Do not remove trees from outside excavation or fill areas unless authorized by the Owner; protect from permanent damage by construction activities
- I. Provide temporary bridges for roadways, walkways, driveways, etc.

1.8 QUALITY ASSURANCE

- A. All imported material to be free of hazardous and organic wastes, "clean" as defined by EPA, and approved for its intended use by the Owner or project Geotechnical Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General - Soil materials, whether from sources on or off the site must be approved by the Geotechnical Engineer as suitable for intended use and specifically for required location or purpose.
- B. Classification of Excavated Materials:
 - 1. No classification applies. Remove and handle all excavated materials regardless of its type, character, composition, condition, or depth.
- C. Fills and Embankments
 - 1. To the maximum extent practical use excess earth from onsite excavation for fills and embankments.
 - 2. Free from rocks or stones larger than 12 inch in greatest dimension and free from brush, stumps, logs, roots, debris, and organic and other deleterious materials

3. Fill and embankment material must be acceptable to Engineer
 4. No rocks or stones larger than 6 inch in upper 18 inches of fill or embankment. Where allowed, distribute rocks and stones through the fill to not interfere with compaction.
- D. Imported Fill or Structural Fill for Fills and Embankments:
1. The Contractor is responsible for obtaining additional material for fills and embankments as necessary to meet the requirements shown on the Drawings.
 2. Imported fill conforming to the following:
 - a. Gradation (percent finer by weight ASTM C136): 3" – 100% passing, and No. 200 Sieve – 20% passing (maximum)
 - b. Liquid Limit: 30 (maximum), Plasticity Index: 15 (maximum)
- E. Topsoil
1. Topsoil is defined as fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of rocks, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth for areas to be seeded or planted. Coordinate testing requirements with Engineer and Owner.
 2. Clean topsoil free of plants and seeds will be spread to 4-inch minimum depth or as specified by Drawings, whichever is greater.
- F. Grubbings
1. Grubbings are defined as the first 1 inch of surface vegetation and topsoil consisting of primarily existing grass groundcover free of roots, brush, and other objectionable material and debris.
 2. Reuse grubbing and surface topsoil containing plants and seeds in designated revegetation areas only.
- G. Pipe Embedment: Refer to Drawing Details for required Class 6 materials in pipe embedment zone. Use of graded gravel requires Engineer approval only if groundwater is present. All gravel pipe embedment must be wrapped with Mirafi N-140 filter fabric. Full wrap of gravel is required to meet "burrito" style requirements.
1. Comply with Basalt Sanitation District requirements for pipe embedment for public utilities, when applicable.
 2. 1-1/2" Washed rock

Sieve Size (Inch)	Percent Passing by Weight
2"	100
1-1/2"	95-100
1"	80-95
3/4"	30-45
1/2"	10-25
3/8"	<1

3. 3/4" – 1" Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4"	90-100
1/2"	25-60
3/8"	20-55
NO. 4	0-10

Sieve Size (Inch)	Percent Passing by Weight
NO. 8	0-5
NO. 200	0-2

4. Well-Graded Sand

Sieve Size	Percent Passing by Weight
3/8"	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	10-30
No. 200	2-10

5. Drain Gravel

- Crushed rock, granular material with a maximum size of 1-1/2 inch.
- Minimum 50% passing No. 4 sieve, maximum 5% retained on No. 200 sieve

H. Compacted Trench Backfill

- Job excavated material finely divided, free of debris, organic material, and stones larger than 6 inches in greatest dimension without masses of moist, stiff clay, or topsoil
- In upper 18 inches, no rock or rock excavated detritus, larger than 6 inches except with specific approval from Geotechnical Engineer.
- No rock greater than 6 inches in greatest dimension within 3 feet of top of pipe
- Graded gravel: as specified or shown on Drawings for pipe embedment

I. Coarse Base Rock

- Granular material, maximum 3 inches, less than 10% passing 1-inch sieve.
- Free of trash, clay and dust
- Compaction as specified by Geotechnical Engineer

J. Road Base

- Will meet ASTM specification for Class II aggregate base and CDOT Class 6 gradation

Sieve Size	Percent Passing by Weight
1"	100
3/4"	90-100
No. 4	35-55
No. 30	10-30
No. 200	2-9

2.2 ACCESSORIES

A. Controlled Low Strength Material (Flow Fill)

- If required Flow fill or cellular controlled low strength material (CCLSM) shall be used for encasing the sewer or water pipeline. When the option is available, encasement of sewer line is preferred. Concrete

is not allowed. Flow fill must be excavatable by hand.

2. Mix design shall be designed in accordance to ACI 211.1-93 Section 5.3.7.2 (Absolute volume method).
3. The CLSM mix design shall meet latest CDOT Section 206 specifically for areas that may require future excavation.
 - A. Contractor shall submit mix design to Owner for approval. Field verification of mix design is required by means of delivery ticket, field testing, or other priorly Owner approved method.
4. The mix design shall meet the following requirements:
 - A. The Removability Modulus (RM) shall be 1.5 or less, and shall be calculated in accordance with CDOT Section 206.
 - B. The 28-day compressive strength shall be in the range of 50 – 100 psi and unit weight shall be 50 – 110 lb/ft³. See Removability Modulus Matrix below for example ratios.
 - C. Standard Slump shall be 7-10 inches, and is dependent upon jobsite conditions and delivery method.
 - D. Target air/foam content = 20%+/-

Removability Modulus (RM) Matrix

Compressive strength, psi	Unit Weight, lb/ft ³						
	50	60	70	80	90	100	110
50	0.26	0.34	0.43	0.53	0.63	0.74	0.85
75	0.32	0.42	0.53	0.64	0.77	0.90	1.04
100	0.37	0.48	0.61	0.74	0.89	1.04	1.20

5. Mix design components shall meet the following parameters and proportions:

Mix Components	Per CY
Cement	80 lb
Flyash	250 lb
Water	350 lb
Foaming Agent Admix	Per manufacturer
Fine Aggregate	2280 lb

meet requirements of Type I or II cement.

- A. Cement shall meet the standard chemical

- B. Fly ash shall meet requirements of ASTM C618 Type C or Type F. Fly ash not meeting these requirements may be used if prior testing indicates acceptable, consistent results for strength and air content.
 - C. Water shall be potable and reasonably clean and free of chemicals injurious to the final product are to be used.
 - D. Chemical admixtures include foaming agent mix, which shall conform to ASTM C869 and C796 or approved equal. Manufacturer's reference is MasterCell 25 or approved equal.
 - E. Fine aggregate shall meet ASTM C33 gradation requirements, unless otherwise approved by the Owner.
- F. Except as otherwise provided or approved by the Owner, after the pipe or conduit is laid trenches shall be backfilled with CLSM according to standard pipe bedding detail except the distance from the top of pipe to the top of the bedding zone shall be as follows:

Pipe or Conduit	Bedding Zone (above pipe)
2-inch or less diameter	6 inches
Greater than 2-inch excluding clay pipe	12 inches
Clay pipe	24 inches

1. CLSM shall be well mixed and discharged directly from the truck into the space to be filled, or by other methods if pre-approved by the Owner.
 2. When being installed, care should be taken to prevent flotation or misalignment of the pipe by means of straps, soil anchors, or other approved means of restraint.
 3. CLSM shall not be placed when the trench bottom or walls are frozen or contain frozen materials.
 4. Compaction of CLSM shall not be performed.
 5. Contractor shall adhere to all Construction Requirements in accordance with CDOT Section 206.
 6. Contractor shall adhere to all excavation and backfill requirements as described in the Project Manual and Drawings.
- B. Non-woven geotextile fabric
1. Needle-punched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Product must be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Product must meet AASHTO M288-06 Class 3 for elongation > 50%.
 - a. Mirafi 140N or accepted substitution.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Field verify the location of all underground utilities, pipelines and structures prior to excavation

3.2 PERFORMANCE — GENERAL

- A. Contractor to verify quantities of cuts and fills and perform all earthwork required to meet the grades as shown on the Drawings, including but not limited to, additional import or export required to handle compaction, building and pavement subgrade preparation, and pipe bedding.
- B. Perform work in a safe and proper manner with appropriate precautions against hazard
- C. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities
- D. Contain all construction activity on the designated site and within the limits of work. Cost of restoration offsite will be the responsibility of the Contractor
- E. Maintain service to pipelines and utilities indicated on Drawings during construction

3.3 PREPARATION

- A. Clearing and Grubbing
 - 1. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris.
 - 2. Strip subgrade for fills and embankments of surface vegetation, sod, tree stumps and organic topsoil. Strip and stockpile all on-site material meeting the topsoil definition for all areas receiving grading where shown on Drawings
 - 3. Remove all waste materials from site and dispose. Stockpile all acceptable grubblings for reuse in revegetation areas.
 - 4. Remove and dispose of tree stumps and roots over 3 inches in diameter to a minimum depth of 18 inches below the natural surface or 5 feet below finished surface level, whichever is lower.
 - 5. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted
 - 6. Backfill all excavated depression include grub holes with approved material
- B. Preservation of Trees
 - 1. Do not remove trees outside fill or excavated areas, except as authorized by Engineer
 - 2. Protect trees and their roots within the drip line that are to remain from permanent damage by construction operation
 - 3. Trim standing trees in conflict with construction operations as directed by Owner and Engineer.
- C. Topsoil Stripping
 - 1. Strip onsite material meeting the topsoil definition to minimum depth of 4 inches from areas to receive grading as shown on Drawings.
 - 2. Stockpile topsoil in areas designated by Owner and indicated on Drawings where it will not interfere with construction operations and activities and existing facilities
 - 3. At the completion of work in each area, place and grade topsoil to maintain gradient as indicated and required. Roughen surface as required for erosion control.
- D. Waste and Debris
 - 1. Stockpile all acceptable grubbing for reuse in native revegetation areas
 - 2. Remove and dispose of all waste materials and debris from clearing, grubbing, stripping and demolition off site
- E. Stockpiles
 - 1. Segregate materials suitable for the following:
 - a. Topsoil
 - b. Embankments and fills
 - c. Backfill
 - d. Spoils and waste only

2. No excavation will be deposited or stockpiled at any time so as to endanger stability of banks or structures, health of trees and shrubs to be protected, or portions of the Work, either by direct pressure or indirectly by overloading banks contiguous to the operation
3. Stockpile soil materials away from edge of excavations
4. Do not obstruct or prevent access to roads, driveways, ditches, natural drainage channels, and utility control devices
5. If in result of adjacent structures, easement limitations, or other restrictions sufficient storage is not available within Project limits, Contractor will arrange for off-site areas for stockpiling and for moving material to and from the storage area at no additional cost to the Owner

3.4 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

- A. Excavation and backfill operations will be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work.
- B. Backfill will be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work
- C. Any excavations improperly backfilled or where settlement occurs will be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner
- D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage will be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, will be borne by the Contractor at no additional expense to the Owner

3.5 DEWATERING

- A. General
 1. All dewatering activities in accordance with all federal, state, and local regulations regarding site drainage, dewatering, and erosion and sediment control including permitting requirements
 2. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom and/or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a "quick" or "boiling" condition. System will not be dependent solely upon sumps and/or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation's stability
 3. Provide and maintain adequate dewatering equipment including power supply, if necessary, to remove and dispose of surface and groundwater entering excavations, trenches, and other parts of the Work
 4. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow all Work to be installed in a dry condition
 5. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary to these purposes, lower water level in advance of excavation, utilizing wells, wellpoints, jet educators, or similar positive methods
 6. Keep each excavation dry during subgrade preparation and continually thereafter until the structure to be built or the pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result
 7. Dewater excavations which extend to or below groundwater by lowering and keeping the groundwater level beneath such excavation at least 12 inches below the bottom of the excavation
 8. Design, furnish, install, test, operate, monitor and maintain dewatering system of sufficient scope, size and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades
 9. Divert surface water or otherwise prevent it from entering excavated areas or trenches to the extent practical without damaging adjacent property
 10. Maintain all drainage pipes, keep clean and free of sediment during construction and final cleanup

11. Open pumping with sumps and ditches will be allowed, provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes
12. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head
13. Dewatering to surface waterways requires Colorado Department of Public Health and Environment dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, including water treatment prior to discharge, if necessary

B. Design

1. Contractor will be responsible for the accuracy of the Drawings, design data, and operational records required
2. Contractor will be solely responsible for the design, installation, operation, maintenance, and any failure of any component of the system

C. Damages

1. Contractor will be responsible for and will repair without cost to the Owner any damage to work in place, or other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation including, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system
2. Remove sub grade materials rendered unsuitable by excessive wetting and replace with approved backfill material at no additional cost to the Owner

D. Maintaining Excavation in Dewatered Condition

1. Dewatering will be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted
2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction and/or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance
3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner
4. System maintenance will include supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavation in dewatered condition

E. System Removal

1. Remove dewatering equipment from the site, including related temporary electrical service
2. Wells will be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction

3.6 SHEETING, SHORING AND BRACING

- A. All sheeting, shoring and bracing in accordance with OSHA and IBC requirements.
- B. Prevent undermining and damage to all structures, buildings, underground facilities, pavements and slabs.
- C. Contractor will responsible for obtaining all required permits or easements for encroachments into the public right-of-way and for coordinating any encroachments onto adjacent properties.
- D. If sheet pile cut off walls are required, submit design calculations, stamped by a Colorado licensed Professional Engineer.

- E. Contractor will be solely responsible for proper design, installation, operation, maintenance, and any failure of any system component
 - 1. Engineer review of Contractor's design and data does not relieve the Contractor from full responsibility for errors or from the entire responsibility for complete and adequate design and performance of the sheeting, shoring and bracing system.
- F. Provide proper and substantial sheeting, shoring, and bracing, in accordance with OSHA Standards as required, to prevent caving or sliding, to protect workmen and the Work, and to protect existing structures and facilities
- G. Design, furnish, build, maintain and subsequently remove, to extent required a system of temporary supports for cut and cover, open cut, temporary bypass road, or trench excavations, including bracing, dewatering, and all associated items to support the sides and ends of excavations where excavation slopes may endanger in-place or proposed improvements, extend beyond construction right-of-ways or as otherwise specified or indicated in the Drawings
 - 1. Design and build sheeting, shoring, and bracing to withstand all loads that might be caused by earth movement or pressure
 - 2. Design and build sheeting, shoring and bracing to be rigid, maintain shape and position under all circumstances.
- H. Design excavation support system and components for the following to allow safe and expeditious construction of permanent structures without movement/settlement of the ground and to prevent damage to or movement of adjacent buildings, structures, other improvements and underground facilities.
 - 1. To support lateral earth pressures.
 - 2. Loads from utilities, traffic, construction, buildings and surcharge loads.
- I. Provide sheeting, shoring and bracing equipment and materials onsite prior to start of excavation in each section, making adjustments as required to meet unexpected conditions.
- J. Contractor will make his own assessment of existing conditions including adjacent property, the possible effects of his proposed temporary works and construction methods, and will select and design support systems, methods, and details as will assure safety to the public, adjacent property, and the completed Work.
- K. Employ caution in areas of underground facilities, which will be exposed by hand or other excavation methods acceptable to Owner or Engineer.
- L. Space and arrange sheeting and bracing as required to exclude adjacent material and according to the stability of excavation slopes.
- M. Do not pull trench sheeting before backfilling.
- N. Do not brace sheeting left in place against the pipe, but support it in a manner that precludes concentrated loads or horizontal thrusts on pipe.
- O. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment is completed.
- P. Damages
 - 1. Contractor will document and all existing damage to adjacent facilities and submit written documentation to Owner and Engineer prior to performing any excavation. Documentation will include written description of existing damages, measurements, diagrams, maps and associated photographs.
 - 2. Repair all damage resulting from excavation and remove and place any existing structure or underground facility damaged during shoring and sheeting and all undermined pavements with Owner-approved equal, concrete or asphalt, at no cost to the Owner.

3.7 TRENCH STABILIZATION

- A. Thoroughly compact and consolidate subgrades for concrete structures, precast structures, and utility trench bottoms so they remain firm, dense and intact during required construction activities.
- B. Remove all mud and muck during excavation.
- C. Reinforce subgrades with crushed rock or gravel if they become mucky during construction activities.
- D. Finished elevation of stabilized subgrades are to be at or below subgrade elevations indicated on Drawings.
- E. Allow no more than ½ inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon.
- F. Scarify trench subgrade to a depth of 6 to 8 inches before compaction.

3.8 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot.
- B. Remove existing unsuitable/uncompacted fill, old foundations, rubble/debris, soft or otherwise unsuitable material, and replace with suitable material in excavation.
- C. Extend excavations to a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction and inspections.
- D. Trim to neat lines where details call for concrete to be deposited against earth.
- E. Excavate by hand in areas where space and access will not permit use of machines.
- F. Provide dewatering and temporary drainage as required to keep excavations dry.
- G. Reshape subgrade and wet as required.
- H. Notify Geotechnical Engineer when structure excavation has reached designated depth. Do not proceed with structure construction until excavation is approved by Geotechnical Engineer.
- I. Per the geotechnical report, over excavation is not required. If necessary, Geotechnical consultation will be required.
- J. Remove all existing fill material below facility mat foundation to existing undisturbed natural soils or bedrock. Geotechnical Engineer will inspect excavation to ensure all previous fill material has been adequately removed.
- K. Configure subexcavation per Geotechnical Report, Section 00 31 32.
- L. Recompect overexcavation and provide 1 foot of imported structural fill under structures, if applicable.
- M. Proof roll at a maximum of 24 hours prior to paving or concrete placement to located any soft spots in grade. Contractor to stabilize any soft areas with aggregate base course and compact to 95% of maximum density at optimum moisture content, per ASTM D1557, to a minimum depth of 6 inches. Reshape subgrade and wet as required.
- N. Native material is appropriate for subgrade in trench, chlorination shed, and tank. If large cobbles or boulders are removed then structural fill should be placed in its void. Refer to Geotechnical Report for more information.

3.9 FILLS AND EMBANKMENTS

- A. Using suitable approved materials, shape, trim, and finish cut slopes to conform with contours and elevations indicated on Drawings
- B. Suitable materials will consist of excavations or borrow areas
 - 1. Borrow
 - a. Borrow areas will be arranged by Contractor at no additional cost to Owner and will be subject to approval by Engineer or Geotechnical Engineer
 - b. Includes all topsoils and fill materials from approved offsite locations
- C. Place in layers from 4 to 8 inches where high degree of compaction is required. Otherwise, place in 8 to 12 inch layers. Will be placed on subgrades approved by Engineer or Geotechnical Engineer.
- D. Will not be placed on frozen surface. Do not place snow, ice or frozen materials in fill
- E. Level and roll subgrade so surface materials will be compact and bond with the first layer of fill or embankment.
 - 1. Plow and scarify subgrade to a minimum depth of 6 inches until uniform and free of large clods.
- F. Place in horizontal layers at maximum uncompacted depth per compaction specifications herein.
- G. Spread and level material deposited in piles and windrows before compacting.
- H. Thoroughly compact each layer by rolling or other means acceptable to Geotechnical Engineer to meet the moisture and compaction specifications herein.
- I. Alter compaction methods if material fails to meet specified density.
- J. Where a trench passes through a fill or embankment, place and compact fill or embankment to 12 inch above the top of the pipe before excavating the trench.
- K. Add water and harrow, disc, blade, or otherwise work each layer to obtain the uniform moisture content and adequate compaction.
- L. Refer to geotechnical report for additional requirements for fill and embankment preparation requirements.

3.10 COMPACTION

- A. Place backfill and fill materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 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. Place backfill and fill uniformly along the full length of each structure as described herein.
- C. Refer to geotechnical report for additional requirements for site development material, subexcavation, compaction and related earthwork operations.
- D. Percentage of Maximum Dry Density Requirements: Moisture treat and compact soil to not less than the following percentages of maximum dry density and to within the specified moisture content range of optimum moisture content according to ASTM D698 as follows:

Surface Improvement	Compaction %	Moisture Content
Structures	98%	-2 to +2

Paved Areas	95%	-2 to +2
Synthetic Turf Fields	95%	-2 to +2
Utility Trenches	95%	-2 to +2
Lawns or Unpaved Areas	90%	-2 to +2
Public Right-of-way	Per municipal/County standards	

1. Do not deposit or compact tamped or otherwise mechanically compacted backfill if frozen or if in water.
 2. Take particular care to compact backfill which will be beneath slabs, pipes, drives, roads, parking areas, curb, gutters, or other surface construction.
- E. Compaction testing to be performed by third party inspector, hired by Owner. Testing will include under all structures including Chlorination Shed, water storage tank, and bridge abutments. Contractor to provide schedule to Owner 1 week in advance for coordination with inspector.
- F. For trench backfill, testing shall occur for every 200 feet of pipeline installed. Owner will provide testing inspector. Contractor to provide schedule to Owner 1 week in advance for coordination with inspector.

3.11 BORROW OR SPOIL AREA

- A. Obtain suitable material required to complete fill and embankments from excavation, on-site areas.
- B. Offsite borrow or export areas
 - a. Contractor is responsible for identifying, and hauling any off-site materials for the site. Contractor shall use on-site materials when possible.
- C. The location, size, shape, depth, drainage, and surfacing of borrow or spoil pits will be acceptable to Owner.
- D. Make all areas regular in shape with graded and surfaced side and bottom slopes when completed
- E. Cut side slopes not steeper than 1:1 and uniform for the entire length of any one side
- F. Final grade disturbed areas of borrow to uniform slope (maximum slope = 4:1, minimum slope = 50:1).
- G. Use material free of debris and deleterious material
- H. Contractor is responsible for compliance with Colorado Discharge Permit System and local erosion control permitting requirements for any and all onsite and offsite, disturbed spoil and borrow areas. Upon completion of spoil and/or borrow operations, clean up spoil and/or borrow areas in a neat and reasonable manner to the satisfaction of the offsite property owner, Owner and Engineer.

3.12 DISPOSAL OF EXCESS EXCAVATED MATERIALS

- A. Use excess excavated materials in fills and embankments as indicated on the Drawings to the extent needed. Coordinate with Owner and Engineer on locations for excess material placement.
- B. The Contractor is responsible for disposing of all excess excavated materials from the site to a location approved by the Owner or Engineer and permitted with the local authorities.
- C. At the Owner's discretion and with the Engineer's approval, suitable excess excavated materials from onsite may be disposed offsite at locations directed by Owner or specified on the Drawings. The quantity of excess excavated material from onsite that may be disposed of onsite is limited based on final grading and site conditions.

- D. Remove debris, junk, broken concrete, broken asphalt, rock, stones, stumps, logs, roots, and other unsuitable material from the site and dispose of it.

3.13 BLASTING

- A. Blasting or other use of explosives is not permitted without Town of Basalt approval

3.14 TRENCH EXCAVATION

- A. Establish alignment and grade or elevation from offset stakes provided by the Contractor's surveyor.
- B. Excavate trenches so pipes can be laid straight at uniform grade without dips or bumps, between the terminal elevations indicated on the Drawings.
- C. Comply with pipe specification sections regarding vertical and horizontal alignment and maximum joint deflection.
- D. Where grades or elevations are not fixed on the Drawings, excavate trenches to provide a minimum depth of backfill cover over the top of pipe as follows. Coordinate depth of cover with utility owners. Increase depth as required by utility owner and at crossings. Minimum depths are:
 - 1. 2.0 feet for drainage piping
 - 2. 2.5 feet for gas piping
 - 3. 2.5 feet for electric, telecom, and fiber optic conduit
 - 4. 3.0 feet for irrigation piping
 - 5. 6.0 feet for sanitary sewer
 - 6. 6.0 feet for water piping
 - 7. Increase depth as required at vertical curves and for clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades
- E. Measure pipe cover depth vertically from top of pipe to finished ground or surface elevation
- F. Do not open more trench in advance of pipe laying than is necessary to expedite the work; not more than 100 feet
- G. Total length of open trench will be limited to 100 feet unless otherwise approved by the Engineer
- H. Except where tunneling or boring is indicated on the Drawings, specified, required by jurisdictional agency or permitted by Engineer, excavate trenches by open cut from the surface
- I. Limiting trench widths
 - 1. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, embedment
 - 2. If needed to reduce earth loads to prevent sliding, cut banks back on slopes which extend not lower than 1 foot above the top of the pipe
 - 3. Stipulated minimum clearances are minimum clear distances, not minimum average distances
 - 4. Maximum trench width from six inches above the top of pipe to trench bottom is the pipe outside diameter plus 24 inches
 - 5. Limiting trench widths and permissible clearances from 6 inches above top of pipe to trench bottom for installed pressure and non-pressure piping

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
3	1' 6"	2' 6"
4	1' 6"	2' 6"
6	1' 6"	2' 6"
8	1' 8"	2' 8"

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
10	2' 0"	3' 0"
12	2' 0"	3' 0"
16	2' 8"	3' 8"
18	3' 0"	4' 0"
24	3' 6"	4' 6"
36	4' 6"	5' 0"

6. If the width of the lower portion of the trench exceeds the maximum permitted, provide special pipe embedment, or concrete encasement as required by loading conditions
 7. No excessive trench widths will be allowed to avoid the use of sheeting or shoring and bracing
- J. Trench Side Walls
1. Will be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the federal, state, and local ordinances and regulations
 2. Sheet and brace where necessary and as specified herein
 3. Excavate without undercutting
- K. Trench Bottom
1. Will be thoroughly protected and maintained when suitable natural materials are encountered
 2. Will be thoroughly compacted and in approved condition prior to placing gravel bedding, if required
 3. Where in earth, trench bottoms for 6 inches and smaller pipe may be excavated below pipe subgrade and granular embedment provided or the trench may be graded to provide uniform and continuous support between bell holes or end joints of the installed pipe at the Contractor's option
 4. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material approved by Engineer
 5. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined
 6. PVC pipe will not be laid directly on trench bottom
- L. Mechanical excavation
1. Do not use where its operation would damage buildings, culverts, or other existing property, structures, or utilities above or below ground; hand excavate only in such areas
 2. Use mechanical equipment of a type, design, and construction and operated to provide the following:
 - a. Rough trench bottom elevation can be controlled
 - b. Uniform trench widths and vertical sidewalls are obtained from 1 foot above the top of the installed pipe to the bottom of the trench
 - c. Trench alignment is such that pipe is accurately laid to specified alignment and is centered in the trench with adequate clearance between pipe and trench sidewalls
 3. Do not undercut trench sidewalls
 4. Recompect trench bottom disturbed by bucket teeth prior to placement of embedment material.
- M. Except as otherwise required, excavate trenches below the underside of pipes as indicated in the Drawings to provide for installation of granular embedment pipe foundation material.
- N. Where in earth, trench bottoms for 6 inches and smaller pipe may be excavated below pipe subgrade and granular embedment provided or the trench may be graded to provide uniform and continuous support (between bell holes or end joints) of the installed pipe, Contractor's option.
- O. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material as Engineer may direct
- P. For unstable soils, provide concrete or other bedding as directed by Engineer.

- Q. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined.
- R. Cuts in existing surface construction
 - 1. No larger than necessary to provide adequate working space.
 - 2. Cut a clean groove not less than 1½ inch deep along each side of trench or around perimeter of excavation area.
 - 3. Remove pavement and base pavement to provide shoulder not less than 6 feet wide between cut edge and top edge of trench.
 - 4. Do not undercut trenches, resulting in bottom trench width greater than top widths
 - 5. Make pavement cuts to and between straight or accurately marked curved lines parallel to trench centerline or limits of excavation.
 - 6. Remove pavement for connections to existing lines or structures only to the extent required for the installation.
 - 7. Replace the pavements between saw cuts to match original surface construction.

3.15 PIPE EMBEDMENT

- A. Embed pipes above and below the bottom of pipe as indicated on the Drawings and as specified herein.
- B. Granular embedment
 - 1. Spread and surface grade granular embedment to provide continuous and uniform support beneath pipe at all points between pipe joints.
 - a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout length.
 - b. Barrel of pipe will have a bearing for its full length.
 - 2. Form depressions under each joint to permit the proper jointing. No part of joint will be in contact with trench when pipe is placed in position.
 - 3. After grading, aligning, and placing pipe in final position, and shoring home, deposit and compact sufficient embedment under and around each side of the pipe to hold the pipe in proper position and alignment during subsequent operations.
 - 4. Place and compact embedment material uniformly and simultaneously on both sides of pipe to prevent displacement.
 - 5. Complete embedment promptly after jointing operations and approval to proceed by Engineer.
 - 6. Granular embedment compaction by slicing with shovel or vibrating
 - a. Maximum uncompacted thickness of layers: 6 inch
 - 7. Compacted embedment will be compacted to 90 percent maximum density per ASTM D1557.
 - a. Maximum uncompacted depth thickness of horizontal layers: 12 inch
- C. Arch and concrete encasement
 - 1. Include in locations indicated on Drawings or where over-width trench conditions need correction as approved by Engineer.
 - 2. Install and form as indicated on Drawings or as specified.
 - 3. Concrete will have a 28-day minimum 3,000 psi compressive strength.
- D. Do not backfill until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

3.16 TRENCH BACKFILL

- A. Backfilling will be conducted in a continuous manner to prevent damage to the pipe and its coating and kept as close to the pipe laying operation as possible. Backfilling procedures will be in accordance with additional requirements, if any, of local authorities or private right-of-way agreements.
- B. Compacted backfill
 - 1. Provide full depth of trench above embedment at all locations.
 - 2. Beneath pavements, surfacing, driveways, curbs, gutters, walks or other surface construction or structures.

3. In street or highway shoulders.
 4. Beneath fills and embankments.
- C. Where the trench for one pipe passes beneath the trench of another pipe, compact the backfill for the lower trench to the bottom of the upper trench.
- D. Site excavated materials
1. Place job excavated materials in 12 inches maximum uncompacted thickness, uniform layers.
 2. Increased layer thickness may be permitted for incohesive material if Contractor demonstrates to Engineer's satisfaction that specified compacted density will be achieved.
 3. Use methods and equipment appropriate to the material to be compacted to prevent transmission of damaging shocks to pipe.
 4. Thoroughly compact each layer to meet the moisture and compaction specifications herein.
- E. Graded gravel
1. Deposit in uniform layers of 9 inches maximum uncompacted thickness
 2. Compact with suitable vibrating roller or platform vibrator to not less than 70 percent relative density per ASTM D4253/D4254.
- F. Uncompacted backfill
1. Compaction of backfill above pipe embedment in locations other than those specified, is required only to prevent future settlement.
 2. May be placed by any method acceptable to Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on, and will not result in displacement of installed pipe.
 3. Until compacted depth over conduit exceeds 3 feet, do not drop fill material over 5 feet. Distance may be increased 2 feet for each additional 1 foot of cover.
- G. Finish the top portion of backfill with at least 4 inches of topsoil or as specified by landscaping specifications, whichever is greater, corresponding to, or better than, that underlying adjoining turf areas.
- H. Trench backfill within the public right-of-way will conform to utility standards.
- I. Trench backfills through unimproved areas should be restored to previous conditions and left 3" above adjacent grades to allow for settlement. Seed all disturbed areas according to erosion control and landscape specifications.
- J. Protection of trench backfill
1. Where trenches are constructed in ditches or other water courses, protect backfill from erosion.
 2. Install ditch checks where the ditch grade exceeds 1 percent
 - a. Minimum depth: 2 feet below the original ditch or water course bottom for the full bottom width
 - b. Minimum width: 18 inches into the side slopes
 - c. Minimum thickness: 12 inches
- 3.17 DRAINAGE MAINTENANCE
- A. Do not backfill trenches across roadways, drives, walks or other trafficways adjacent to drainage ditches or water courses prior to backfilling the trench on the upstream side of the trafficway to prevent impounding water after pipe is laid.
- B. Backfill so that water does not accumulate in unfilled or partially filled trenches.
- C. Remove materials deposited in roadway ditches or other water courses crossed by the trench line immediately after backfilling is completed and restore ditches and water courses to original section, grade, and contours.
- D. Do not obstruct surface drainage any longer than necessary.

- E. Provide and maintain temporary bridges and other structures across unfilled trenches as required to maintain traffic.
- F. Provide adequate storm flow conveyance through the site at all times during construction to avoid flooding of any buildings or adjacent property. Provide overland drainage routing when storm sewer inlets are not fully functioning due to erosion and sediment control measures.

3.18 FINAL GRADING

- A. After completion of all other outside work and after backfilling is completed and settled, bring to grade at the indicated elevations, slopes and contours, all areas being graded on site.
- B. Graders and other power equipment may be used for final grading and slope dressing if the result is uniform and equivalent to hand work.
- C. Grade all surfaces for effective drainage, provide a 2 percent minimum slope except as otherwise shown on the Drawings.
- D. Provide a smooth transition between adjacent existing grades and new grades.
- E. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- F. Slope grades to direct water away from buildings and prevent ponds from forming where not intended.
- G. Finish subgrades at lawns and unpaved areas to required elevations within a tolerance of plus or minus one (1) inch.
- H. Finish grades will be no more than 0.1 foot above or below those indicated.
- I. Finish all ditches, swales and gutters to drain readily.
- J. Coordinate final subgrade depth with finish landscape treatment and required topsoil depths.
- K. Topsoil
 - 1. Clean topsoil, free of plants and seed will be spread to 4-inch minimum depth, or as specified by Drawings, whichever is greater, for areas of the site as detailed by the Drawings.
 - 2. Reuse grubblings and surface topsoil containing plants and seeds in designated revegetation areas only.

3.19 SETTLEMENT

- A. Warranty for settlement of all fills, embankments, and backfills is stipulated in the General Conditions from final completion of Contract under which Work is performed.
- B. Repair or replace within 30 days after notice by Engineer or Owner.

3.20 FIELD QUALITY CONTROL

- A. Provide under provisions of General Conditions and Division One Specifications
- B. Coordinate testing with Owner. Owner will provide all field testing to determine compliance of in-place and backfill materials and compaction in accordance with the specifications, and to verify design bearing capacities.
- C. Fills and Embankment Testing
 - 1. Two moisture-density relationship tests, ASTM D698, on each type of fill material.
 - 2. One in-place compaction test for each 5,000 square feet every 1.5 feet of vertical lift of material placed.
 - 3. Additional in-place compaction tests at the discretion of the Owner.

D. Pipe Embedment and Backfill Testing

1. Two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate for each type of embedment on backfill material proposed, except granular embedment material
2. One in-place compaction test every 200 lineal feet of trench in the compacted embedment zone and at every 1.5 feet of vertical lift of backfill materials, per ASTM D6938
3. One in-place compaction test near top of trench for trench depth of 2 feet or less, per ASTM D6938
4. Additional in-place compaction tests at the discretion of the Owner.

E. Pavement and Structural Subgrade Testing

1. At a minimum, two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate and adequate for each type backfill material proposed.
2. Perform tests for each footing, concrete site feature, and drainage structure subgrade. Perform tests at every 100 linear feet of subgrade of foundation walls, retaining walls, and every 150 feet for curbing, pans, drainage features, walks, etc. (or portions thereof). Perform tests every 1,000 square feet required of building slab area, exterior slabs and pavement/flatwork areas (with no less than 3 tests). Test at subgrade and at every vertical lift of backfill materials placed.
3. Additional in-place compaction tests at the discretion of the Owner.

F. Inspection and approval

1. A qualified Geotechnical Engineer will inspect the natural soil at bottom of excavations for structures and bridges.
2. Do not prepare subgrade or place concrete until Geotechnical Engineer's inspection has taken place and any resulting recommendations of the Geotechnical Engineer have been fulfilled or until the inspection has been waived by the Geotechnical Engineer.
3. Prior to placement of structural fill, overexcavated foundations subgrades will be observed and tested by a qualified Geotechnical Engineer to ensure suitable bearing materials exist.
4. Geotechnical Engineer will provide a letter to Engineer to confirm the presence of suitable subgrade material and properly placed fill materials by Contractor in accordance with Drawings and geotechnical report.

- G. Retesting of failed compaction will be performed by Geotechnical Engineer for Owner, but paid for the Contractor.

END OF SECTION

SECTION 312319 DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Design and installation of a dewatering system to protect excavation from subsurface water and to allow construction of foundations and damp-proofing of new construction in dry conditions.
2. Extent of construction dewater is shown on civil drawings and described in General Notes. Discharge of groundwater or river water is subject to conformance with the approved Stormwater Discharge Permit issued by CDPHE.
3. The Contractor is responsible for obtaining and maintaining a Construction Dewatering and Stormwater Discharge permit from the State.

1.02 SYSTEM DESCRIPTION

- A. Design Criteria: Dewatering Contractor shall be solely responsible for design and installation of a dewatering system capable of allowing construction of all work located inside the excavation support system in dry conditions.
1. Dewatering system shall consist of a series of well points or dry wells located outside the

excavation support system.

2. Comply with requirements of soil and foundation investigation.

3. Dewatering system must be compatible with construction procedures and acceptable to the Engineer, Geotechnical Engineer and Owner.
4. Dewatering system to comply with Construction Dewatering and Stormwater Discharge Permit.

- B. Maintenance: After installation, the dewatering system shall be continuously maintained by the Contractor until completion of foundation backfill.

1.03 SUBMITTALS

- A. Dewatering Plan: Contractor shall submit a plan indicating proposed locations of well points, submersible pumps and points of proposed discharge, alternate well point locations, if additional well points become necessary add temporary electrical service. Dewatering plan shall be approved by the Owner and Engineer before work begins.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Contractor shall obtain and pay for all required permits.

1.05. PROJECT CONDITIONS

- A. Historical Conditions: Groundwater is known to be present in the trench during runoff season. Low flow and winter season should minimize dewatering required outside of the river crossing.
- B. Existing Utilities: Locate all existing utilities prior to drilling. Contractor shall pay for any damage to utilities caused by dewatering.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Dewatering System: Provide all necessary materials for installation and complete operation of dewatering system. Provide spare pumps, hoses, etc. as required. All pumps shall be new and in good working condition at the time of installation.

PART 3 EXECUTION

3.01 Examination

- A. Existing Conditions: Examine existing conditions to determine dewatering requirements.

3.02 Protection

- A. Take all necessary precautions and make provisions to protect adjacent existing improvements from damage from dewatering operations.

3.03 Installation

- A. Design and install systems as required. Furnish stand-by equipment of sufficient size and capacity to insure continuous operation of the system. Remove all pumps and piping upon completion of foundation backfill. Fill all well casings with gravel and cut off casing below level of final grading.

3.04 Field Quality Control

- A. Make periodic inspections and verify that the system is maintaining a dry excavation.

3.05 Damage to foundations

- A. Any damage or settlement to the installed structures or other work by the failure or operation of the dewatering system shall be repaired by the Contractor at no cost to the Owner.

END OF SECTION

SECTION 312500 EROSION CONTROL AND PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This work consists of temporary measures needed to control erosion and water pollution. These temporary measures will include, but not be limited to, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the project and during site restoration, and as directed by ENGINEER, and as shown on the drawings.
- B. The Erosion Control Plan measures presented in the drawings serves as a minimum for the requirements of erosion control during construction. Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the project. Therefore, if the provided plan is not working sufficiently to protect the project areas, then Contractor shall provide additional measures as required to obtain the required protection.
- C. Contractor shall include in the bid price for erosion control a minimum of all items shown on the Erosion Control Plan and any additional items that may be needed to control erosion and water pollution.

1.2 RELATED SECTIONS

- A. Section 01 50 00 – Construction Facilities and Temporary Controls
- B. Section 02 40 00 – Demolition
- C. Section 31 23 00 – Earthwork
- D. Section 32 92 19 - Seeding

1.3 REFERENCES AND STANDARDS

- A. CDOT – Colorado Department of Transportation
- B. UDFCD – Urban Drainage and Flood Control District
- C. CDPHE – Colorado Department of Public Health and Environment
- D. City of Rifle Seeding standards
- E. Army Corp Permit Requirements

1.4 SUBMITTALS

- A. Submit under provisions of Division One specifications.
- B. Submit the following information:
 - 1. Erosion Control Plan,
 - 2. Construction schedule for Erosion Control per Article Scheduling,
 - 3. Sequencing Plan per Article Scheduling,
 - 4. All applicable permits for Erosion Control.
 - 5. Reseeding and replanting plan for temporary and permanent control measures.
- C. Product data: Submit on all products or materials supplied herein.

1.5 REGULATORY REQUIREMENTS

- A. Obtain and comply with all requirements of OWNER and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.
- B. 401 Construction Dewatering Industrial Wastewater Permit (Construction Dewatering Permit 401):
 - 1. Contractor shall apply for and obtain a Construction Dewatering Permit 401 from the Colorado Department of Public Health and Environment.
 - 2. All costs for this permit shall be the responsibility of Contractor.
 - 3. This permit requires that specific actions be performed at designated times.
 - 4. Contractor is legally obligated to comply with all terms and conditions of the permit including testing for effluent limitations.
 - 5. Contractor shall allow the Colorado Department of Public Health and Environment or other representatives to enter the site to test for compliance with the permit.
 - 6. Non-compliance with the permit can result in stoppage of all work.
- C. In the event of conflict between these requirements and erosion and pollution control laws, rules, or regulations of other Federal, State, or local agencies, the more restrictive laws, rules, or regulations shall apply.

1.6 SCHEDULING

- A. Sequencing Plan:
 - 1. Contractor shall submit a sequencing plan for approval for erosion control in conformance with Contractor's overall Construction Plan for approval by Owner.
 - 2. Changes to the Erosion Control Sequencing Plan may be considered by Owner only if presented in writing by the Contractor.
- B. Temporary Erosion Control:
 - 1. When so indicated in the Contract Documents, or when directed by Owner Contractor shall prepare construction schedules for accomplishing temporary erosion control work including all maintenance procedures.
 - 2. These schedules shall be applicable to clearing and grubbing, grading, structural work, construction, etc.
- C. Contractor shall submit for acceptance the proposed method of erosion control on haul roads and borrow pits and a plan for disposal of waste material.
- D. Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Temporary erosion control measures shall then be used to correct conditions that develop during construction.
- E. Work shall not be started until the erosion control schedules and methods of operations have been accepted.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Comply with all applicable municipal or local Municipal Separate Storm Sewer System (MS4) requirements.
- B. All materials shall be submitted for approval prior to installation.
- C. Natural or biodegradable materials shall be reasonably clean, free of deleterious materials, and certified weed free. Materials may include, but are not limited to, hay bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel.
- D. Grass Seed:
 - 1. Temporary grass cover (if required) shall be a quick growing species, suitable to the area, in accordance with local criteria and permit requirements, which will provide temporary cover, and not compete with the grasses sown for permanent cover.
 - 2. All grass seed shall be approved by Engineer and in accordance with local regulations prior to installation.
- E. Fertilizer and soil conditioners shall be approved by Owner and in accordance with local regulations prior to installation.
- F. Silt Fence Fabric: woven polypropylene
 - 1. Mirafi 100X, "Envirofence"
 - 2. Or accepted substitution
- G. Temporary Slope Stabilization Mat (short term): 1.5 pound photodegradable polypropylene top and bottom nets, 100% straw fiber matrix, with a longevity of 12 months.
 - 1. North American Green S150
 - 2. Or accepted substitution
- H. Temporary Slope Stabilization Mat (extended term): 3.0 pound UV-stable polypropylene top net, 1.5 pound photodegradable polypropylene bottom net, 70% straw/30% coconut fiber matrix with a longevity of 24 months.
 - 1. North American Green SC150
 - 2. Or accepted substitution
- I. Biodegradable Slope Stabilization Mat (short term): 9.3 pound leno-woven biodegradable jute top net, 7.7 pound woven biodegradable jute bottom net, 100% straw fiber matrix with a longevity of 12 months.
 - 1. North American Green S150BN
 - 2. Or accepted substitution
- J. Biodegradable Slope Stabilization Mat (extended term): 9.3 pound leno-woven biodegradable jute top net, 7.7 pound woven biodegradable jute bottom net, 70% straw/30% coconut fiber matrix with a longevity of 18 months.
 - 1. North American Green SC150BN
 - 2. Or accepted substitution
- K. Permanent Channel Stabilization Mat: 24 pound UV-stable polypropylene top and bottom nets, 24 pound UV-stable polypropylene corrugated center net, 100% polypropylene fiber matrix.
 - 1. North American Green P550
 - 2. Or accepted substitution

PART 3 EXECUTION

3.1 GENERAL

- A. All temporary and permanent erosion and sediment control practices will be maintained and repaired as needed to ensure continued performance of their intended function.
- B. Owner will monitor Contractor's erosion control methods. If the overall function and intent of erosion control is not being met, Owner will require Contractor to provide additional measures as required to obtain the desired results.
- C. The erosion control features installed by Contractor shall be adequately maintained by Contractor until the project is accepted.
- D. Working In or Crossing Watercourses and Wetlands:
 - 1. Construction vehicles shall be kept out of watercourses to the extent possible.
 - 2. Where in-channel work is necessary, precautions shall be taken to stabilize the work area during construction to minimize erosion.
 - a. The channel, including bed and banks, shall always be restabilized immediately after in-channel work is completed.
 - 3. Where a live (wet) watercourse must be crossed by construction vehicles during construction, a Temporary Stream Crossing shall be provided for this purpose.

3.2 PROTECTION OF ADJACENT PROPERTIES

- A. Properties adjacent to the site of a land disturbance shall be protected from sediment deposition.
- B. In addition to the erosion control measures required on the drawings, perimeter controls may be required if damage to adjacent properties is likely, and may include, but is not limited to:
 - 1. Vegetated buffer strip around the lower perimeter of the land disturbance.
 - a. Vegetated buffer strips may be used only where runoff in sheet flow is expected and should be at least twenty (20) feet in width.
 - 2. Sediment barriers such as straw bales, erosion logs, and silt fences.
 - 3. Sediment basins and porous landscape detention ponds.
 - 4. Combination of above measures.

3.3 CONSTRUCTION

- A. Stabilization of Disturbed Areas:
 - 1. Temporary sediment control measures shall be established within five (5) days from time of exposure or disturbance.
 - 2. Permanent erosion protection measures shall be established within five (5) days after final grading of areas.
- B. Stabilization of Sediment and Erosion Control Measures:
 - 1. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas shall be constructed as a first step in grading and be made functional before land disturbance takes place.
 - 2. Earthen structures such as dams, dikes, and diversions shall be stabilized within five (5) days of installation.
 - 3. Stormwater outlets shall also be stabilized prior to any upstream land disturbing activities.
- C. Stabilization of Waterways and Outlets:
 - 1. All onsite stormwater conveyance channels used by Contractor for temporary erosion control purposes shall be designed and constructed with adequate capacity and protection to prevent erosion during storm and runoff events.
 - 2. Stabilization adequate to prevent erosion shall also be provided at the outlets of all pipes and channels.

- D. Storm Sewer Inlet Protection: All storm sewer inlets which are made operable during construction or which drain stormwater runoff from a construction site shall be protected from sediment deposition by the use of filters.
- E. Construction Access Routes:
 - 1. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.
 - 2. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day.
 - 3. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment controlled disposal area.
 - 4. Street washing shall be allowed only after sediment is removed in the manner described above.

3.4 DISPOSITION OF TEMPORARY MEASURES

- A. All temporary erosion and sediment control measures shall be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary measures are no longer needed as determined by Owner.
- B. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.
- C. Substantial Completion of Erosion Control Measures:
 - 1. At the time specified in the Contract Documents, and subject to compliance with specified materials and installation requirements, Contractor shall receive a Substantial Completion Certificate for temporary erosion control measures.
 - 2. Maintenance of Erosion Control Measures after Substantial Completion: Contractor shall be responsible for maintaining temporary erosion control measures as specified in the drawings and Contract Documents until such time as work has been accepted by Owner and as specified in Division 1 for Closeout Procedures.

END OF SECTION

DIVISION 33 – SITE UTILITIES

SECTION 330516 MANHOLE FRAMES AND COVERS

PART 1 GENERAL

1.04 DESCRIPTION

- A. This Section includes cast iron manhole frames and covers for access openings in utility structures including but not limited to tanks, vaults, wet wells, and buried structures.
- B. Work includes furnishing and installing cast iron frames and covers including anchorage, seating surfaces, and accessories required for a complete installation.

1.05 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete: 03 30 00.

1.06 REFERENCES

- A. ASTM A48/A48M – Standard Specification for Gray Iron Castings
- B. ASTM A536 – Standard Specification for Ductile Iron Castings
- C. AASHTO M306 – Drainage, Sewer, Utility, and Related Castings

1.07 SUBMITTALS

- A. Product Data: submit manufacturer's product data for frames and covers including:
 - 1. Material specifications
 - 2. Dimensions and weights
 - 3. Load rating
 - 4. Coating system
 - 5. Manufacturer installation recommendations
- B. Shop Drawings: Submit shop drawings indicating: Frame dimensions, lid type and seating configuration, bearing surfaces, bolt-down hardware if applicable, and markings or lettering cast into the cover
- C. Certifications: Provide manufacturer certification confirming compliance with ASTM and AASHTO requirements.

1.08 QUALITY ASSURANCE

- A. Castings shall be true to pattern, free from defects, cracks, cold shuts, blowholes, or other imperfections.
- B. Machined seating surfaces shall provide a stable, non-rocking fit between frame and cover.

PART 2 - MATERIALS

2.08 MANUFACTURER

Basis of Design Manufacturer:
Neenah Foundry Company
2121 Brooks Avenue
Neenah, Wisconsin

Acceptable Manufacturers:

Neenah Foundry Company
EJ Group
US Foundry

Approved equal meeting all specified requirements

2.09 MATERIALS

Cast Iron

Gray Iron castings shall conform to ASTM A48, Class 35B minimum.

Ductile Iron castings shall conform to ASTM A536 where specified.

Hardware

Bolts, nuts, and washers shall be stainless steel Type 304 or 316 unless otherwise indicated.

2.10 MANHOLE COVER AND FRAME

Frame and cover shall be heavy duty traffic rated cast iron.

Units shall be designed to support AASHTO H20 or HS20 loading unless otherwise indicated.

Frames shall include a continuous bearing surface providing uniform support for the cover.

Covers shall be machined or ground to ensure a stable, non-rocking fit.

Covers shall include lifting pick holes or lifting devices compatible with standard manhole cover lifting tools.

Where indicated, covers shall include bolt-down provisions for security or safety.

2.11 IDENTIFICATION

Covers shall include cast-in lettering as indicated on the Drawings. Typical markings may include:

“WATER”

“SEWER”

“SANITARY”

“STORM”

“ACCESS”

2.12 COATINGS

Frames and covers shall receive a shop-applied protective coating consisting of:

Bituminous coating applied by dipping or spraying; or

Manufacturer’s standard asphaltic coating.

Coating shall protect castings during shipment and installation.

PART 3 - EXECUTION

3.16 INSTALLATION

Install frames and covers in accordance with manufacturer's recommendations and the Drawings.

Set frames level and at the correct finished elevation.

Frames set in concrete shall be fully embedded and supported to prevent rocking or settlement.

Adjust frame elevation to match surrounding surface finish including pavement or concrete slabs

3.17 FIELD QUALITY CONTROL

Verify frames and covers seat properly without rocking.

Verify covers can be removed using standard lifting tools.

Replace frames or covers exhibiting cracks, distortion, or casting defects.

Protect frames and covers from damage during construction.

Clean seating surfaces prior to final placement of covers

END OF SECTION

SECTION 333100 SANITARY SEWERAGE SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polyvinyl chloride (PVC) non-pressure pipe for gravity sanitary sewer with all jointing materials, fittings, and other appurtenances required for complete installation.
- B. All precast manholes complete with steps, ring and cover as required.
- C. All pressurized HDPE piping for force main installation.
- D. All internal DIP for lift station piping.

1.2 RELATED SECTIONS

- A. Section 01 78 23 – Operation and Maintenance Data
- B. Section 31 23 00 – Earthwork
- C. City of Rifle Public Works Manual.
- D. Geotechnical Report.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A48 – Standard Specification for Gray Iron Castings
 - 2. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

3. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
 4. A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
 5. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 6. C33 – Standard Specification for Concrete Aggregates
 7. C150 – Standard Specification for Portland Cement
 8. C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 9. C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
 10. C497 – Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
 11. C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
 12. C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete manhole Structures, Pipes, and Laterals
 13. C1227 – Standard Specification for Precast Concrete Septic Tanks
 14. C1619 – Standard Specification for Elastomeric Seals for Joining Concrete
 15. C1821 – Standard Practice for Installation of Underground Circular Precast Manhole Structures
 16. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 17. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
 18. D1330 – Standard Specification for Rubber Sheet Gaskets
 19. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
 20. D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC)
 21. D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 22. D2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
 23. D2240 – Standard Test Method for Rubber Property – Durometer Hardness
 24. D2321 – Standard Specification for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 25. D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 26. D2774 – Standard Specification for Underground Installation of Thermoplastic Pressure Piping
 27. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 28. D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 29. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
 30. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
 31. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 32. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
 33. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 34. F412 – Standard Terminology Relating to Plastic Piping Systems
 35. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 36. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
 37. F679 – Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
 38. F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
 39. F2164 – Standard Specification for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
- B. American Water Works Association (AWWA):
1. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 2. C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
 3. C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 4. C115 – Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges

5. C150 – Standard for Thickness Design of Ductile-Iron Pipe
6. C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast
7. C504 – Standard for Rubber-Seated Butterfly Valves
8. C512 – Standard for Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
9. C600 – Standard for Installation of Ductile Iron Mains and Their Appurtenances
10. C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
11. C905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution
12. M23 – PVC Pipe: Design and Installation

C. Occupational Safety and Health Administration (OSHA)

D. National Association of Corrosion Engineers (NACE):

1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2. SP0286 – Electrical Isolation of Cathodically Protected Pipelines

E. Plastics Pipe Institute (PPI):

1. TR-4 – HDB / HDS / SDB / PDB / MRS Ratings for Thermoplastic Piping Materials or Pipe
2. TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
3. Handbook of Polyethylene Pipe
4. Polyethylene Piping Systems Field Manual for Municipal Water Applications
5. Material Handling Guide

1.4 SUBMITTALS

A. Submit under provisions of Division 1 Specifications

B. Shop Drawings: Provide piping layout and assembly drawings with fitting dimensions. Provide sufficient information to verify compliance with specifications.

C. Product Data: Provide manufacturer's catalog information with dimensions, material and assembled weight.

1. Pipe materials
2. Special, fitting, and coupling details
3. Gasket materials
4. Valves
5. Laying and installation schedule
6. Specifications and data sheets
7. Affidavits of compliance for protective shop coatings and linings

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and applicable standards. Provide prior to shipment.

E. Test Reports: Submit reports of field exfiltration/infiltration, mandrel and lamp tests under provisions of Division 1 Specifications.

F. TV Inspection Files: Submit videos and reports

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 Specifications.

B. Accurately record actual locations of piping mains, valves, connections, invert elevations, and any mapped or unmapped utilities.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Rifle Public Works Manual and CDPHE Stormwater and/or Groundwater Discharge Permit, notes on the drawings and as specified herein.
- B. Manufacturers shall be experienced in the design and manufacturing of materials specified herein for a minimum period of 5 years.
- C. All PVC pipe, regardless of diameter, shall be supplied by a single manufacturer.
- D. Perform Work in accordance with the Colorado Department of Public Health and Environment (CDPHE) and City of Rifle Public Works Manual.
- E. Contractor shall conduct visual inspection before installation.
- F. Provide manufacturer's name and pressure rating marked on piping and valves.
- G. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational sewer lines.

1.7 REGULATORY REQUIREMENTS

- A. Conform to all municipal codes and ordinances, laws and regulations of City of Rifle, CDPHE, the notes and details on the drawings and as specified herein, and CDPHE Stormwater Management and/or Construction Dewatering Permit.
- B. In case of apparent conflict, CDPHE and City of Rifle PW Manual requirements govern these specifications.
- C. Contractor, not Owner, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1 Specifications.
- B. During loading, transporting and unloading, exercise care to prevent damage to material.
 - 1. Use nylon slings only
 - 2. Do not drop pipe or fittings
 - 3. Do not roll or skid against pipe already on ground
 - 4. Repair any damage done to coating or lining
 - 5. Handle per manufacturer's recommendations
 - 6. Store rubber gaskets in cool dark location
 - 7. Store all material on wood pallets or timbers
- C. Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or other operations shall be repaired to the approval of and at no additional cost to the Owner
- D. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the Owner
- E. Pipe
 - 1. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation
 - 2. PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling PVC pipe during cold weather

3. Do not store PVC pipe uncovered in direct UV light
4. Pipe stored along the trench side shall be suitably supported off the ground to avoid damage to the coating

F. Valves

1. Prepare valves for shipping as follows:
 - a. Ensure that valves are dry and internally protected against rust and corrosion
 - b. Protect valves against damage to threaded ends, flange faces, and weld ends
 - c. Seal valve ends to prevent entry of foreign materials into valve body
 - d. Set valves in best position for handling
 - e. Set valves closed to prevent damage
2. Deliver and store valves and accessories in shipping containers with labeling in place
3. Storage: Use the following precautions for valves during storage:
 - a. Do not remove end protectors unless necessary for inspection; then reinstall for storage
 - b. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary

G. Precast Concrete Structures

1. Transport and handle precast concrete units with equipment to protect from dirt and damage
2. Do not place precast concrete units in position which will cause damage
3. Handle precast concrete structures by means of lifting inserts. Do not move from manufacturer's yard until curing is complete.

1.9 JOB CONDITIONS

- A. All work which requires the interruption of active sanitary sewer service lines must be completed as quickly as possible in order to minimize inconvenience to City customers and coordinated as specified in Division 1.
- B. Underground Obstructions
 1. Underground Obstructions known to Engineer are shown on Drawings
 - a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered
 - b. Contractor shall field locate and verify all obstructions where or not shown on the Drawings
 2. Notify each utility owner and request utility be field located by surface reference at least 48 hours prior to trenching or excavation
 3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of a conflict
 - a. Notify Engineer and Owner in case of a conflict
 - b. In case of a conflict, the proposed work may be changed by Engineer
 4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances

PART 2 PRODUCTS

2.1 PIPE, MANHOLES, AND ACCESSORIES

- A. Comply with City of Rifle PW Manual regulations and specifications where applicable.

2.2 PVC GRAVITY SANITARY SEWER PIPE (NON-PRESSURE)

- A. The following piping shall be non-pressure PVC pipe for gravity sanitary sewer application as indicated on the drawings and as specified herein
 1. Gravity sanitary sewer piping and fittings: 18-inch and 15-inch
 2. Services: None
- B. Pipe and fittings: ASTM D3034, T-1 wall, SDR 35, non-pressure pipe

1. Cell classification: ASTM D1784
 2. Pipe length: 12-20 feet standard manufactured length for construction
- C. Joints: ASTM D3212 and F477 - Rubber gasket with one compression gasket ring, integral bell and spigot type
1. Designed to hold pipe in alignment, provide flexibility, separate the ends of pipe lengths, resist applied earth pressures, and provide fluid tightness
 2. Rubber rings: ASTM F477
- D. Reference: Refer to City of Rifle PW Manual for more details.

2.3 FORCE MAIN PIPE (PRESSURIZED) HDPE

- A. The force main pipe shall be HDPE DR 17 (DIPS) butt fusion welded in the field.
1. The pipe shall be manufactured from a PE 4710 resin compound listed with the Plastic Pipe Institute (PPI) as TR-4.
 2. The resin material shall be in accordance with ASTM D3350 with a minimum cell classification of 445574C/E.
 3. This resin material shall have a Long Term Hydrostatic Strength of 1600 PSI when tested in accordance to ASTM D2837.
 4. Pipe dimensions shall be in accordance with ASTM D3035 as a minimum.
 5. The final compounded material shall contain a minimum of 2% carbon black
 6. The pipe shall contain no recycled material except that generated by the pipe manufacturer in their own plant from resin compound of the same specification and raw material supplier. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.
 7. Pipe shall have a manufacturing standard of ASTM F714 and be manufactured by an ISO 9001 certified manufacturer.
 8. All pipes and fittings shall be suitable for use as pressure conduits, listed as NSF 14, and per AWWA C906 Pressure Class (PC) 100 have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe and/or fitting
 9. The pipe shall be DR11 unless noted otherwise on the Drawings
- B. Joints:
1. Weld and install per manufacturer's recommendation
 2. Installation Standards: ASTM D2774, ASTM D2657, ANSI/AWWA C906, and AWWA Manual M55.
- C. Fittings
1. All fittings shall be PE 4710 HDPE, minimum Cell Classification of 445574C/E as determined by ASTM D3350, and approved for AWWA use.
 2. All fittings shall be of the same base resin as the pipe.
 3. All fittings shall have a working pressure rating equal to the pipe unless otherwise specified in the plans.
 4. All fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.
 5. Butt Fusion Fittings
 - a. Molded butt fusion fittings shall be in accordance with ASTM D3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification.
 6. Compression Type Mechanical Coupling
 - a. Suitable for joining HDPE to HDPE, HDPE to PVC (C900), or HDPE to DIP
 - b. Factory coat coupling internally and externally with a fusion bonded epoxy
 - c. Reinforce HDPE pipe with a split ring type stiffener in pipe bore
 - i) Size stiffeners for size of HDPE pipe being joined
 - ii) Supply feature that prevents stiffener from sliding completely into pipe
 - iii) Size stiffeners for length of mechanical coupling and not to extend outside of body of mechanical coupling

- iv) Mark stiffener with pipe diameter
 - v) Factory coat stiffeners internally and externally with fusion bonded epoxy
- d. Use seal and restraint type coupling. Requirements for type of couplings are specified herein or shown on Drawings
 - i) Approved Manufacturers:
 - a) EBAA Iron
 - b) Romac Industries
 - c) Or accepted substitution
- 7. Specialty Fittings include:
 - a. For Transition between HDPE and C900: Megaflange 3800 or approved equal
 - i) Note that fitting should include all required accessories for HDPE compatibility including a pipe wall stiffening insert.
 - ii) Stabilizing rods are required for full buried restraints.
 - b. For transition between concrete wall DIP and buried HDPE pipe: EBAA IRON Single Ball Flex-tend Coupler or approved equal
 - i) Note that the coupler shall be flange by flange with one flange connecting to DIP wall pipe, and second flange connected to fused flange on HDPE buried pipe.
 - ii) A filler flange is required for proper seal contact.
- 8. All joints shall be HDPE compatible including but not limited required extra stabilizing rods, material gaskets, or other requirements from each specific manufacturer for a compatible transition.
- D. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe
- E. Flange Gaskets
 - 1. Flange gaskets shall be full-faced and shall be in accordance with ASTM D1330
 - 2. Flange gasket drilling pattern shall conform to ANSI B16.1/B16.5
 - 3. Flange gaskets shall be 1/16" thick for flanges up to 14" diameter. 1/8" thick gaskets shall be provided for flanges over 14" diameter
 - 4. Gasket material shall be EPDM
- 2.4 FORCE MAIN PIPE (PRESSURIZED) C900
 - A. The force main pipe when connecting to existing piping and valves shall be C900 DR 14.
 - B. Marking: Identification markings on pipe shall conform to AWWA C900
 - C. Fittings: Ductile iron compact fittings: ANSI A 21.53/AWWA C153
 - 1. Working pressure rating: 350 psi rating
 - 2. Joint: Mechanical joints with restraints
 - 3. Coating:
 - a. Exterior: AWWA C111, Asphalt coated
 - b. Interior: AWWA C104 and C111, lined with double thickness cement seal coated
 - c. Or interior and exterior: AWWA C116, fusion bonded epoxy coating
 - D. Joints: ASTM D3139, integral bell or mechanical joint
 - 1. Push-on joints: pipe to pipe joints, except as otherwise specified or indicated on Drawings. Push on joints are not permitted on fittings or valves.
 - a. Integral bell type with elastomeric gaskets, ASTM F477 factory installed
 - b. Suitable for buried service
 - c. Gaskets:
 - i) Material: Virgin SBR rubber suitable for potable water conforming to AWWA C111
 - ii) Lubricant shall be suitable for potable water contact

2.5 INTERIOR DUCTILE IRON PIPING

- A. Ductile Iron Process Piping: The following piping shall be ductile iron pipe as indicated on Drawings and provided for locations specified herein:
1. As indicated in the Pipe Schedule 01 67 00.
- B. Pipe:
1. AWWA C115, C150, and C151: As listed below except as otherwise specified or indicated on Drawings.
 - a. Where fitted with flanged, grooved or restrained joints: Class 53
 - b. Where fitted with push-on joints, mechanical joints or mechanical joints with joint restraint device 4-Inch to 12-Inch: Class 350
 - c. Thickness (minimum) for screw-on flanges shall be in accordance with AWWA C115
 - d. Pipe with grooved or shouldered joints for any restrained joint shall have wall thickness increased to provide the minimum wall thickness in accordance with AWWA C606
- C. Fittings
1. Ductile iron: ANSI A21.10/AWWA C110, ASTM A536, Grade 80-60-03 or 70-50-05
 - a. 24-inch and below: 350 psi rating, mechanical joint or flanged
 2. Ductile iron compact fittings: ANSI A21.53/AWWA C153
 - a. 16-inch and below: 350 psi rating, mechanical joint or flanged
 3. Ductile iron grooved fittings: ANSI/AWWA C606, AWWA Fittings, conform to AWWA C110 for center-to-center dimensions and AWWA C153 for wall thickness,
 - a. 12-inch and below: 350 psi rating, grooved joint
 4. Provide all specials, taps, flanges, plugs and wall fittings as required
- D. Joints
1. All joints shall be of restrained type unless otherwise indicated on Drawings
 2. Mechanical and push-on joints
 - a. Mechanical joints: ANSI A21.11/AWWA C111
 - i) Bolts and nuts: High strength, low alloy steel, in accordance with ASTM A307 or accepted substitution
 - b. Push-on joints: ANSI A21.11/AWWA C111, except gaskets shall be neoprene or other synthetic rubber. Natural rubber is not acceptable. Gaskets for air piping to be high temperature EPDM (Ethylene Propylenediene Monomer).
 - i) Lubricant: Heavy vegetable soap solution suitable for potable water contact
 - ii) Pressure rated 350 psi
 3. Mechanical joints with tie rods
 - a. Tie rods: ASTM A307, galvanized entire length
 - b. Steel pipe spacers: ASTM A120, standard weight galvanized
 - c. Washers: ANSI A27.2 plain steel, galvanized
 4. Flanged joints (interior piping)
 - a. Flanged joints shall be provided for all interior and exposed exterior pipe unless otherwise indicated or specified
 - b. Flanges
 - i) General use: ANSI A21.15/AWWA C115 and ANSI B16.1, Class 125
 - ii) Where Class 250 indicated on Drawings or specified: ANSI B16.1, Class 250, flat faced
 - c. Hardware
 - i) For all exterior applications
 - a) Stainless steel, Type 316
 - ii) All other locations
 - a) Hot dipped zinc galvanized steel conforming to ASTM A307, grade B (Class B & D flanges), grade B7 (Class E & F flanges)
 - b) Heads and dimensions per ANSI B18.2
 - c) For mechanical couplings furnish ASTM A183 or A194 bolts and nuts

- d) Provide two nuts for one-inch diameter and larger bolt applications
- 5. Mechanical couplings:
 - a. All couplings shall be fully restrained unless otherwise specified.
 - b. Acceptable manufacturers:
 - i) Romac Alpha Restrained Joint
 - ii) EBAA Iron 3800 Mega Coupling
 - iii) Or engineer approved accepted substitution
- 6. Tapping (service) saddles:
 - a. Ductile iron with double stainless steel straps and rubber sealing gasket, 250 psi pressure rating
 - b. Acceptable Manufacturer:
 - i) Smith-Blair
 - ii) Romac
 - iii) Ford
 - iv) Or engineer approved equal
- 7. Mechanical joint with restraint device
 - a. Where approved by the Engineer, multiple wedging action type follower gland used in lieu of tied pipe restraint
 - b. Twist off nuts used to insure proper actuating of the restraining device
 - c. Working pressure rated to at least 250 psi
 - d. EBAA Iron Sales, Inc., MEGA LUG or accepted substitution
- 8. Wall castings: Mechanical and/or flanged joints, refer to Pipe Penetration Structural detail with link-seal, grout, and waterproofing material.
- E. Flanged coupling adapters 12 inch and under
 - a. All coupling adapters shall be restrained unless otherwise specified.
 - b. Acceptable manufacturers:
 - i) EBAA Iron Megaflange Series 2100 – for interior material transition
 - ii) EBAA Iron Megaflange Series 3800 – for buried material transition
 - iii) ROMAC RFCA
 - iv) Or engineer approved accepted substitution
- 2. Flanged end and body to be one unit conforming to AWWA C219. Coupling end to be compression gland type with follower ring
- 3. Adapters for joining exposed interior iron pipe may be steel or iron
- 4. Flanged end bolt circle, bolt size, and spacing shall conform to the applicable provisions of ANSI B16.1 and shall be drilled Class 125 for iron adapters. Flanges on steel adapters shall be AWWA C207, Class D, drilled ANSI B16.1 Class 125
- 5. Bolts and nuts shall be ductile iron for iron adapters and high-strength, low-alloy steel for steel adapters
- 6. Anchor studs shall not be used where joint restraint is required. Furnish adapters with tie rod harness assemblies where indicated
- 7. Lining and Exterior Coating for Steel Adapters:
 - a. Two-part epoxy or nylon fuse-coated to a minimum 10 mils thickness
 - b. Completely coat adapter sleeve and end follower gland plus line interior for adapters intended for exposed exterior, vault or pit installations
 - c. Line interior of all adapters intended for exposed interior installations. Coat exterior with normal shop coating
- F. Expansion and Flexible Joints
 - a. All flexible expansion joints shall be EBBA Iron Flex-Tend single ball with 4 inches of expansion or greater
 - b. Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53.

- c. Foundry certification of material shall be readily available upon request.
- d. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2 inch and 30 inch diameter and larger.)
- e. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.
- f. Factory Mutual Approval for the 3 inch through 12 inch sizes is required.
- g. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2" - 12"; 15°, 14" - 36"; 12°, 42"-48" and 4-inches minimum expansion. Additional expansion sleeves shall be available and easily added or removed at the factory or in the field.
- h. Both standardized mechanical joint and flange end connections shall be available.
- i. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.
- j. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- k. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.
- l. Manufacturer's certification of compliance to the above standards and requirements shall be readily available upon request. The purchaser (or owner) shall reserve the right to inspect the manufacturer's facility.

2. Joints

- a. Except as indicated on Drawings
 - i) Bells in wall pipe or casting: Mechanical with tapped holes for follower bolts or extended minimum 6 inches beyond wall
 - ii) Exposed: Flanged or grooved
- b. 12 inch and smaller branch outlets where main line is at least twice the diameter of the branch, tee or a tapping saddle is acceptable
- c. Tie rods may be required as indicated on Drawings
- d. Mark the centerline of each flange and mechanical joint piece
- e. Screw flanges onto screwed-on flanged pipe so that pipe extends completely through and flush with the flange
- f. Finish machine pipe ends and flange faces flat and perpendicular to pipe centerline in a single operation

3. Shop coating and lining

- a. Comply with provisions under Section 01080 and Section 09900
- b. Shop prime exterior surfaces of pipe and fittings to be installed in exposed interior or exterior locations
- c. Shop coat flange faces with rust preventive compound
- d. Lining: See Pipe Schedule in 01 67 00.

2.6 SOURCE QUALITY CONTROL

- A. Testing per ASTM D3034 (PVC pipe), ASTM D3261 and ASTM D2387 (HDPE pipe), and ASTM A536 (DIP).
 - 1. Test products not manufactured in the U.S. at an acceptable laboratory in the U.S.

2.7 PIPE ACCESSORIES

- A. Underground Type Plastic Line Marker
 - 1. Manufacturer's standard permanent, continuous-printed plastic tape with metallic core, intended for direct-burial service; not less than 6-inch wide x 4 mils thick. Provide green tape with black printing reading "CAUTION SANITARY SEWAGE LINE BURIED BELOW." Provide identification markers of one of the following:
 - a. Allen Systems, Inc.
 - b. Emed Co., Inc.

- c. Seton Name Plate Corp.
- d. Or accepted substitution

B. Tracer Wire for Buried Pipe

- 1. Provide tracer wire for all PVC pipe
- 2. All tracer wire shall be 12 AWG solid copper wire coated with 45 mil Type HMW - PE blue insulation compliant with ASTM D1351 specifically designed for direct burial in corrosive soil or water
- 3. UL listed

C. Tracer Wire Test Stations

- 1. 4-inch with locking lid
- 2. Manufacturers:
 - a. CP Test Services
 - b. Glenn Series "Glenn-4"
 - c. Or accepted substitution

D. Valve Accessories

- 1. Extension stems
 - a. Provide where indicated on drawings, specified, or required for proper operation and for buried valves.
 - b. Non-rising stems
 - i) Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
 - ii) Connected to the valve by a flexible socket coupling
 - iii) All other connections pinned, keyed, or socket
 - c. Stem guides
 - i) Cast iron, bronze brushed, adjustable in two (2) directions
 - ii) If extension stem length exceeds 10 feet or the weight exceeds 50 lbs., design top guide to carry the stem weight and provide a collar on the stem to bear against the thrust guide
 - iii) Max spacing:
 - Non-rising stems: 100 times stem O.D.
 - Rising stems: 60 times stem O.D.
 - Ten foot maximum
 - d. Buried valves
 - i) Extend stem to within 1.0 foot of grade.
 - ii) Provide spaces to center stem in valve box
 - iii) Provide wrench nut
- 2. Valve boxes
 - a. Provide for all buried valves
 - b. Boxes shall consist of a cast iron cover, lid, and base castings. No slip type boxes shall be allowed
 - c. Type: Cast iron or ductile iron, extension sleeve (screw) type
 - d. Minimum thickness: 3/16 inch at any point
 - e. Coating: Bituminous varnish
 - f. Cast appropriate name designation of service in cover.
 - g. Shaft shall be ductile iron and minimum diameter of 5-1/4"
 - h. An appropriate word designating the valve service type on the cover
 - i. Manufacturer:
 - i) Neenah Foundry Company
 - ii) Tyler Company
 - iii) Mueller Company
 - j.

2.8 HATCH

A. Manufacturers:

- 1. Bilco
- 2. Or accepted substitution

- B. Provide hatches as indicated on Drawings
- C. Hatch shall be single leaf
- D. Performance Characteristics
 - 1. Cover shall be reinforced to support a minimum live load of 300 psf with a maximum deflection of 1/150th of the span
 - 2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing
 - 3. Operation of the cover shall not be affected by temperature
 - 4. Entire hatch, including all hardware components, shall be highly corrosion resistant
- E. Cover
 - 1. Cover shall be 1/4" aluminum diamond pattern
- F. Frame
 - 1. Channel frame shall be extruded aluminum with bend down anchor tabs around the perimeter
- G. Hinges
 - 1. Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts
- H. Drain Coupling
 - 1. Provide a 1-1/2" drain coupling as indicated on Drawings
- I. Lifting Mechanism
 - 1. Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing
 - 2. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly
 - 3. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4" gusset support plate
- J. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug
- K. Hardware
 - 1. Hinges: Heavy forged Type 316 stainless steel hinges, each having a minimum 1/4" diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame
 - 2. Cover shall be equipped with a hold open arm which automatically locks the cover in the open position
 - 3. Cover shall be fitted with the required number and size of compression spring operators. Springs and spring tubes shall be Type 316 stainless steel
 - 4. A Type 316 stainless steel snap lock with a fixed handle shall be mounted on the underside of the cover
 - 5. Hardware: Shall be Type 316 stainless steel throughout
 - 6. Ladder Up post
- L. Finishes
 - 1. Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame

2.9 MANHOLES

- A. Precast Concrete Manholes:

1. Manufacturers:
 - a. Rinker Materials
 - b. Old Castle Precast
 - c. Forterra
 - d. Or accepted substitution
- B. Drawing details precede specifications when in conflict.
 1. Specification: ASTM C478 and traffic rated
 2. Minimum wall thickness: greater of 5 inch or 1/12 of internal diameter per ASTM C478 requirements.
 3. Reinforced
 4. Grade rings as required and detailed on drawings.
- C. Precast Units or Cast-in-place as shown.
 1. Use concrete that will attain a 28-day compressive strength of not less than 4,000 psi with a cement content of not less than 6 sacks per cu. yd. Openings to be precast per plan. Sawcut in field only if no other option.
- D. Manhole Steps: Steel bar, 1/2 inch Grade 60, drop-front type, with polypropylene coating applied by manufacturer, Type MA Industries, Inc. "PS2-PF"

2.10 FABRICATION

- A. Vault/Manhole Sections
 1. Precast concrete dimensions as shown on plans
 2. Minimum manhole inside diameter: 48 inch
 3. Precast lid and Cones: Same or greater reinforcement and wall thickness as vault or manhole section with capability for H20 loading or greater
 4. Vault Joints: Shiplap or tongue and groove with double mastic gaskets, each joint to set equally and tightly.
 5. Manhole Joints: Keylock type with double mastic gaskets, each joint to set equally and tightly.
 6. Access opening: Minimum 24 clear or as indicated.
 7. Pipe connection: As indicated on Drawings
 8. Pipe knockout: As indicated on Drawings
 9. Precast concrete, monolithic base or cast-in-place base for tie-ing into existing piping.
 10. Manhole steps: 12 inch on center, vertical alignment above largest bench or open area.
- B. Grating and Metal Frame: As specified on drawings.

2.11 ACCESSORIES

- A. Plugs and Caps: Use pipe plugs or caps provided by the pipe manufacturer and approved by the Engineer for pipe stubouts
- B. Cleanouts: Provide as indicated, pipe extension to grade with ferrule and countersink cleanout plug. Provide round cast-iron access frame over cleanout, with heavy duty secured scoriated cover with lifting device cast with the word "SANITARY"
- C. Reinforcement:
 1. Reinforcing Steel: ASTM A615 Grade 60
 2. Welded Wire Fabric: ASTM A185
- D. Concrete: Refer to Division 3 Specifications if applicable
 1. Minimum compressive strength: 4000 psi at 28 days
 2. Cement: ASTM C150, Portland Cement, Type II
 3. Aggregates: ASTM C33, free of deleterious substances
- E. Gaskets: ASTM C923

1. Mastic: FS SS-S-210A, "RAM-NEK" or approved substitution
2. Rubber: Neoprene, 40±5 hardness when measured by ASTM D2240, Type A durometer

F. Boots: ASTM C923

1. Flexible rubber boots

G. Frames and Castings: ASTM A48 with asphalt varnish coating hot dip applied at foundry, 6 mils thick Class 30b

H. Manhole Rings and Covers

1. Cast iron, heavy duty traffic type, ASTM A48, Class 35B. Grind bearing surfaces to ensure flat, true surfaces.
2. Cover to be bolted type to prevent flooding and flotation.
3. Lid shall be bolted for all new manholes.
4. Covers to seat at all points on ring
5. Covers to be cast with "SANITARY" in 2" tall flush letters
6. Provide type as indicated on the drawings

I. Manhole Height Adjustment: Use precast concrete grade rings

J. Rock Subbase: 1-1/2 inch minus, well-graded gravel over compacted subgrade

K. Water: Clean and free of deleterious substances

L. Grout: Provide under provisions of Division 3 Specifications

M. For drop manhole, interior epoxy coating required

1. Raven 400 Epoxy Coating system or approved equal

N. For cast-in-place manhole base concrete shall be waterproofed with epoxy system:

1. CS-55 Con Seal coating or approved equal

O. Manhole to be encapsulated with shrink wrap product:

1. Canusa-CPS WrapidSeal
2. Riser Wrap
3. Or approved equal

2.12 GROUT MANUFACTURERS

A. Non-Shrink, Non-Metallic Grout

1. Master Builders: Masterflow 928
2. Burke: Non-Ferrous Non-Shrink
3. M.R. Meadows: Sealtight 588
4. Sonneborn: SonogROUT G.P.
5. Tamms: TammsgROUT 621
6. Sika: SikaGrout 212
7. Or accepted substitution

B. Epoxy Grout

1. Burke: BurkEpoxy Anchoring Grout
2. L&M Inc.: EpogROUT
3. Sika: Sikadur 42, Grout Pack
4. Or accepted substitution

2.13 CONCRETE MATERIALS

A. Follow requirements specified in details. All bases shall meet ASTM C478 requirements.

2.14 SOIL MATERIALS

- A. Furnish pipe bedding and cover as specified in See Section 31 23 00

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions under provisions of Division 1 specifications
- B. Verify locations and inverts or tops of pipe are as indicated
- C. Carefully examine pipe and fittings for cracks, damage to linings, and other defects prior to installation
- D. Remove all defective pipe from site and replace
- E. Examine areas for weak or structural defects or deviations beyond allowable tolerances for piping clearances that adversely affect excavation and quality of Work.
- F. Start installation only when conditions are satisfactory

3.2 INSPECTION

- A. Examine pipe and fittings and do not use individual sections containing cracks, dents, abrasions, and other defects.

3.3 PERFORMANCE - GENERAL

- A. Perform work in a safe and proper manner with appropriate precautions against hazard
- B. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities
- C. Contain all construction activity on the designated site and within the limits of work. Cost of restoration of site will be the responsibility of the Contractor
- D. Contractor to verify quantities to perform all earthwork required according to Drawings, including but not limited to, additional import or export required to handle compaction, pavement subgrade preparation, and pipe bedding
- E. Contractor shall take precautions to limit the removal of or damage to existing pavements, multi-use paths sidewalks, curbs, lawns, shrubbery, trees, hedges, walls, fences, buildings, or other existing improvements to the least practicable amounts and shall replace or restore such improvements to their original location and condition after the excavation has been backfilled and compacted

3.4 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

- A. Excavation and backfill operations shall be performed in such a manner to prevent cave- ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work
- B. Backfill shall be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work

- C. Any excavations improperly backfilled or where settlement occurs shall be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner
- D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage shall be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, shall be borne by the Contractor at no additional expense to the Owner

3.5 DEWATERING

- A. Comply with CDPHE Dewatering Requirements
- B. Dewatering discharge to surface waterways requires CDPHE dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, if necessary

3.6 PREPARATION

- A. Thoroughly clean pipe and fittings of foreign matter before installation. Remove scale and dirt, on inside and outside, before assembly
- B. Ream pipe and tube ends and remove burrs
- C. Prepare pipe connections to equipment with flanges or unions. Clean joint contact surfaces with wire brush is necessary, wipe clean, and keep clean until jointing is complete.
- D. Cut ends of metallic pipe, recoat with manufacturer's coatings
- E. Shape trench and place bedding as specified in Division 31 23 00 and as shown on the drawings. Do not disturb trench bottom during excavation. Hand trim excavation for accurate placement of pipe to elevations indicated
 - 1. Dig bell or coupling holes
 - 2. Do not support pipe on blocks or mounds of earth
 - 3. Provide uniform and continuous bearing and support for full length of pipe between bell holes
 - 4. Minor disturbance over a maximum length of 18 inches near the middle of each length of pipe will be permissible by the withdrawal of pipe slings or other lifting tackle
 - 5. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent
 - 6. Backfill in accordance with Section 31 23 00 and HDPE Installation Requirements. All HDPE shall be bedded with Class 1 material as defined by 20th Plastic Pipes Conference, PPXX Report.
- F. Alignment and Grade
 - 1. Except as indicated on the Drawings, lay all pipe straight and at a uniform grade
 - 2. Use batter boards to determine and check pipe subgrades
 - 3. Other methods of maintaining alignment and grade may be acceptable if approved by the Engineer

3.7 INSTALLATION OF HDPE PRESSURE PIPE

- A. Trenching, Pipe Embedment, Backfill, and Compaction: Refer to Manufacturer's Installation Guide for all requirements. Installation shall meet all ANSI/AWWA Installation Technique Requirements.
- B. Pipe and Fittings
 - 1. Follow pipe manufacturers installation instructions for field cutting and heat fusion joining techniques for HDPE pipe
 - a. Include acceptable size and shape of fusion bead; and minimum radius of curvature of various sizes of pipe for installing curved sections of pipe

2. Carefully lower pipe, fittings, valves, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage
 3. Do not dump or drop pipe or accessories into trench
 4. Lay to lines and grades indicated on drawings or as specified
 - a. Lay piping beginning at a low point of system, true to line and grade with unbroken continuity of invert.
 - b. Join to form a smooth flow line
 5. Do not install flanges, fittings, or valves in curved sections of pipe
 6. Keep pipe clean during and after laying
 7. Close all open ends with watertight expandable type sewer plugs or test plugs
 8. Do not lay pipe when
 - a. There is water in the trench
 - b. Trench conditions are unsuitable
 - c. Weather conditions are unsuitable
 9. Use acceptable adaptors at manhole and structure connections to provide a watertight seal and flexibility; provide a short length of pipe outside each connection
 10. Protect from lateral displacement by placing and compacting bedding material as noted in details
 11. Protect pipe from hot and cold thermal expansion using manufacturer and other recommended techniques
- C. Joining
1. Use butt fusion joining technique for connections between pipe sections or fittings unless otherwise noted herein.
 2. Butt Fusion
 - a. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground.
 - b. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations.
 - c. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer.
 - d. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.
 3. Sidewall Fusion
 - a. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications.
 - b. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused.
 - c. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.
 4. Mechanical
 - a. Bolted joining may be used where the butt fusion method cannot be used.
 - b. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring.
 - c. Mechanical joint joining will be accomplished using either a molded mechanical joint adapter or the combination of a Sur-Grip Restrainer and Pipe Stiffener as manufactured by JCM Industries, Inc.
 - d. Either mechanical joint joining method will have a ductile iron mechanical joint gland.
 5. Other
 - a. Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.
- D. Water Line and Sanitary Sewer Crossings
1. Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18-inches between invert of water main and crown of sewer.
 2. If above separation cannot be met, provide one continuous length of watertight sewer pipe 20 feet long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inches either side of joint or encase sewer pipe in 6-inches of concrete completely around pipe, for not less than 10 feet either side of water main.

3. Water Mains Passing Under Sewers: If vertical separation less than 18-inches provide structural support for sewer.

3.8 PROTECTIVE COATING

- A. Provide polyethylene tube encasement on all buried ductile iron fittings, valves, and fire hydrant extensions
 1. Encase ductile iron fittings and valves in polyethylene per AWWA C105, Method A, secured with polyethylene compatible adhesive tape. Overlap polyethylene onto PVC pipe a minimum of 6 inches
 2. Before backfilling, inspect polyethylene for rips, punctures and other damage and repair following AWWA C105
- B. Coat exposed ferrous metal surfaces of joints, couplings, and uncoated steel with primer and tape coating system after installation. Do not coat stainless steel or high strength low alloy steel nuts and bolts
 1. Surface Preparation: Clean surfaces of rust, scale, soil, mud, oil, grease, and other contaminants by hand or power tool following SSPC-SP2 or SP3 and other appropriate means as recommended by coating manufacturer Remove excess moisture and provide surface dryness as recommended by coating manufacturer
 2. Application: Apply primer in uniform manner to clean and dry surfaces following coating manufacturer's recommendations
 - a. Fill complex and irregular surfaces with appropriate mastic or filler tape to eliminate bridging; then apply tape/wrap to primed and filled surfaces following coating manufacturer's recommendations.
 - b. When coating restraining rods or strapping, apply tape wrap longitudinally
 - c. Where metal being coated enters concrete, overlap coating onto concrete by minimum of 2 inches after placement of concrete
 3. Inspection: After field coating of specified items, conduct visual inspection to verify complete coverage has been accomplished.
 - a. Repair damaged or incompletely coated surfaces following coating manufacturer's recommendations

3.9 INSTALLATION – BURIED VALVES

- A. Install valves and accessories in accordance with the manufacturer's recommendations and in accordance with referenced standards and specifications
- B. Set valves on solid bearing
- C. Center and plumb valve box over valve. Set box cover flush with finished grade. Evenly fill around box and thoroughly compact on all sides
- D. Extend stem to within 6 inches of final grade. Provide spacers to center stem in valve box
- E. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards
- F. Provide an isolation or shutoff valve and union at the water connections to each fixture and unit of equipment, whether shown on the drawings or not

3.10 FIELD QUALITY CONTROL

1. General
2. Utilize pressures, media and pressure test durations as specified on Piping Schedules
3. Isolate equipment which may be damaged by the specified pressure test conditions
4. Perform pressure test using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge's range. Notify Engineer 24 hours prior to each test
5. Completely assemble and test new piping systems prior to connection to existing pipe systems

6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance
7. Provide all necessary equipment and perform all work required in connection with the tests and inspections
8. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination

B. Testing methods and criteria

1. Ductile iron pipe systems: Test ductile iron pipe in accordance with the latest version of AWWA C600. Per AWWA C600, the allowable leakage in gallons per hour from buried ductile iron pipe systems shall be less than the length of pipeline tested in feet, times the nominal diameter of the pipe in inches, times the square root of the average test pressure during the leakage test in pounds per square inch (gauge), divided by 133,200. The duration of each leakage test shall be two hours. The equation for computing the allowable leakage is:

$$i) \quad L = (SDP0.5)/133,200$$

Where:

L = allowable leakage, in gallons per hour

S = length of the pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in psi

2. Polyethylene (PE) pressure pipe systems: Test PE pressure pipe in accordance with the latest version of ASTM F2164. For PE pipe, pressurize the test section to the system test pressure and maintain this pressure for four hours by adding make-up water. After this initial expansion phase, reduce the test pressure by 10 PSI and stop adding make-up water. If the test pressure remains steady (within 5% of the target value) for one hour, no leakage is indicated
3. Unless otherwise specified, the allowable leakage in gallons per hour from other buried liquid piping systems shall be less than the length of pipeline tested in feet, times the nominal diameter of the pipe in inches, times the square root of the average test pressure during the leakage test in pounds per square inch (gauge), divided by 133,200. The duration of each leakage test shall be two hours. The equation for computing the allowable leakage is:

$$i) \quad L = (SDP0.5)/133,200$$

Where:

L = allowable leakage, in gallons per hour S = length of the pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in psi

4. The following liquid piping systems shall have zero allowable leakage at the specified test pressure throughout the specified duration:
 - a. Exposed piping
 - b. Buried insulated piping
 - c. Buried or exposed piping carrying liquid chemicals
5. Hydrostatic pressure testing
 - a. For buried piping: Perform testing after backfill and proper compaction of trenches. Where lines are installed under roadways and parking areas, perform tests after completion of final grade preparation and prior to application of surface courses. Notify Engineer at least 48 hours prior to testing. Provide temporary restraints for expansion joints for additional pressure load under test. Isolate equipment in piping system with rated pressure lower than pipe test pressure by valves or blind flanges
6. Low pressure air test
 - a. Check pneumatic plugs for proper sealing

- b. Place plugs in line at each manhole and inflate to 25 PSIG
- c. Introduce low pressure air into sealed line segment until air pressure reaches 4 PSIG greater than ground water that may be over the pipe. Use test gauge conforming to ANSI B40.1 with 0 to 15 PSI scale and accuracy of 1 percent of full range
- d. Allow 2 minutes for air pressure to stabilize
- e. After stabilization period (3.5 PSIG minimum pressure in pipe) discontinue air supply to line segment
- f. Acceptable time for loss of 0.5 PSIG of air pressure in plastic pipe shall be:

	Minimum Time for 0.5 PSIG Loss in Plastic Pipe (minutes: seconds)								
Pipe Size	≤100 Feet	150 Feet	200 Feet	250 Feet	300 Feet	350 Feet	400 Feet	450 Feet	500 Feet
4 Inch	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6 Inch	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	3:34
8 Inch	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	6:20
10 Inch	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	9:53
12 Inch	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	14:14
15 Inch	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	22:16
18 Inch	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	32:03
21 Inch	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	43:38
24 Inch	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	56:59
27 Inch	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	72:07
30 Inch	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	89:02

NOTE: If there has been no (zero psi) drop after 1 hour of testing, the test section shall be accepted and the test completed

- h. For pipe lengths not shown in the above table, use the two nearest pipe lengths to estimate the minimum time necessary for a 0.5 PSIG loss
- i. For concrete pipe 24" and smaller refer to ASTM C-924 for acceptable test procedures and times
- j. For concrete pipe 24" and larger refer to ASTM C-1103 for acceptable test procedures and times

3.11 INSTALLATION OF PVC GRAVITY SANITARY SEWER PIPE (NON-PRESSURE)

- A. Trenching, Pipe Embedment, Backfill, and Compaction: See City Public Works Manual and Section 31 23 00
- B. Install pipe in accordance with ASTM D2321 as modified herein or on the drawings
- C. Cutting
 1. Cut and bevel ends in accordance with manufacturer's standard recommendations
 2. Machine cut ends smooth and square to proper dimensions
 3. Do not cut with a cold chisel, iron pipe cutter, flame or any other method that may fracture the pipe or leave ragged, uneven edges
 4. Remove burrs and wipe off all dust and dirt from jointing surfaces
- D. Pipe Laying
 1. Inspect pipe and accessories for cracks and other defects before lowering into trench
 2. Repair or replace any defective, damaged or unsound pipe
 3. Remove all dirt and foreign material from the inside of pipe before laying
 4. Check bedding for firmness and uniformity of surface immediately before laying each section of pipe

5. Carefully lower pipe, fittings, valves, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage
 6. Do not dump or drop pipe or accessories into trench
 7. Lay to lines and grades indicated on drawings or as specified
 - a. Lay piping beginning at a low point of system, true to line and grade with unbroken continuity of invert.
 - b. Closely joint to form a smooth flow line
 - c. Place bell end or groove ends of piping facing upstream
 - d. Maximum length of pipe that can be used without exceeding the allowable deflection at a coupling shall be determined
 - e. Maximum deflection at flexible couplings as recommended by the manufacturer
 - f. Maximum deflection at a joint: As recommended by the manufacturer, but not more than 3-1/2 inches
 8. Utilize implements, tools, and facilities as recommended by the manufacturer
 9. Keep pipe clean during and after laying
 10. Close all open ends with watertight expandable type sewer plugs or test plugs
 11. Remove and relay any pipe which has floated
 12. Do not lay pipe when
 - a. There is water in the trench
 - b. Trench conditions are unsuitable
 - c. Weather conditions are unsuitable
 13. Use acceptable adaptors at manhole and structure connections to provide a watertight seal and flexibility; provide a short length of pipe outside each connection
 14. Protect from lateral displacement by placing and compacting bedding material under provisions of Section 02300
- E. Jointing
1. Assemble in accordance with the manufacturer's instructions
 2. Wipe clean pipe ends, gasket and gasket groove before inserting gasket
 3. Apply lubricant furnished by the pipe manufacturer to the gasket and the outside of the spigot end
 4. Utilize an assembly tool as recommended by the manufacturer to center the sleeve over the spigot end
 5. Insert the spigot end to the reference mark
 6. Check gasket location after assembly with a suitable gage
 - a. Gasket locations to be the distance from the sleeve and recommended by the coupling manufacturer for their full circumference
 - b. If not within the required limits, disassemble and reassemble the joint
- F. Fittings
1. Install utilizing standard methods
 2. Lower into trench with rope or other means to prevent damage
 3. Attach rope around the exterior
 4. Do not attach rope through the interior
 5. Carefully connect to pipe or other facility
 6. Check joint to insure a sound and proper joint
- G. Water Line and Sanitary Sewer Crossings
1. Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18-inches between invert of water main and crown of sewer.
 2. If above separation cannot be met, provide one continuous length of watertight sewer pipe 20 feet long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inches either side of joint or encase sewer pipe in 6-inches of concrete completely around pipe, for not less than 10 feet either side of water main.
 3. Water Mains Passing Under Sewers: If vertical separation less than 18-inches provide structural support for sewer

3.12 MANHOLE PREPARATION

- A. Verify items provided by other section of Work are properly sized and located
- B. Verify that built-in items are in proper location, ready for roughing into Work
- C. Verify excavation for manholes is correct
- D. Excavation, Backfill, Subgrade Compaction: Refer to Section 31 23 00 for requirements
- E. Rock Subbase
 - 1. Remove water and place 6 inch minimum depth
 - 2. Vibrate for compaction
 - 3. Level top to accept precast sections with uniform bearing all around
 - 4. If material below vault is unsuitable, excavate as directed by the Engineer and backfill to grade with 1-1/2 inch minus rock and compact

3.13 PLACING MANHOLE

- A. Cast-in-place: Place base pad, trowel top surface level to accept manhole section with uniform bearing all around
 - 1. Place sufficient non-shrink grout on base to ensure watertight fit between first manhole section and base of place first manhole section directly in wet concrete.
- B. Place manhole sections plumb and level, trim to correct elevations
- C. Clean ends of sections and place double mastic gasket
- D. Fill inside and outside of joint completely with non-shrink grout and trowel smooth
- E. Cure non-shrink grout using approved methods outlined in Division 3 Specifications.
- F. Set cover rings and covers level without tipping, to correct elevations or set cover rings and covers with slight tip to match cross slope of finished surface where directed by Engineer
- G. Completed manholes shall be rigid and watertight
- H. Coordinate with other sections of work to provide correct size, shape, and location

3.14 PREFORMED GASKETS

- A. Remove and replace manhole sections which have chipped or cracked joints
- B. Thoroughly clean section joints
- C. Install gasket in conformance with manufacturer's recommendations
- D. Only use primer furnished by gasket manufacturer

3.15 MANHOLE INVERT

- A. Place concrete in bottom of manhole and form smooth transition. Trowel smooth and brush for non-skid finish. Slope bench 1 inch per foot for drainage to invert.
- B. Invert shape to conform to radius of pipe it connects

- C. Remove all rough sections or sharp edges which tend to obstruct flow or cause material to snag. Remove all grout droplets from invert
- D. Construct in conformance with standard drawings

3.16 MANHOLE RINGS AND COVERS

- A. Place rings in ramneck on top of manholes
- B. Ensure no infiltration will enter manhole at this location
- C. Carry ramneck over flange of ring
- D. Set top of ring flush with all surfaces subject to foot and vehicular traffic.
- E. Set manhole ring and cover 1/4-inch to 1/2-inch below roadway surface.
- F. Use precast grade rings for height adjustment of manhole ring and cover per Detail.

3.17 CONNECTION TO EXISTING MANHOLES

- A. Maintain flow at all times.
- B. Prior approval of proposed method for maintaining flow must be obtained from Engineer.
- C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure.
- D. Make connection during low flow periods.

3.18 FIELD QUALITY CONTROL – PIPE

- A. Exfiltration/Infiltration Test
 - 1. Perform an exfiltration test on each reach of sanitary service and sewer pipe between manholes or discharge
 - a. Test the first reach prior to backfilling and before installing any of the remaining pipe
 - b. Provide all necessary piping between the reach to be tested and the water supply, together with all required materials and equipment
 - c. Methods used, scheduling, and duration of tests shall be acceptable to Engineer
 - d. Air testing may be allowed: Submit complete information to Engineer for review describing the proposed test method including the method of testing manholes before beginning testing
 - 2. Procedure
 - a. Block off all manhole openings except those connecting with the reach under test
 - b. Fill the line
 - i) Average depth: 10 feet above invert except as required by manhole depth
 - ii) Maximum depth at lower end: 25 feet above crown
 - iii) Minimum depth at upper end: 5 feet above crown
 - c. Add and measure water as required to maintain a constant level
 - i) Maximum exfiltration/infiltration: 0.039 gallons per inch of nominal diameter per hour per 100 feet of pipe.
 - ii) Manholes considered section of 48-inch pipe
 - iii) Maintain test for at least 2 hours or as long as necessary, in the inspector's opinion, to locate all leaks
 - 3. Repair and retest any reach which exceeds the allowable exfiltration/infiltration
- B. Infiltration
 - 1. At any time prior to expiration of the correction period, infiltration exceeds 0.039 gallons per inch of nominal diameter per 100 feet per hour, locate the leaks and make repairs

C. Pipe Deflection Test

1. No sooner than 30 days after placement and compaction of backfill, but prior to placement of permanent surface materials, clean and mandrel each line to detect obstructions (deflections, joint offsets, lateral pipe intrusions, etc.)
2. Use a rigid mandrel with diameter of at least 95 percent of the pipes specified average inside diameter and a length of the mandrel circular portion at least equal to the nominal pipe diameter
3. Maximum allowable deflection is 5 percent of the base internal diameter. Mandrel outside diameters in inches are as follows:

Pipe Size	Base I.D.	Mandrel O.D.
6	5.792	5.50
8	7.764	7.38

4. Pull the mandrel through the pipe by hand
5. Relay or replace all pipe exceeding the 5 percent deflection at no additional cost to the Owner
6. Retest repaired sections
7. Maximum allowable deflection at end of one year correction period, 7-1/2 percent of the base internal diameter tested in the same manner. Uncover and repair sections exceeding the allowable deflection

D. TV Inspection will be provided as requested by Owner and approved by the Engineer at the expense of the Contractor. Digital video files to be provided with reach noted, footage, inverts, and manhole number at each end, and pipe size and type.

E. All sewer lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The full diameter of the pipe should be visible when viewed between consecutive manholes. The method of test can be photography, closed circuit television or visually lamping with mirrors and lights.

F. Lamp Test

1. Each section between manholes will be lamped by Contractor in the presence of engineer
2. A true circle will be required in the lamp tests to indicate a properly constructed sewer line
3. Repair any sections not passing the lamp test at Contractor's expense.

3.19 FIELD QUALITY CONTROL – MANHOLES

A. Test all manholes:

1. Vacuum test:
 - a. Plug all inlets and outlets in such a manner as to prevent displacement of plugs
 - b. Install and operate vacuum tester head assembly in accordance with equipment specifications and manufacturer instructions
 - c. Attach the vacuum pump assembly to the proper connection on the test head assembly. Ensure that vacuum inlet/outlet valve is closed
 - d. Inflate sealing element to twice the pressure test to be used. Do not over inflate
 - e. Start vacuum pump assembly engine and allow preset RPM to stabilize
 - f. Open vacuum inlet/outlet valve and evacuate manhole to 5-inches Hg (mercury)
 - g. Close vacuum inlet/outlet valve, disconnect vacuum pump and monitor vacuum. Record time for vacuum to drop from initial 5 inches Hg to 4 inches Hg.
 - h. Acceptance for 5 foot diameter manhole is when the time to drop from 5 inches Hg to 4 inches Hg meets or exceeds requirements as defined below:

Maximum Allowable Vacuum Drop		
Manhole Depth	Manhole Diameter in feet	Time for Vacuum to Drop 1 inch Hg
10 feet or less	5	150 seconds
10 feet to 15 feet	5	180 seconds

15 feet to 25 feet	5	210 seconds
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- i. Adjust time to drop from 5 inches Hg to 4 inches Hg for other manhole diameters as follows:
 - i) 4 foot diameter manhole: Subtract 30 seconds from time shown above
 - ii) 6 foot diameter manhole: Add 30 seconds to time shown above
- j. Repair all manholes that fail leakage test and retest until manhole passes test at no additional cost
- k. If joint mastic or gasket is displaced during vacuum test, disassemble manhole and replace seal
- l. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn, Retesting shall proceed until a satisfactory test is obtained.
2. All testing shall be witnessed by Engineer. Contractor shall provide a minimum of 48 hours notice to Engineer prior to testing.

3.20 CLEANUP AND RESTORATION

- A. Restore pavements, curbs and gutters, utilities, and other improvements to condition equal to or better than before work began and to satisfaction of Engineer.
- B. Deposit waste material in designated waste areas and disposal site graded and shaped.

3.21 FINAL ACCEPTANCE

- A. Comply with project standards and specifications for placing sewer line in service
- B. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
 1. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete.
- C. Provide record drawings with manhole number, inverts, and location (x, y, z) for each service connection.
- D. Provide test report for tracer wire continuity.
- E. Provide pipe and manhole tests and results.
- F. Provide video files of TV inspection on USB or via Dropbox.

END OF SECTION

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 460753 PACKAGED WASTEWATER LIFT STATION EQUIPMENT

PART 1 - GENERAL

1.01 Section Includes

- A. Work under this section includes, but is not limited to, furnishing and installing a factory built duplex pump station as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

1.02 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.

1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
 - a. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
 - b. ANSI/AWWA C115/A21.51 Cast/ductile iron pipe with threaded flanges.
 - c. ANSI 253.1 Safety Color Code for Marking Physical Hazards.
 - d. ANSI B40.1 Gages, Pressure and Vacuum.
 - e. AWWA C508 Single Swing Check Valves.
2. American Society for Testing and Materials (ASTM)
 - a. ASTM A48 Gray Iron Castings.
 - b. ASTM A126 Valves, Flanges, and Pipe Fittings.
 - c. ASTM A307 Carbon Steel Bolts and Studs.
 - d. ASTM A36 Structural Steel.
3. Institute of Electrical and Electronics Engineers (IEEE)
 - a. ANSI/IEEE Std 100 Standard Dictionary of Electrical Terms.
 - b. ANSI/IEEE Std 112 Test Procedure for Polyphase Induction Motors.
 - c. IEEE Std 242 Protection of Industrial and Control Power Systems.
4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
 - a. NEC National Electric Code.
 - b. NEC 701 National Electric Code article 701.
 - c. NEMA Std MG1 Motors and Generators.
5. Miscellaneous References
 - a. Ten-State Standards Recommended Standards for Sewage Works.
 - b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
 - c. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards
 - d. ISO 9001 International Organization for Standardization.

1.03 System Description

- A. Contractor shall furnish and install one factory built base mounted, automatic pump station. The station shall be complete with all equipment specified herein, factory assembled on a common steel base.
- B. Principal items of equipment shall include two horizontal, self priming, centrifugal sewage pumps, V-belt drives, motors, piping, valves, motor control panel, automatic liquid level control system, and integral wiring.
- C. Factory built pump station design, 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.

1.04 Performance Criteria

- A. The pump manufacturer must be ISO 9001 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, unscreened, domestic sanitary sewage. Pumps shall have 6" suction connection, and 6" discharge connection. Each pump shall be selected to perform under following operating conditions:

1. Capacity (GPM)	500
2. Total Dynamic Head (FT)	84
3. Total Dynamic Suction Lift(FT)	16.5
4. Maximum Repriming Lift (FT)	14.5
5. Maximum Static Suction Lift (FT)	16
6. Total Discharge Static Head (FT)	-2.00

- D. Site power furnished to pump station shall be 3 phase, 60 hertz, 480 volts, 4 wire, maintained within industry standards. The available fault current provided at the pump station control panel is 10,000 kA rms symmetrical. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

1.05 Submittals

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit electronic copies of submittal data for review and approval.
2. 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 and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

- B. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Contractor piping connections 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.

C. Operations 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 NMTBA and JIC standards. 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, motors, 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.

1.06 Quality Assurance

- A. The pumps and pump station manufacturer must be ISO 9001 certified, with scope of registration including design control and service after sales activities.
- B. The pump station 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. 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.
- D. 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.

E. The term “pump manufacturer” or “pump station 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” or “pump station 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.

F. Reprime 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 repriming 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 required.
3. Pump must reprime 14.5 vertical ft. at the specified speed and impeller diameter. Reprime 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 reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:
 - a. A check valve to be installed down stream 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 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 reprime test shall incorporate a 2 feet minimum horizontal run, a 90 degree 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 reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
 - f. Liquid to be used for reprime test shall be water.
4. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

5. head, capacity, rated speed and horsepower.

G. Factory System Test

1. All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall duplicate actual performance anticipated for the complete station.
 2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer's facility.
- H. 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.

1.07 Manufacturers 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. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures (where applicable) are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.
 2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.
- B. Components failing to perform as represented by the manufacturer or as proven defective in material or workmanship during the warranty period, shall be repaired, replaced, or modified by the manufacturer.
- 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. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.
- E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report completed by an authorized

manufacturer's representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 - PRODUCT

A. Unitary Responsibility

- B. 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. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

2.01 Manufacturer

- A. The pump station system integrator must be ISO 9001 certified, with scope of registration including design control and service after sales activities.
- 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 and match existing equipment and systems currently in use by the owner. The contractor shall prepare their bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified Gorman-Rupp equipment and materials.

2.02 Unit Base

- A. The unit base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 1/4" thick. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

2.03 Pump Design

- A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.
- B. The pump manufacturer must be ISO 9001 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 coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads 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 1 1/4" NPT to insure complete and rapid draining.
 - d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.
2. Coverplate assembly shall be cast iron Class 30. Design must incorporate following maintenance features:
 - a. A lightweight inspection coverplate, retained by acorn nuts, for access to pump interior for removal of stoppages. Designs that require removal of complete coverplate assembly for access to the impeller will not be accepted.
 - a.
 - b. Retained by acorn nuts for complete access to pump interior. Back coverplate removal must allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping. Back coverplate shall incorporate an obstruction free flow path by combining four support posts into a two-point "webbed" plate design for increased durability, reduced clogging, and increased operational efficiency.
 - 1) A replaceable wear plate secured to the back cover plate by studs and nuts. Wear plate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.
 - 2) 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.
 - c. In consideration for safety, a pressure relief valve shall be supplied in the inspection coverplate. Relief valve shall open at 75-200 PSI.
 - d. One O-ring of Buna-N material shall seal inspection coverplate to back coverplate.
 - e. Two O-rings of Buna-N material shall seal back coverplate to pump casing.
 - f. Pusher bolt capability to assist in removal of inspection coverplate or back coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

- g. Easy-grip handle shall be mounted to face of inspection coverplate.
3. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate 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.
 - 1) 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.
 - 2) 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.
 - 3) 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 lockscrew and conical washer.
 - c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.
 - 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 capscrews as used for retaining rotating assembly.
4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

- a. Clearances shall be maintained by a four point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.
 - b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above
 - c. 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 coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.
 - 6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

2.06 Drain Kit

- A. Pumps to be supplied with a drain kit for ease of maintenance. The kit to contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel gate valve and aluminum male quick connect fitting.

2.07 Spare Parts Kit

- A. The following minimum spare parts shall be furnished with the pump station:
 - 1. One spare pump mechanical seal (complete with shaft sleeve).
 - 2. One cover plate O-Ring.
 - 3. One rotating assembly O-Ring.
 - 4. One set of impeller clearance adjustment shims.

2.08 Valves & Piping

- A. Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. 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. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. 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. Automatic air release valves:

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric reinforced neoprene or similar inert material.
3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Valves shall be field adjustable for varying discharge heads.
5. Connection of the air release valves to the station piping shall include stainless steel fittings.

C. Gauge Kit

1. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.
2. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

D. 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 degrees between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

E. Supports and Thrust Blocks

1. Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.
2. Refer to Pipe Support and Details on drawings for required supports.

2.09 FINISH

- A. Pumps, piping, and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces shall be applied with one coat of Tnemec Series 69 Polyimide Epoxy Primer and one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating. See Product Data Sheet for additional information.

2.10 Electrical Components

- A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.

2.11 Panel Enclosure

- A. Electrical control equipment shall be mounted within a NEMA 1 steel, dead front type, control enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs.
- B. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount and component. All control devices shall be clearly labeled to indicate function.

2.12 UL Label Requirement

- A. Pump station components and controls shall conform to third party safety certification. The station shall bear a UL label listed for "Packaged Pumping System". The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The pump station components, panel enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

2.13 Branch Components

A. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. the lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.

B. Circuit Breakers and Operating Mechanisms

1. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
2. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

C. Motor Starter

The variable frequency drive shall be capable of operation under any combination of the following conditions without mechanical or electrical damage. Ambient Temperature: 0 to + 40 degrees C

1. Relative Humidity: Less than 95% non-condensing
2. Altitude: 5,348 feet above sea level.
3. Vibration: .006 inches displacement, 1G peak
4. Shock: 15G peak for 11mS (+/- 1.0mS)
5. Control Specification
6. Control System: Sinusoidal pulse width modulated voltage waveform
7. Frequency Accuracy: +/- 0.4% of max. frequency
8. Volts/Hertz Ratio: V/Hz user programmable
9. Operation Frequency: 0 to 400 Hz
10. Overload Capacity: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds

D. Digital Readout and Monitor

1. Interface to the drive is provided via a module with integral LCD display. Unit is a 7 line by 21 character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch. The unit will display standby status (power on, not running), output frequency (drive run), set-up parameters and fault. With keypad, user can monitor current, voltage, frequency, acceleration and deceleration time, minimum frequency and maximum frequency. Readout also provides inverter status and protective circuit status.

E. Protection

1. The variable speed drive system shall include a diode or fully gated bridge rectifier, capacitor filter, and transistorized inverter section. Base driver signals to control firing of the power transistors will be designed with optically coupled isolators for maximum protection of the control circuits from high voltage and noise. The output will be a sinusoidal, pulse width modulated, voltage waveform for reduced harmonic heating in the motor.

F. The system protection will provide the following:

1. Intermittent overload - 50 to 150%
 2. Current limit - 50 to 115%
 3. Overcurrent - 220-300% of rated output current
 4. Inverse time overload - 50 to 100%
 5. Short circuit - Phase to phase or phase to ground
 6. Overvoltage - 10% above input line or DC bus voltage
 7. Undervoltage - 10% below line voltage
 8. Power loss ride-through - 500mS
- G. When the inverter trips out on a fault, the fault relay shall activate and the display shall indicate the reason for the trip as follows:
1. Overcurrent
 2. Short circuit
 3. Overload
 4. Overvoltage
 5. Undervoltage
 6. Overheat
 7. Ground fault
 8. Motor stalled
 9. Power supply fault
- H. Auto restart shall occur when the inverter faults. Auto restart shall be adjustable up to 9 attempts with a 0.5 to 30 second interval. Auto restart will not be attempted for ground fault, output shorted, transistor shorted or internal microprocessor fault but will trip out immediately, activate the fault relay and make the appropriate indication on the display.
- I. In the event of a fault trip, the microprocessor shall save the status of the inverter at the time of the fault and make that information available on the digital display. Information regarding the last 4 faults is maintained in event of a power loss.
- J. Operational Functions:
1. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).
 2. Volts/Hertz patterns user selectable.
 3. Maximum and minimum frequency limit adjustments.
 4. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.
 5. 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.
 6. An overload reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.

2.14 Phase Monitor

- A. 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. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

2.15 Surge Protective Device

- A. All Control Panels shall have Surge Protective Devices installed immediately after the main overcurrent device or immediately after the supply conductors to the panel have been terminated. The Surge Protective Device(s) shall follow IEEE C62.41 recommendation for cascading to protect all voltage levels to and including 24 volts AC/DC and shall be as follows:
- B. Be UL 1449 3rd Edition Recognized for UL Type 2 applications except at 48 volts AC/DC and below may be UL 1449 3rd Edition for Type 3 applications.
- C. Provide suppression for both normal mode (L-N [Wye]) and common mode (L+N-G [Wye] or L-G [Delta]).
- D. Have a Surge Current Capacity (Imax) of at least 40kA.
- E. Have a Nominal Surge Current Rating (In) of 20kA.
- F. Have SCCRs of 200kA, except that 347Y/600V, 240/480V High leg Delta and 347V single-phase SPDs shall have a minimum SCCR of 125kA.
- G. Use MOV technology with thermal disconnect.
- H. Be RoHS compliant.
- I. SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.
- J. Hardwired Listed Type 1 or Type 2 Surge Protective Devices Shall:
 - 1. All Type 1 or Type 2 surge protective devices shall be manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical distribution system/ equipment protection. Surge protective devices shall be UL Listed with a Short-Circuit Current Rating of 200kA, Nominal Discharge Current (In) of 20kA, and Surge Current Capacity (Imax) of 120kA, 200kA, 300kA or 400kA. These SPDs shall be installed in accordance with the NEC® and/or local code requirements. The said manufacturer shall offer a minimum five (5) year warranty for its Type 1 and Type 2 surge protective devices.
 - 2. The hardwired surge protective device shall have specifications as shown below:
 - a) The Maximum Continuous Operating Voltage (MCOV) shall not exceed 25% on Wye and 40% on Delta systems of the nominal voltage (system voltage) in the configuration being used
 - b) Prewired NEMA 1 or NEMA 4X factory sealed enclosure suitable for the intended installation location
 - c) Shall have a two color LED status indicator per phase
 - d) Have an operating temperature range of at least -40°C to +50°C
 - e) Only use thermally protected MOV technology, such as Bussmann SurgePOD™.
 - 3. Surge Protective Device Agency Information: SPDs shall be "Listed" by Underwriters Laboratories, Inc. to UL 1449 3rd Edition as a Type 1 or Type 2 device and shall exhibit the UL Listing mark for the UL category VZCA for USA and/or VZCA2 for Canada; and must have CSA certification.
 - 4. Manufacturers must provide verification of performance data for UL and CSA standards.
 - 5. All SPDs must be RoHS compliant.
 - 6. Surge protective devices shall be installed and located in accordance with the all applicable agency, NEC® and local code requirements. The SPDs must be suitable for the particular installation, be it on the upstream side (Type 1) or downstream side (Type 1 or Type 2) of service entrance Overcurrent Protective Device (OCPD).
 - 7. All SPDs shall match voltage and system specific requirements as provided by the manufacturer.

8. All SPDs shall provide surge protection for both normal mode (L-N [Wye], L-L [Delta]) and common mode (L+N-G [Wye] or L-G [Delta]).
9. Surge protective device shall be clearly marked with specifications as required by UL 1449 3rd Edition along with UL holographic label on the SPD.
10. Each surge protective device should be serial numbered along with barcode for easy identification and traceability.

2.16 Pump Start Delay

- A. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

2.17 Control Circuit

- A. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
- B. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.
- C. Control logic shall be accomplished using a programmable controller.
- D. Electromechanical relays and timers shall be equipped with 120VAC coils and contacts rated Nema A-300 minimum. Timers shall be pneumatic or synchronous motor driven.
- E. Programmable controls shall operate on 120VAC power and be equipped with 120VAC inputs and hard contact outputs. Outputs shall have an inductive load rating equivalent to a size 4 contactor. Inputs shall incorporate a filter time delay and the overall controller noise immunity shall meet Nema standard ICS 2-230. The power supply to the programmable control shall include an active tracking filter protection system to minimize the effects of electrical noise.
- F. Operator interface equipment shall be provided to permit field adjustment of the programmable control timers and counters and shall be mounted on the control panel with other operator controls and displays.
- G. The program logic shall be stored in battery backed random access memory, as well as on a programmable, read only memory module. The memory module shall be included to facilitate field repair or replacement of the programmable control hardware.
- H. The O&M manual shall be provided with complete ladder logic program documentation including English names, rung comments, and coil/contact cross-references.
- I. The control shall be pre-programmed or wired to provide the following routines:
 1. Pump alternation at lead stop
 2. Excessive pump run time alternation (1-9999 minutes)
 3. Jump to idle pump/drive on lead failure
 4. Pump start delays after power restoration
 5. Flashing alarm/steady acknowledge on all alarm pilot lights
 6. Station trouble alarm (115vac and normally open dry contact)
 7. High and low level alarms
 8. Pump high temperature shutdown
 9. Motor high temperature
- J. The control system shall be equipped with the following dry contacts wired to the terminal blocks at minimum:
 1. Refer to specification Division 26 for all control system contacts required.

- K. Six digit elapsed time meter shall be displayed on the Integrinex™ Standard operator interface to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable and password protected.
- L. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to the Integrinex™ Standard. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the Integrinex™ Standard to interrupt power to the motor. The Integrinex™ Standard will display an alarm banner indicating the motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.
- M. Wiring
1. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.
 2. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).
 3. All user serviceable wiring shall be type MTW or THW, 600 volts, 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
 4. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
 5. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.
 6. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.
- N. Conduit
1. Factory installed conduit shall conform to following requirements:
 - a) All conduit and fittings to be UL listed.
 - b) Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.

- c) Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
- d) Conduit shall be sized according to the National electric Code.

O. Grounding

- 1. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.
- 2. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

P. Equipment Marking

- 1. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - a) Equipment serial number
 - b) Control panel short circuit rating
 - c) Supply voltage, phase and frequency
 - d) Current rating of the minimum main conductor
 - e) Electrical wiring diagram number
 - f) Motor horsepower and full load current
 - g) Motor overload heater element
 - h) Motor circuit breaker trip current rating
 - i) Name and location of equipment manufacturer
- 2. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
- 3. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.18 Primary Liquid Level Control System

- a. Refer to Division 26 for Specification Requirements.

- 2.17 An intrinsically safe repeater shall be supplied in the control enclosure. Repeater must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from repeater to feeder lines and motor controls. Installing contractor shall make connections from repeater to transducer.

2.19 Secondary Liquid Level Control System

- a. Refer to Division 26 for Specification Requirements.
- B. Float switches shall be supplied for installation by the contractor. Each float shall contain a non-mercury switch sealed in a polypropylene housing, with 30 feet of power cord, and polypropylene mounting hardware. A PVC or stainless steel mounting pipe shall be furnished by the contractor to secure the switches in the wet well.
- C. A junction box shall be supplied for installation in the wet well by the contractor. Junction box shall be NEMA 4X, non-corrosive type incorporating terminal blocks match-marked to terminals in the control panel.
- D. Intrinsically safe relays shall be supplied and must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from relays to

feeder lines and motor controls. Installing contractor shall make connections from relays to float switch junction box.

- E. Float switches, and intrinsically safe relays shall be used to alert maintenance personnel to a high water level in the wet well (low level float switch is optional). Should the wet well level rise to the "high water alarm" level, the float switch assembly and intrinsically safe relay shall energize the alarm signal. An indicator, visible from front of control panel, shall indicate high level condition exists. The alarm signal shall be maintained until wet well level is lowered and alarm circuit manually reset.
- F. An alarm silence switch and relay shall provide maintenance personnel a means to de-energize the external alarm device while corrective actions are under way. After silencing the alarm, manual reset of the alarm signal shall provide automatic reset of the alarm silence relay.

2.18 Alarm Light (External)

- 1. Station manufacturer will supply one 115 volt AC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.

2.19 MODULAR PUMP STATION ENCLOSURE

A. Enclosure Construction and Design:

- 1. The enclosure is to be square/rectangular with outside dimensions of 16' long by 11'-6" wide and having a maximum outside height of 9' at the roof peak.
- 2. A minimum of (4) four lifting eyes shall be provided to ease handling and installation onto a concrete pad furnished by the contractor.
- 3. Enclosure walls and roof shall be seamless, one-piece sprayed fiberglass panels laminated to form a structural composite as follows: 1/8" thick fiberglass outside surface, minimum 2" thick urea-foam polyurethane core, 7/16" oriented strand board (OSB), and 3/32" thick fiberglass inside surface. OSB shall replace foam at all cut-out openings and penetration points.
- 4. Each wall panel shall overlap at the corner and form an internal connection joint using stainless steel hardware. All panel joints shall be thoroughly sealed with silicone caulk. The enclosure shall have a minimum R-10 insulation factor and shall be capable of withstanding 140 mph wind loads.
- 5. All exterior surfaces shall be textured (green, tan, or gray colored) isophthalic gel coat finish incorporating ultra-violet inhibitors.
- 6. All interior surfaces shall be sprayed white isophthalic gel coat finish offering the same characteristics as the exterior surfaces.
- 7. The roof panel shall be a peaked, one-piece design incorporating the same materials of construction as the side walls. The roof shall be removable as a unit, allowing for complete access to the pumping equipment with a crane. The pitch of the roof shall be sufficient for good moisture drainage, and withstand a minimum snow load of 40 pounds per square foot.
- 8. After the pumping equipment is installed, the fully assembled station enclosure shall be positioned on the concrete mounting pad and sealed with butyl sealant tape as furnished by the pump station manufacturer. The interior base flange shall be drilled and fastened to the pad using expansion anchors on 24" maximum centers.

B. Enclosure Functional Equipment:

- 1. The interior of the station shall be illuminated by factory installed 120 volt LED light fixtures. All lights will be prewired and run to a load center through PVC conduit and a weatherproof switch shall be installed adjacent to each station entrance. The lighting circuit shall be protected by a thermal-magnetic circuit breaker.
- 2. A thermostatically controlled 120 VAC exhaust fan with screen and weatherproof shutters shall be installed in the wall approximately opposite the fresh air intake vent. The fan shall have a minimum capacity of 1600 CFM at free air and be capable of changing the air in the enclosure a minimum of six times per hour. The exhaust fan shall be protected by a thermal-magnetic circuit breaker.

3. The enclosure shall be equipped with a 5 kVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer.
4. A high capacity electric blower type station heater shall be provided for the protection of the pumping equipment. The heater shall maintain an inside/outside differential temperature of 60 degrees F while operating on the primary voltage supplied to the station. The heater shall be provided with an adjustable thermostat, circuit breaker, and contactor.
5. The pump station enclosure shall incorporate an optional insulation package which increases the standard R10 insulation rating to R20 by doubling the thickness of the urea-foam polyurethane core in the wall and roof panels.
6. The station enclosure shall be furnished with extra wide doors. A double hung door design with 3-point locking hardware, door holder, and hinges on each section shall allow complete access to the 6'-0" x 6'-8" full door opening without the need for a center sill.
7. The station enclosure shall be furnished with an overhead rolling hurricane style service door measuring 8'x8'. The door shall be sealed and gasketed for weather protection, and shall be capable of being internally padlocked. Door shall include overhead receiver and track hardware installed and shall be constructed with locking provisions. Door shall be capable of being electrically operated by one or more optional devices including a pushbutton and/or key pad. It will also include manual override in the event of a power outage.
8. A wall mounted duplex GFI utility receptacle providing 120 volt AC power shall be installed and prewired through PVC conduit with the station lighting. The receptacle shall be protected by thermal magnetic circuit breaker.
9. The station enclosure shall include limit switches with defeater switch alarm circuit and time delay, mounted and wired in the station enclosure to indicate that there has been a door left open or unauthorized entry to the station. There shall be an adjustable time period for the operator to disable alarm with an unmarked pushbutton located inside the station. The notification shall be activated when a station door is opened. Includes dry contacts pre-wired to a terminal strip for remote monitoring.

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. 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 station 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 station 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.

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.

B. Manufacturer's Start-up Services

1. Co-ordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. He will 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, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.

END OF SECTION

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