CONSULTING ENGINEERS

SET NO. _____

PROJECT MANUAL

BID SET

CITY OF GRAND JUNCTION

TIARA RADO FORCE MAIN

APRIL 2022

PROJECT MANUAL

BID SET

CITY OF GRAND JUNCTION

TIARA RADO FORCE MAIN

JVA, Inc.
817 Colorado Avenue, Suite 301
Glenwood Springs, CO 81601

JVA Job No. 1071.5e

April 2022

PROJECT MANUAL

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CITY OF GRAND JUNCTION
TIARA RADO FORCE MAIN

SECTION 01010

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F. Protection of public and private property

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1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work will include all necessary labor, supervision, equipment, tools, and materials to install approximately 4,800 lineal feet (LF) of 12-inch fusible HDPE force main, concrete encasement, a flowmeter, and associate manholes and vaults. The force main shall pass beneath Interstate 70 through existing box culverts and the Colorado River, which will require concrete encasement for approximately 2,000 LF of force main and will require the use coffer dams in the Colorado River channel for construction.

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 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 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 WORK BY OTHERS

A. Construct work to allow for work by others. Coordinate construction schedule with the Owner.

1.4 CONTRACTOR USE OF SITE AND PREMISES

A. Contractor shall limit use of the premises for Work and will use the designated staging area for field offices, equipment, and material storage. Areas have been designated on the Drawings 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 may use only those areas indicated on the Drawings for storage and such additional areas as Engineer may designate

E. Contractor should plan for normal workdays, Monday through Friday, within the hours of 7:00 am to 5:00 pm. Other work hours and days may be allowed by City and Engineer upon 48 hours written notice

1.5 OWNER USE OF SITE AND PREMISES

A. 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

B. Existing force main and lift station are to remain operational during construction. Access to the lift station shall be maintained at all times during construction.

1.6 WORK SEQUENCE AND WORK RESTRICTIONS

A. Existing lift station and force main shall remain in service until construction is complete and entire system (i.e., new Tiara Rado force main) is operational, has been tested, and has been accepted by the City and Engineer. Contractor shall expose lift station

connection to verify existing conditions and extent of concrete encasement. Contractor shall coordinate temporary shutdown of existing lift station, cutover and connection to new force main with the City and Engineer. Contractor shall conduct cutover during low flow periods to be approved by the City and Engineer. Contractor to provide all necessary personnel and equipment to perform cutover to new forcemain including vacuum/pumper trucks and temporary wastewater storage if deemed necessary.

B. Provide open and continuous access for City operations staff to the Tiara Rado lift station and other City 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 prepare a detailed work sequence and schedule for the connection to the existing lift station and cutover to the new force main. The work sequence and schedule shall be submitted to the City and Engineer for review and approval at the pre-construction meeting.

D. Contractor shall flush the existing force main after cutover to the new force main. Contractor to cap ends of existing force main after flushing is complete.

E. Contractor shall submit a detailed CPM format schedule outlining all steps required to assure complete and satisfactory construction, testing, and startup of work. Address all work sequence and constraints described in this Section.

F. Sequences other than those specified will be considered by Engineer, provided they afford equivalent continuity of operations.

G. Sewer service interruptions will not be permitted outside of business hours
   1. Schedule each outage with Engineer and Owner
      a. Number of outages to be kept to a minimum

H. All work within the Colorado River shall be completed between October 15, 2022, and February 28, 2023.

I. Work within the Colorado River shall be completed in accordance with United States Army Corps of Engineers (USACE) Nationwide Permit #58 (attached).

J. Work which impacts the active channel of the Colorado River shall not be permitted between March 1 and October 14 during any calendar year within the contract duration.

1.7 EASEMENTS AND RIGHT-OF-WAY

A. Work will be performed in the dedicated street Right-of-Way, Colorado Parks & Wildlife Access Agreements, CDOT Right-of-way, and on Owner's property.

B. 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 and existing vegetation.

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.

C. 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.

D. 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.

E. Within Street Right-of-Way and Access Agreements

1. Perform all work and conduct all operations of Contractor, his employees, and his subcontractors in accordance with the requirements of the City, CDOT, and Colorado Parks & Wildlife (CPW).

1.8 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.

1.9 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.

1.10 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 Colorado Department of Transportation (CDOT) 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.

1.11 BARRICADES AND LIGHTS

A. Protect streets, roads, highways, and other public thorough fares 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

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 Mesa County, and/or CDOT

1.12 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 tools, 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

1.13 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 of Grand Junction and Mesa 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 USACE Nationwide Permit No. #58 and CDOT Utility Permit, attached.

1.14 CUTTING AND PATCHING

A. Contractor shall be responsible for all cutting, and patching, including attendant excavation and backfill, required to complete the Work or to
   1. Uncover portions of the Work to provide for installation of ill-timed work
   2. Remove and replace defective work
   3. Remove and replace work not conforming to requirements of Contract Documents
   4. Remove samples of installed work as specified for testing

B. Provide products as specified or as required to complete cutting and patching operations

C. Inspection
   1. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching
   2. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work
   3. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with the work until the Engineer has provided further instructions

D. Preparation
   1. Provide devices and methods to protect other portions of the Project from damage
   2. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water
   3. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes
   4. Restore work which has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01020

GEOTECHNICAL REPORT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reports of explorations and tests of subsurface conditions at the project site.

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 02300 – Earthwork

1.3 INVESTIGATION

A. Soil and subsurface investigations were conducted at the site, the results of which are to be found in the following reports:
   1. *Geologic Hazards and Geotechnical Investigation, Persigo Wastewater Treatment Plant Outfall* issued by Huddleston-Berry Engineering & Testing, LLC, October 10, 2017
      a. The 2017 Huddleston-Berry report is available by request from the Engineer.
   2. *Geotechnical Investigation Report, Tiara Rado Force Main Project, Persigo WWTF, Grand Junction, Colorado* issued by Rocksol Consulting Group, January 25, 2021.
      a. A reference copy of the report is included herein, Supplement A (01020)

B. Bidders are expected to examine soils investigation data and to make their own investigation of the site on or prior to the bid date.

1.4 INTERPRETATION

A. Soil investigation data is provided only for information and the convenience of bidders. Owner and Engineer disclaim any responsibility for the accuracy, true location, and extent of the soils investigation that has been prepared by others. They further disclaim responsibility for interpretations of that data by bidders, as in projecting soil-bearing values, rock profiles, soil stability and the presence, and level and extent of underground water.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

Geotechnical Investigation Report
Tiara Rado Force Main Project
Persigo WWTF
Grand Junction, Colorado

Prepared for:

City of Grand Junction
333 West Avenue, Building C
Grand Junction, Colorado 81501

Attention: Mr. Lee Cooper, PE

January 25, 2021

Prepared by:

RockSol Consulting Group, Inc.
566 W Crete Circle, Unit 2
Grand Junction, Colorado 81505
(970)-822-4350

RockSol Project No. 599.22

Geotechnical Investigation Report
Tiara Rado Force Main Project
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RockSol Project No. 599.22

COLORADO REGISTERED
DONALD GORDON HUNT
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PROFESSIONAL ENGINEER

Jacob O'Banion
Civil Engineering Associate

Donald G. Hunt, PE
Senior Geotechnical Engineer

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ATTACHMENTS

1.0 PROJECT PURPOSE AND DESCRIPTION

This report documents the Geotechnical investigation performed by RockSol Consulting Group, Inc. (RockSol) to assist with the design of the Tiara Rado Force Main Project in Grand Junction, Colorado. The proposed force main alignment extends from the Persigo Wastewater Treatment Facility (WWTF), south across Interstate 70 (I-70) and the Colorado River, to the existing Lift Station. The geotechnical investigation program was conducted to obtain information on the subsurface soil, groundwater if encountered, and bedrock conditions for the proposed sewer line installation.

The scope of work for this geotechnical investigation included:

- Preparing a drilling/sampling program to perform a subsurface investigation and implementing the program to collect soil samples for laboratory testing.
- Performing laboratory tests and analyzing the data.
- Preparing a geotechnical report presenting the field and laboratory data obtained, geological conditions, and geotechnical recommendations for the proposed sewer line excavation and backfill.

2.0 PROJECT SITE CONDITIONS

The Persigo WWTF is located just north of I–70 and north of the Colorado River at Persigo Wash (See Image 1). The Colorado River flows northwest followed by trailheads and residential neighborhoods to the south. To the north of the Colorado River are commercial and industrial businesses intertwined with I-70 and River Road which runs east to west adjacent to Persigo WWTF. The Force Main sewer line will be tied in at the existing lift station located approximately 300 feet down a dirt road connected to a residential neighborhood and approximately 500 feet south of the Colorado River. The Force Main alignment will cross the Colorado River and tie in at the northeastern most part of Persigo WWTF.

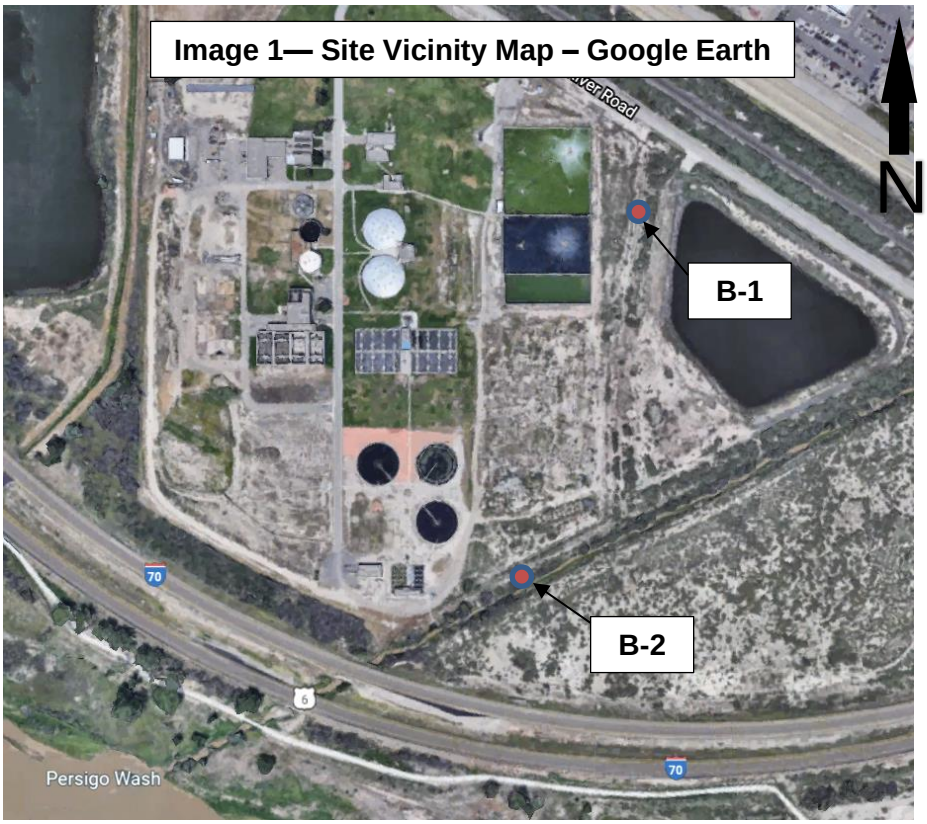


Image 1— Site Vicinity Map – Google Earth

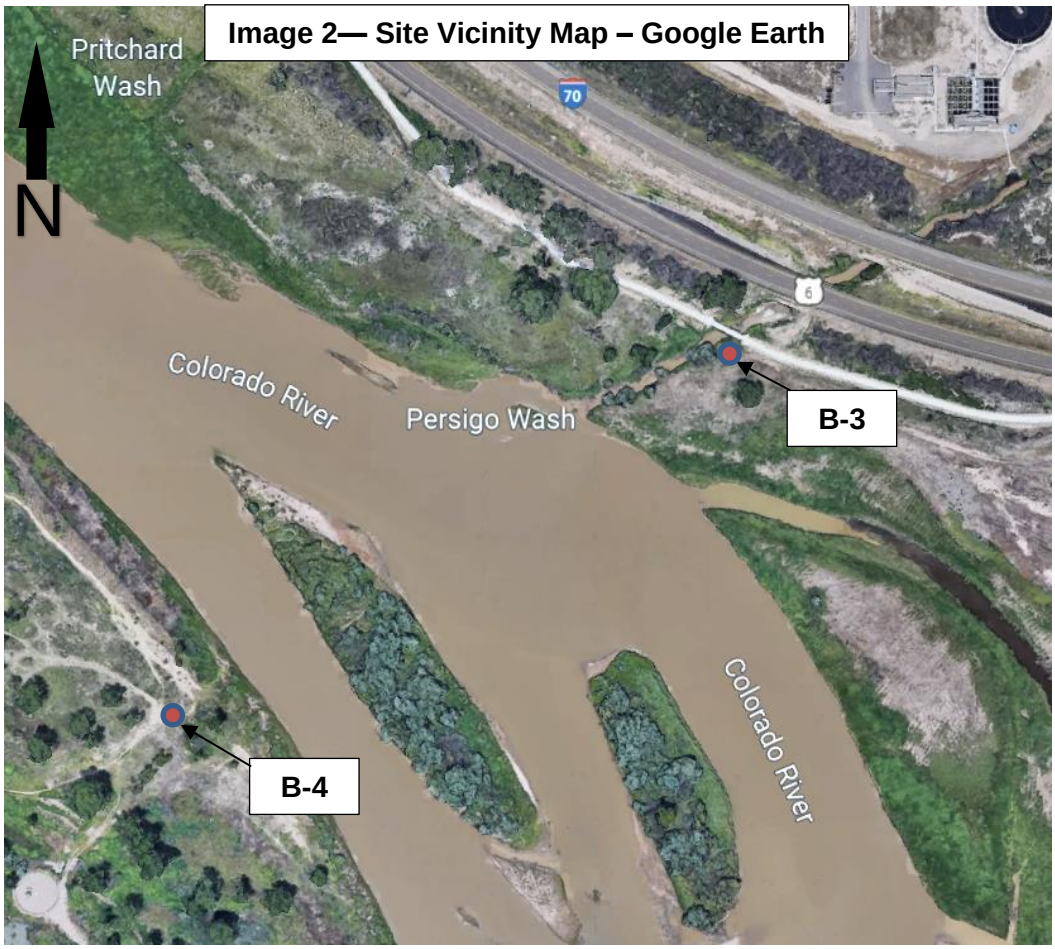
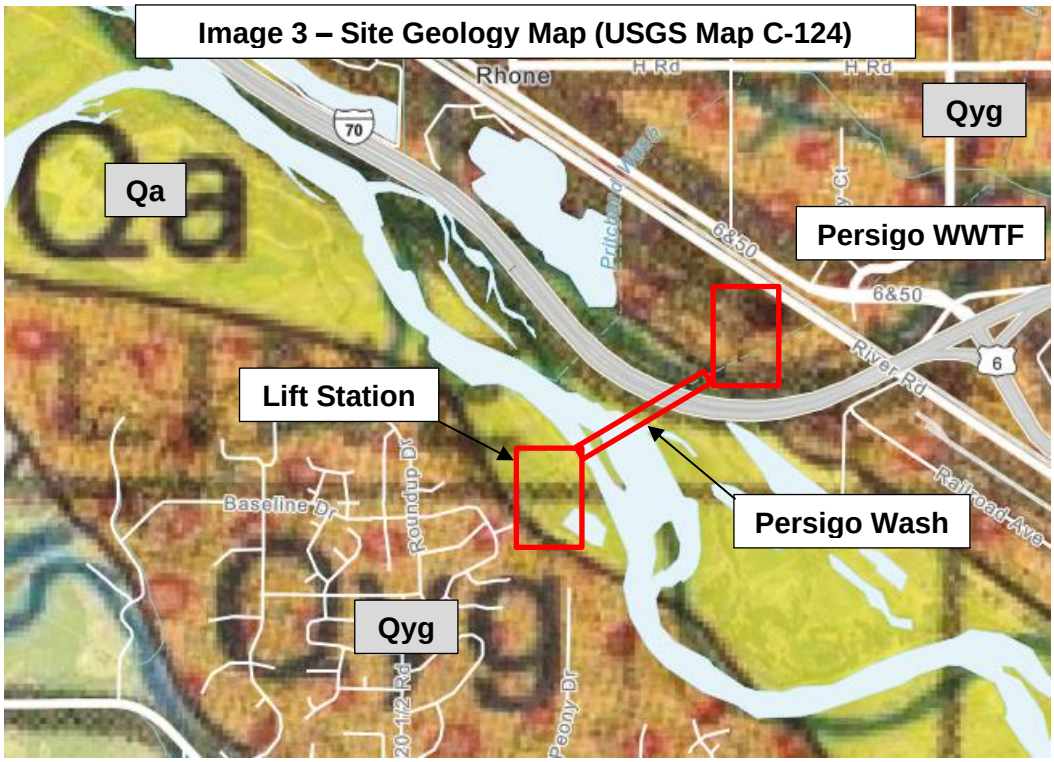


Image 2— Site Vicinity Map – Google Earth

3.0 GEOLOGICAL SETTING

Geologic information about the project site and site vicinity is presented in the United States Geological Survey (USGS) *Geologic Map and Cross Sections of Parts of the Grand Junction and Delta 30' x 60' Quadrangles, West-Central Colorado (USGS Coal Investigations Map C-124)* by Margaret S. Elis and Virginia Gabaldo, dated 1989 (See Image 3, Site Geology Map).

Based on the USGS map, alluvium and colluvium, undivided, (Holocene and late Pleistocene) (Qa) is mapped at the project site. Alluvium generally consists of silt, sand and gravels and the colluvium generally consists of sandy silt, silty to clayey sand, and sandy clay. The materials identified by the USGS mapping was consistent with native soils encountered during our geotechnical investigation of Boreholes B-3 and B-4. Based on the USGS map, the site which from Boreholes B-1 and B-2 were sampled is characterized as a young gravel (Late Pleistocene) (Qyg). Young Gravel usually consists of well-sorted pebbles, cobbles, and boulders within a sandy matrix. Samples obtained from Boreholes B-1 and B-2 more closely resemble the characterization of the alluvium and colluvium (Qa) material described as sandy silt, silty to clayey sand, and sandy clay with gravels and cobbles in parts from the Young Gravel (Qyg).



4.0 SUBSURFACE EXPLORATION

For this investigation, RockSol completed 4 boreholes identified as B-1 through B-4 (See Images 1 and 2 and Appendix A).

Boreholes B-1 and B-2 extended to approximate depths of 10 feet for characterization of subsurface conditions, including groundwater depths/elevations, to assist with trench excavation considerations. Borehole B-1 was drilled approximately 10 feet west of the eastern most fence at Persigo WWTF and approximately 200 feet south of River Road. Borehole B-2 was drilled approximately 10 feet north of southern most fence and approximately 150 feet southeast of southern most secondary clarifier (see Image 1).

Boreholes B-3 and B-4 extended to approximate depths of 19 to 21 feet for characterization of subsurface conditions, including groundwater depths/elevations and bedrock depth/elevations to assist with the proposed force main installation operations. Borehole B-3 was drilled approximately 200 feet northeast of Colorado River and approximately 10 feet southeast of the Persigo Wash. Borehole B-4 was drilled approximately 160 feet southwest of Colorado River and approximately 400 feet northeast of lift station (see Image 2).

The general locations of the geotechnical investigation boreholes are summarized in Table 1. The boreholes were drilled between January 4, 2021 and January 5, 2021. The boreholes were surveyed after drilling operations were completed by the City of Grand Junction and the survey information (surface elevations, northing, easting) was provided to RockSol.

Table 1- Borehole Location Summary

Borehole ID	Borehole Location	Location
B-1	South of River Road	West of Eastern Most Property Fence
B-2	Southeast of Secondary Clarifier	North of Southern Most Property Fence
B-3	Southeast of Persigo Wash	Northeast of Colorado River
B-4	Southwest of Colorado River	Northeast of Lift Station

Boreholes were advanced with a CME 55 track mounted drill rig using 5.25-inch outside diameter Odex bit for Boreholes B-3 and B-4 and an 8-inch outside diameter hollow stem auger for Boreholes B-1 and B-2. The boreholes were logged in the field by a representative of RockSol with the depth to groundwater, if encountered, noted at the time of drilling. The boreholes were backfilled at the completion of drilling.

Subsurface materials were sampled and resistance of the soil to penetration of the sampler was performed using modified California barrel and standard split spoon samplers. Penetration Tests were performed using an automatic lift system and a hammer weighing 140 pounds falling 30 inches. The modified California barrel sampler has an outside diameter of approximately 2.5 inches and an inside diameter of 2 inches. The standard split spoon sampler used had an outside diameter of 2 inches and an inside diameter of 1⅜-inches. Brass tube liners were used with the modified California barrel sampler. Brass tube liners are not used with the standard split spoon sampler.

The standard split spoon sampling method is the Standard Penetration Test (SPT) described by ASTM Method D-1586.

The modified California Barrel sampling method is similar to the SPT test with the difference being the sampler dimensions and the number of 6-inch intervals driven with the hammer per ASTM D3550. It is RockSol's experience that blow counts obtained with the modified California sampler tend to be slightly greater than a standard split spoon sampler.

Penetration resistance values (blow counts) were recorded for each sampling event. Blow counts, when properly evaluated, indicate the relative density or consistency of the soils. Depths at which the samples were taken, the type of sampler used, and the blow counts that were obtained are shown on the Borehole Logs (See Appendix B).

5.0 SITE SOIL AND BEDROCK CHARACTERIZATION

5.1 Surficial Materials

Surficial soils at boring locations generally consist of a relatively thin cover of moist, brown, silty sand topsoil, approximately 3 inches in thickness and ranging from supporting a moderate cover of vegetation.

5.2 Subsurface Materials

Subsurface materials encountered at Boreholes B-1 and B-2 consisted of medium stiff to very stiff sandy clay with gravel and cobbles in parts. Subsurface materials encountered at Boreholes B-3 and B-4 consisted of loose to very dense slightly silty to gravelly sand with sandy clay lenses and cobbles in parts. The cobbles ranged in size from 4-inches to 12-inches in diameter and were encountered within the overburden soils from depths ranging from 1-foot to 15-feet below

existing grades. Drilling conditions indicated the cobbles were interbedded within the fine to coarse grained sand soils and did not appear to be uniformly stacked in a single layer.

5.3 Sedimentary Bedrock

Sedimentary bedrock was not encountered to the depths drilled at Boreholes B-1 and B-2. Sedimentary bedrock was encountered at borehole locations B-3 and B-4 depths of 15 feet below existing grades. Bedrock encountered consisted of very hard, dark gray, moist claystone and shale. See Table 2, *Approximate Bedrock Depth and Elevation* for approximate depths and elevations to bedrock.

Table 2 – Approximate Bedrock Depth and Elevation

Borehole I.D.	Ground Surface Elevation (Feet)	Borehole Depth (Feet)	Bedrock Depth (Feet)	Bedrock Elevation (Feet)
B-1	4,520.0	10.0	Not Encountered	Not Encountered
B-2	4,519.3	10.0	Not Encountered	Not Encountered
B-3	4,512.2	19.0	15.0	4,497.2
B-4	4,512.3	20.6	15.0	4,497.3

5.4 Groundwater

Groundwater was encountered during drilling/sampling activities at Boreholes B-1, B-3, and B-4 at approximate depths ranging from 6 feet to 9 feet below existing grade at the time of drilling operations. See Table 3, *Approximate Groundwater Depths and Elevations* for approximate depths and elevations to groundwater, where encountered.

Table 3 – Approximate Groundwater Depths and Elevations

Borehole I.D.	Ground Surface Elevation (Feet)	Borehole Depth (Feet)	Groundwater Depth (Feet)	Groundwater Elevation (Feet)
B-1	4,520.0	10.0	9.0	4,511.0
B-2	4,519.3	10.0	Not Encountered	Not Encountered
B-3	4,512.2	19.0	6.0	4,506.2
B-4	4,512.3	20.6	7.0	4,505.3

NE = Not Encountered to the depth drilled

Groundwater elevations are subject to change depending on climatic conditions, Colorado River flow stages, local irrigation practices, changes in local topography, and changes in surface storm water management. Long-term monitoring of groundwater elevations is required to establish groundwater fluctuations.

6.0 LABORATORY TESTING SUMMARY

Soil samples retrieved from bore hole locations were examined by the project geotechnical engineer in the RockSol laboratory. Selected samples were tested and classified according to the Unified Soil Classification System (USCS). The following laboratory tests were performed in accordance with the American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), and current local practices:

- Percent Passing No. 200 Sieve (ASTM D-1140)
- Liquid and Plastic Limits (ASTM D-4318)
- Soil Classification (ASTM D-2487, ASTM D-2488, and AASHTO M145)
- Gradation (ASTM D6913)

- Water-Soluble Sulfates (CDOT CP-L 2103)
- Water-Soluble Chloride Content (AASHTO T291-91)
- Standard Test Method for pH of Soils (ASTM D4972-01)
- Soil Resistivity (ASTM G187 - Soil Box)

Laboratory test results were used to characterize the engineering properties of the subsurface material. For soil classification, RockSol conducted sieve analyses and Atterberg Limits tests. All laboratory tests were performed by RockSol. Laboratory test results are presented in Appendix C. Please note that soil gradation curves are approximate and do not reflect all oversized material excavated and present in the site soil stratigraphy.

7.0 SUBSURFACE CHARACTERIZATION

Laboratory test results were used to characterize the engineering properties of the subsurface material encountered. For soil classification, RockSol conducted sieve analyses and Atterberg Limits tests. Lab testing was also performed on selected samples to determine the water-soluble sulfate content of subsurface materials to assist with cement type recommendations. A summary of the physical and chemical test results is included in Appendix C.

7.1 Subsurface Soil Classification

Subsurface bulk samples and split spoon samples were obtained at various depths from each borehole location and were tested for AASHTO and USCS soil classification. The subsurface soils tested varied between A-1 and A-47 AASHTO soil types. A summary of the subsurface soil classifications is presented in Table 4.

Table 4 – Subgrade Soil Classifications

Borehole Location	Depth (feet)	AASHTO Classification	USCS Classification
B-1	0-10	A-6 (9)	CL
B-2	0-13	A-7-6 (25)	CL
B-3	17	A-3 (0)	SP
B-4	12	A-1-a (0)	GP-GM

7.2 Water-Soluble Sulfate Content

Cementitious material requirements for concrete in contact with site soils or groundwater is typically based on the percentage of water-soluble sulfate. Mix design requirements for concrete exposed to water-soluble sulfates in soils or water is considered by CDOT as shown in Table 5a and in the CDOT Standard Specifications for Road and Bridge Construction, dated 2019. Water-soluble Sulfate Testing Results are summarized in Table 5b.

Table 5a – Requirements to Protect Against Damage to Concrete by Sulfate Attack from External Sources of Sulfate

Severity of Sulfate Exposure	Water-Soluble Sulfate (SO_4), in dry soil, percent	Sulfate (SO_4), in water, ppm	Water Cementitious Ratio, Maximum	Cementitious Material Requirements
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1,500	0.45	Class 1
Class 2	0.21 to 2.0	1,501 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Table 5b – Water-Soluble Sulfate Testing Summary

Borehole I.D.	Sample Depth (Feet)	Water-Soluble Sulfate (SO_4) in dry soil, percent	Cementitious Material Requirements
B-1	0-10	2.07	Class 3
B-4	17	0.06	Class 0

The concentration of water-soluble sulfates measured in soil samples obtained from RockSol's exploratory boreholes ranged from 0.06 percent to 2.07 percent by weight. The test results indicate a wide range of risk of sulfate attack with the soils on the north side of the Colorado River exhibiting the highest risk. With concrete encasement of the sewer line proposed within the limits of the Colorado River, RockSol recommends all concrete placed for this project be constructed with cement meeting the requirements for CDOT Exposure Class 3 as presented in Section 601.04 of the 2019 CDOT Standard Specifications for Road and Bridge Construction.

8.0 TRENCH EXCAVATION DISCUSSION

Based on information provided to RockSol by the City (60% Review Set for Tiara Rado Force Main, dated October 2020, by JVA), a minimum of 5 feet of riverbed materials/soils is required over the proposed 12-inch HDPE sewer line after placement of the line to provide protection to the pipe from scour. The JVA plan set is included in Appendix D for reference. In addition, within the limits of the Colorado River, the sewer line will be encased in concrete. RockSol also understands that a phased trenching operation using cofferdams will be used to excavate the trench and install the sewer line.

Based on the subsurface conditions encountered in Boreholes B-3 and B-4, claystone and shale bedrock materials were encountered at an approximate elevation of 4,497 feet. Based on the 60% Plan Set the bottom of the Sewer Line at the south side of the Colorado River (River) is set at an elevation of approximately 4,492 feet and on the north side of the River at 4,498 feet. Based on those elevations of the Bedrock surface, excavations into bedrock will be required for the majority of the alignment within the limits of the River. Excavations on the order of 5 feet will be required on the southern portion of the alignment with decreasing depth of excavation into Bedrock approaching the north side of the River. It should be noted that the top of bedrock surface appears to be relatively uniform along the sewer line alignment within the limits of the Colorado River. Variations in the top of bedrock elevation may be encountered, with lower elevations more likely than higher elevations.

Excavation into this claystone and shale bedrock material can be difficult and will likely require heavy duty or specialized backhoe equipment, and rates of production will likely be reduced compared to typical overburden soils. A Pay Item for Rock Excavation might be considered to differentiate this depth of excavation into the bedrock material.

Proper construction practices and adherence to project plans and specifications should be followed during site preparation, earthwork, excavations, and construction of utilities, roadway surfacing, and structures for the suitable long-term performance of the proposed improvements. Excavation support should be provided to maintain onsite safety and the stability of excavations and slopes. Excavations shall be constructed in accordance with local, state, and federal regulations including OSHA guidelines. The contractor must provide a competent person to determine compliance with OSHA excavation requirements. For preliminary planning, native soils may be considered as OSHA Type C soils and the claystone bedrock/shale may be considered as OSHA Type B soil.

9.0 TRENCH BACKFILL DISCUSSION

All embankment placement, subgrade preparation, and backfill placement shall be performed in accordance with City of Grand Junction's *Standard Contract Documents for Capital Improvements Construction,* Revised July 2010, or if more stringent, as specified by recommendations in this report.

9.1 Trench Foundation Preparation

Prior to pipeline construction, the excavation limits should be properly prepared by removal of all organic matter (topsoil), debris, loose material, and any deleterious material identified by the Project Engineer. The bottom of the trench should be prepared as a firm and uniform foundation.

9.2 Backfill Specifications

Backfill placement shall be performed in accordance with City of Grand Junction requirements. Sufficient bedding under the pipe and cover over the pipe should be used to prevent point-loading on the HDPE pipeline from the trench foundation and overlying backfill material, if excavated (native) material is allowed for backfill material after cover over the pipeline is established. To achieve proper compaction of the excavated material significant moisture conditioning is anticipated and oversized material (greater than 6-inch diameter) may need to be segregated and not allowed to be placed in the backfill zone directly above the pipe.

9.3 Compaction Specifications

The minimum compaction recommended by RockSol for this project are summarized in Table 6 and are based on requirements outlined in Section 103.14 of City of Grand Junction's *Standard Specifications for Construction of Underground Utilities.*

Table 6 – Compaction Specifications

Type of Material	Relative Compaction Percent of Maximum	Moisture Content Deviation from Optimum
All Backfill Material	95% Min. AASHTO T-99 (Standard Proctor Method)	-2% to +2%
All Backfill Material	90% Min. AASHTO T-180 (Modified Proctor Method)	-2% to +2%

A representative of the geotechnical engineer or the City should observe and test fill placement operations.

10.0 LIMITATIONS

This geotechnical investigation was conducted in general accordance with the scope of work to provide geotechnical support for construction of the Tiara Rado Force Main Project for the City of Grand Junction

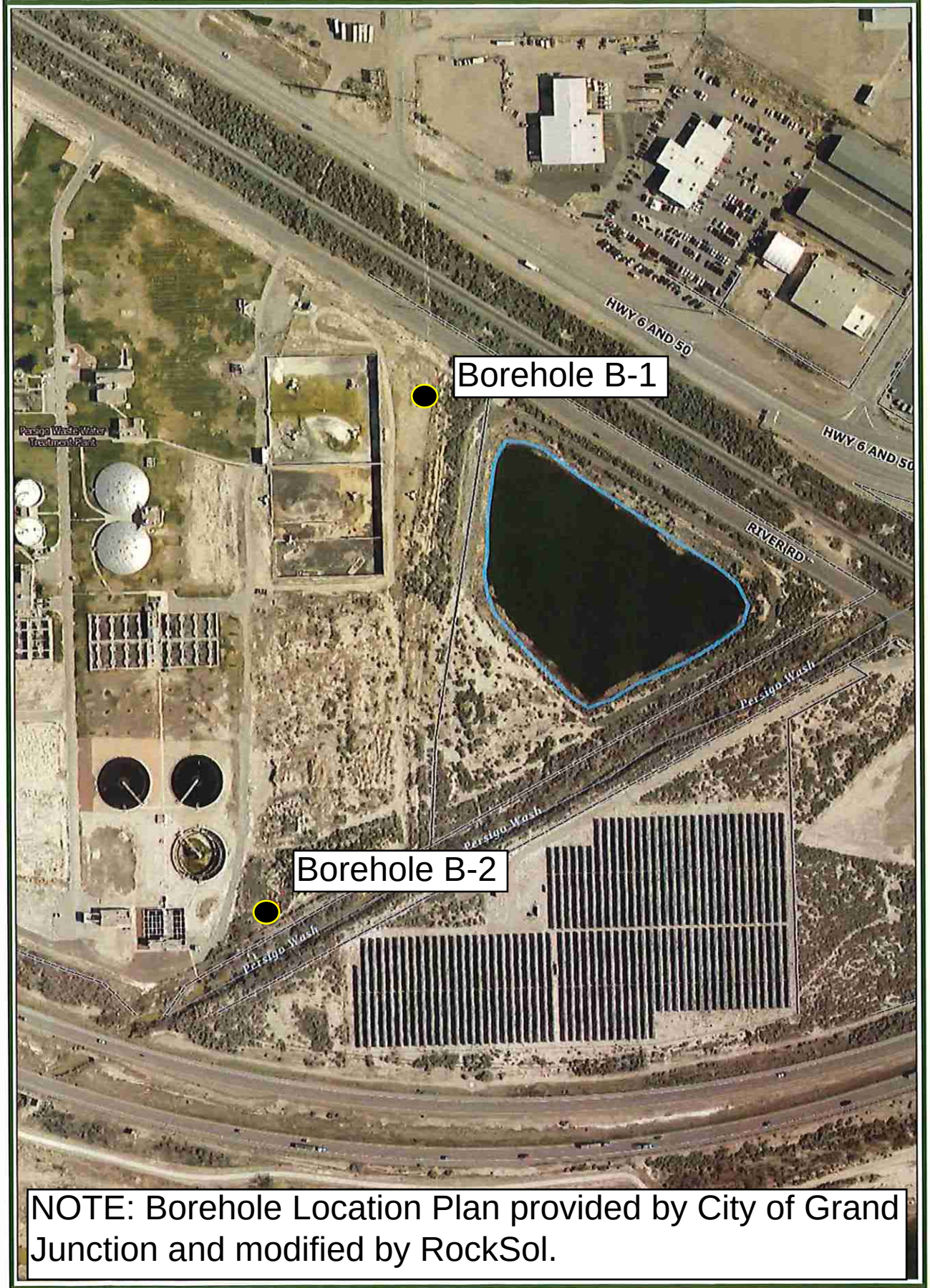
Surface and groundwater hydrology, hydraulic engineering, and environmental studies including contaminant characterization were not included in RockSol's geotechnical scope of work.

The geotechnical practices are similar to that used in Colorado with similar soil conditions and our understanding of the proposed work. This report has been prepared by RockSol for the City of Grand Junction exclusively for the project described in this report. The report is based on our exploratory boreholes and does not take into account variations in the subsurface conditions that may exist between boreholes. Additional investigation is required to address such variation. If during construction activities, materials or water conditions appear to be different from those described herein, RockSol should be advised at once so that a re-evaluation of the recommendations presented in this report can be made. RockSol is not responsible for liability associated with interpretation of subsurface data by others

APPENDIX A

BOREHOLE LOCATION PLANS
(PROVIDED BY THE CITY OF GRAND JUNCTION)

Persigo WWTP - Tiara Rado Borehole Locations



NOTE: Borehole Location Plan provided by City of Grand Junction and modified by RockSol.

N

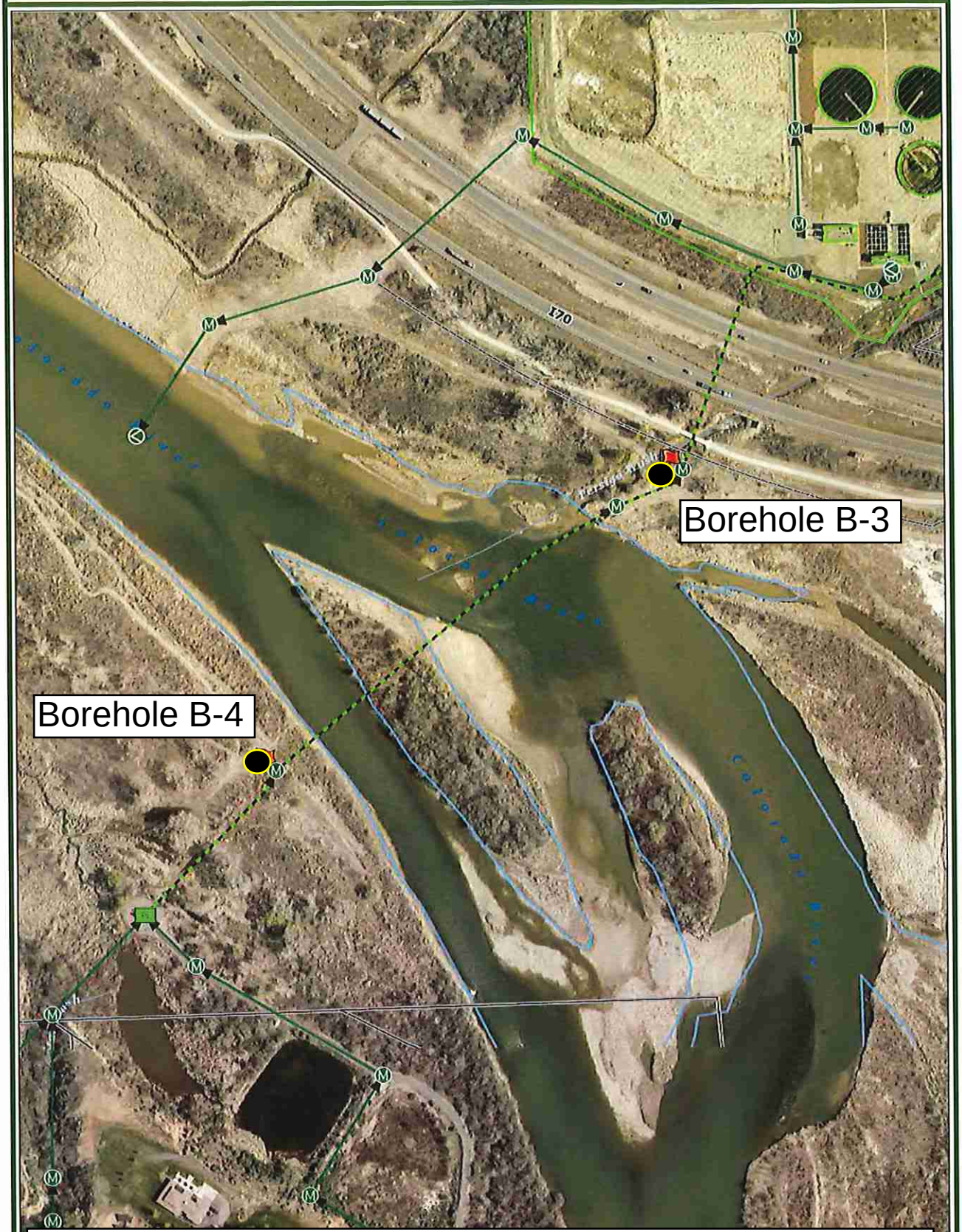
0 0.075 0.15 mi

1 inch = 188 feet

Date: 12/11/2020

CITY OF Grand Junction COLORADO
GEOGRAPHIC INFORMATION SYSTEM

Colorado River Area - Tiara Rado Borehole Locations



NOTE: Borehole Location Plan provided by City of Grand Junction and modified by RockSol.

N

0 0.075 0.15 mi

Date: 12/11/2020

1 inch = 188 feet

CITY OF Grand Junction COLORADO GEOGRAPHIC INFORMATION SYSTEM

APPENDIX B

LEGEND
AND
INDIVIDUAL BOREHOLE LOGS

LEGEND

RockSol Consulting Group, Inc.

CLIENT City of Grand Junction **PROJECT NAME** Tiara Rado Force Main, Persigo WWTF to Tiara Rado Lift Station

PROJECT NUMBER 599.22 **PROJECT LOCATION** Grand Junction, Colorado

LITHOLOGY

- TOPSOIL
- Native - CLAY, trace sand
- Bedrock - SHALE
- Native - SAND, silty with gravel and cobbles
- Bedrock - CLAYSTONE

SAMPLE TYPE

- Auger Cuttings
- MODIFIED CALIFORNIA SAMPLER 2.5" O.D. AND 2" I.D. WITH BRASS LINERS INCLUDED
- SPLIT SPOON SAMPLER 2" O.D. AND 1 3/8" I.D. NO LINERS

Fines Content indicates amount of material, by weight, passing the US No 200 Sieve (%)

15/12 Indicates 15 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 12 inches.

50/11 Indicates 50 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 11 inches.

5,5,5 Indicates 5 blows, 5 blows, 5 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 18 inches.

GROUND WATER LEVEL AT TIME OF DRILLING

RockSol Consulting Group, Inc.

BORING : B-1

CLIENT City of Grand Junction **PROJECT NAME** Tiara Rado Force Main, Persigo WWTF to Tiara Rado Lift Station

PROJECT NUMBER 599.22 **PROJECT LOCATION** Grand Junction, Colorado

DATE STARTED 1/4/21 **COMPLETED** 1/5/21 **GROUND ELEVATION** 4520.0 ft **STATION NO.**

DRILLING CONTRACTOR DA Smith Drilling **NORTH** 65721.2 **EAST** 52642.5

DRILLING METHOD Hollow Stem Auger **HOLE SIZE** 8.0" **BORING LOCATION:** 10' off N part of eastern most fence

LOGGED BY J. Obanion **HAMMER TYPE** Automatic **GROUND WATER LEVELS:**

NOTES **WATER DEPTH** 9.0 ft on 1/4/21

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
4520.0	0.0		(Native) CLAY, trace sand and gravel, slightly moist, brown to brownish red, medium stiff to stiff, calcareous in parts, cobbles noted at 9.5'	BULK			2.07			29	18	11	91.2
			Approximate Bulk Depth 0-10 Liquid Limit= 29 Plastic Limit= 18 Plasticity Index= 11 Fines Content= 91.2 Sulfate= 2.07										
4517.5	2.5			MC	15/12			105.2	20.0				
			(Native) CLAY, trace sand and gravel, moist, brown to brownish red, medium stiff to stiff, calcareous in parts, cobbles noted at 9.5'										
4515.0	5.0			MC	4/12			101.2	22.7				
			(Native) CLAY, trace sand and gravel, wet, brown to brownish red, medium stiff to stiff, calcareous in parts, cobbles noted at 9.5'										
4512.5	7.5												
4510.0	10.0			MC	31/12								
			Bottom of hole at 10.0 feet.										

LOG - STANDARD 599.22_TIARA RADO FORCE MAIN_GRAND JUNCTION.GPJ 1/25/21

RockSol Consulting Group, Inc.

BORING : B-2

CLIENT City of Grand Junction **PROJECT NAME** Tiara Rado Force Main, Persigo WWTF to Tiara Rado Lift Station

PROJECT NUMBER 599.22 **PROJECT LOCATION** Grand Junction, Colorado

DATE STARTED 1/4/21 **COMPLETED** 1/5/21 **GROUND ELEVATION** 4519.3 ft **STATION NO.**

DRILLING CONTRACTOR DA Smith Drilling **NORTH** 65340.4 **EAST** 51605.9

DRILLING METHOD Hollow Stem Auger **HOLE SIZE** 8.0" **BORING LOCATION:** E of circular treatment tanks

LOGGED BY J. Obanion **HAMMER TYPE** Automatic **GROUND WATER LEVELS:**

NOTES **WATER DEPTH** None Encountered on 1/4/21

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
4519.3	0.0		(Native) CLAY, trace sand, dry to moist, brown to gray, very stiff, calcareous in parts	BULK						44	20	24	95.9
			Approximate Bulk Depth 0-13 Liquid Limit= 44 Plastic Limit= 20 Plasticity Index= 24 Fines Content= 96.9										
4516.8	2.5			MC	33/12								
4514.3	5.0			MC	29/12								
4511.8	7.5		(Native) CLAY, trace sand, medium stiff										
4509.3	10.0			MC	6/12								
			Bottom of hole at 10.0 feet.										

LOG - STANDARD 599.22_TIARA RADO FORCE MAIN_GRAND JUNCTION.GPJ 1/25/21

RockSol Consulting Group, Inc.

BORING : B-3

CLIENT City of Grand Junction **PROJECT NAME** Tiara Rado Force Main, Persigo WWTF to Tiara Rado Lift Station

PROJECT NUMBER 599.22 **PROJECT LOCATION** Grand Junction, Colorado

DATE STARTED 1/4/21 **COMPLETED** 1/5/21 **GROUND ELEVATION** 4512.2 ft **STATION NO.**

DRILLING CONTRACTOR DA Smith Drilling **NORTH** 64622.0 **EAST** 51132.0

DRILLING METHOD Odex **HOLE SIZE** 5.75 **BORING LOCATION:** N of river

LOGGED BY J. Obanion **HAMMER TYPE** Automatic **GROUND WATER LEVELS:**

NOTES 5.0" ID, CME 55 **WATER DEPTH** 6.0 ft on 1/4/21

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
4512.2	0		(Topsoil) SAND, silty, moist, brown, approximately 3 inches thick	BULK									
			(Native) SAND, slightly silty to gravelly with cobbles, moist, brown										
4507.2	5		(Native) SAND, silty to sandy CLAY in parts, wet, brownish gray, loose	SS	2/2/2								
4502.2	10		(Native) SAND, slightly silty to gravelly with sandy CLAY lenses, wet, brownish gray, very dense	SS	29/28/27					NP	NP	NP	2.6
4497.2	15		(Bedrock) CLAYSTONE, slightly silty, moist, gray, very hard	BULK SS	83/8.5								
			Bottom of hole at 19.0 feet.										

RockSol Consulting Group, Inc.

BORING : B-4

CLIENT City of Grand Junction **PROJECT NAME** Tiara Rado Force Main, Persigo WWTF to Tiara Rado Lift Station

PROJECT NUMBER 599.22 **PROJECT LOCATION** Grand Junction, Colorado

DATE STARTED 1/4/21 **COMPLETED** 1/5/21 **GROUND ELEVATION** 4512.3 ft **STATION NO.**

DRILLING CONTRACTOR DA Smith Drilling **NORTH** 63761.3 **EAST** 50543.2

DRILLING METHOD Odex **HOLE SIZE** 5.75 **BORING LOCATION:** S of river near wildlife sign

LOGGED BY J. Obanion **HAMMER TYPE** Automatic **GROUND WATER LEVELS:**

NOTES **WATER DEPTH** 7.0 ft on 1/4/21

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SULFATE (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
4512.3	0	(Topsoil) SAND, silty, approximately 3 inches thick	BULK						
		(Native) SAND, silty to gravelly with cobbles, moist, brownish gray, medium dense to dense	BULK						
4507.3	5								
		(Native) SAND, silty to gravelly with cobbles, wet, brownish gray, medium dense to dense	BULK						
			SS	13/15/16		NP	NP	NP	6.0
4502.3	10	(Native) SAND, silty, very dense							
			SS	25/29/32					
4497.3	15	(Bedrock) SHALE, slightly moist, dark gray to black, very hard							
			SS	50/5	0.06				84.8
		(Bedrock) CLAYSTONE, slightly moist, gray to dark brown, very hard							
4492.3	20		SS	50/7					
		Bottom of hole at 20.6 feet.							

LOG - STANDARD 599.22_TIARA RADO FORCE MAIN_GRAND JUNCTION.GPJ 1/25/21

APPENDIX C

SUMMARY OF LABORATORY TEST RESULTS

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT City of Grand Junction

PROJECT NAME Tiara Rado Force Main, Persigo WWTF to Tiara Rado Lift Station

PROJECT NUMBER 599.22

PROJECT LOCATION Grand Junction, Colorado

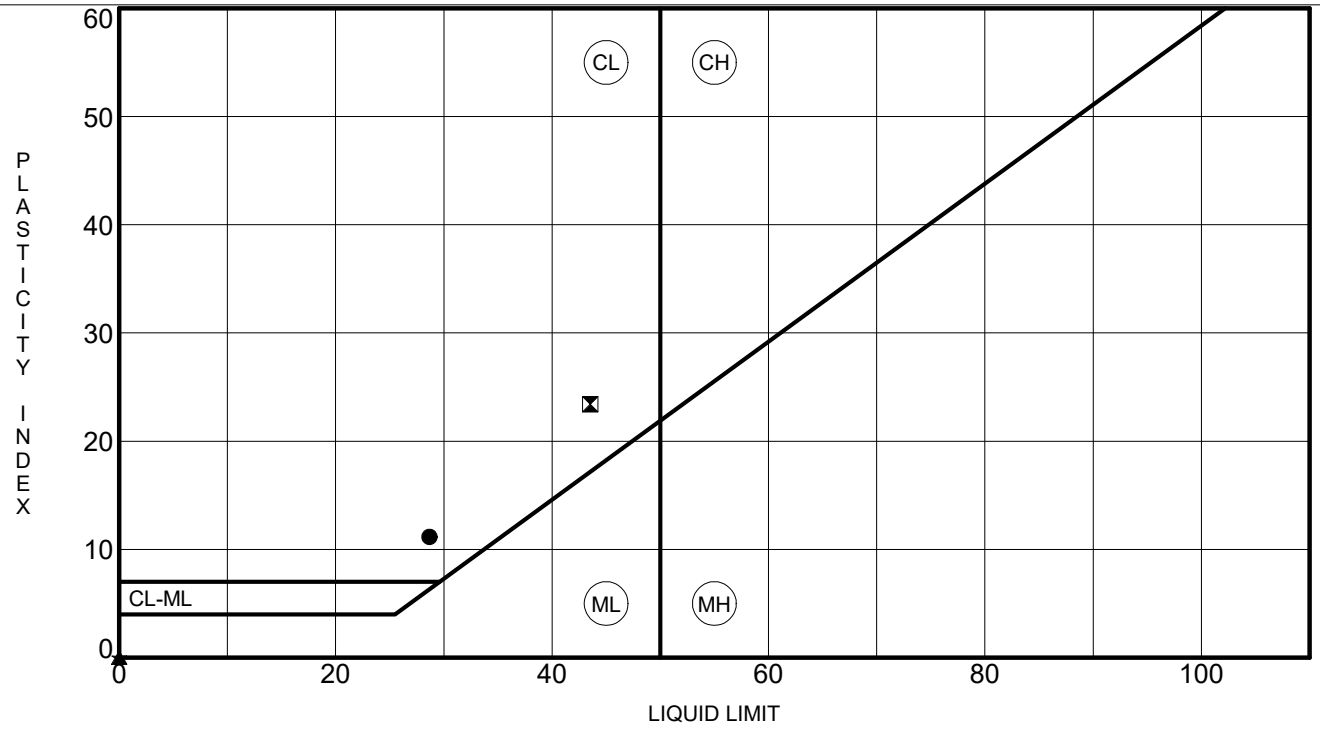
Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
B-1	0-10	29	18	11		91	CL	A-6 (9)				2.07	160 @ 23.0%	8.8	0.1900			
B-1	2								20.0	105.2								
B-1	4								22.7	101.2								
B-2	0-13	44	20	24		96	CL	A-7-6 (25)										
B-3	-15																	
B-3	12	NP	NP	NP		3	SP	A-3 (0)										
B-3	-19																	
B-4	-2																	
B-4	-7																	
B-4	-12																	
B-4	7.1	NP	NP	NP		6	GP-GM	A-1-a (0)										
B-4	17					85						0.06	1600 @ 19.20%	8.4	0.0081			

ATTERBERG LIMITS RESULTS
AASHTO T89 Method A/T90

RockSol Consulting Group, Inc.

CLIENT City of Grand Junction **PROJECT NAME** Tiara Rado Force Main, Persigo WWTF to Tiara Rado Lift Station

PROJECT NUMBER 599.22 **PROJECT LOCATION** Grand Junction, Colorado



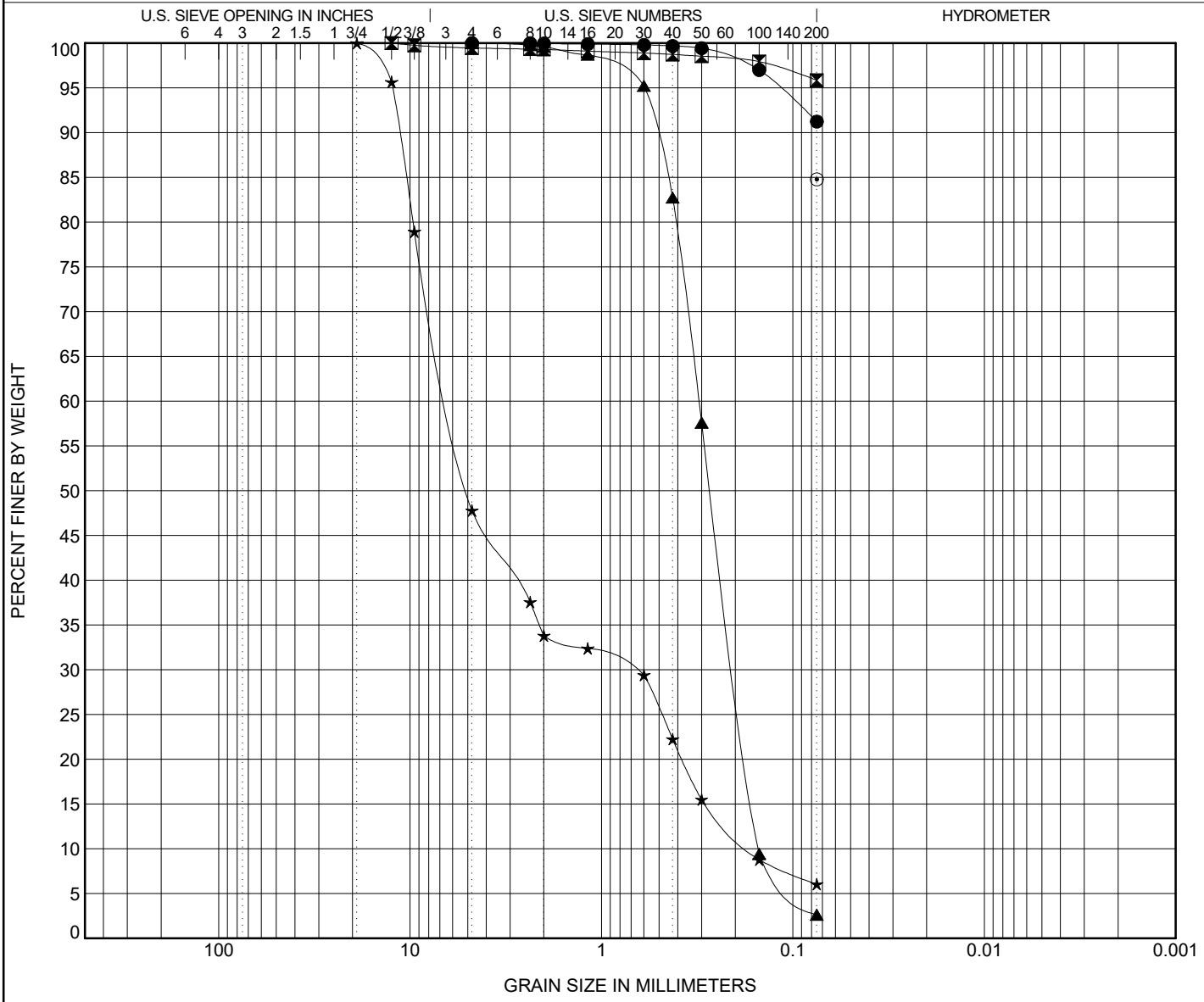
	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-1**	**0.0-10.0**	**29**	**18**	**11**	**91.2**	**LEAN CLAY (CL) (A-6)**
⧓	**B-2**	**0.0-13.0**	**44**	**20**	**24**	**95.9**	**LEAN CLAY (CL) (A-7-6)**
▲	**B-3**	**12.0**	**NP**	**NP**	**NP**	**2.6**	**POORLY GRADED SAND (SP) (A-3)**
★	**B-4**	**7.1**	**NP**	**NP**	**NP**	**6.0**	**POORLY GRADED GRAVEL w SILT & SAND (GP-GM) (A-1-a)**

GRAIN SIZE DISTRIBUTION

Rocksol Consulting Group

CLIENT City of Grand Junction **PROJECT NAME** Tiara Rado Force Main, Persigo WWTF to Tiara Rado Lift Station

PROJECT NUMBER 599.22 **PROJECT LOCATION** Grand Junction, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-1	0.0-10.0	LEAN CLAY (CL) (A-6)	29	18	11		
⊠	B-2	0.0-13.0	LEAN CLAY (CL) (A-7-6)	44	20	24		
▲	B-3	12.0	POORLY GRADED SAND (SP) (A-3)	NP	NP	NP	0.87	2.05
★	B-4	7.1	POORLY GRADED GRAVEL w SILT & SAND (GP-GM) (A-1-a)	NP	NP	NP	0.44	36.67
⊙	B-4	17.0	(Bedrock) SHALE					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-1	0.0-10.0	4.75				0.0	0.3	8.5	91.2	
⊠	B-2	0.0-13.0	12.5				0.7	0.6	2.9	95.9	
▲	B-3	12.0	4.75	0.31	0.202	0.151	0.4	16.9	80.1	2.6	
★	B-4	7.1	19	6.233	0.686	0.17	66.2	11.6	16.2	6.0	
⊙	B-4	17.0	0.075							84.8	

SECTION 01039

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

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 Owner provided survey and shown on Drawings.

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. Colorado Department of Transportation
8. Colorado Parks and Wildlife
9. 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 mutually agree to postpone the weekly meeting.

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
   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 01200

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. Unit Prices for administrative requirements governing use of unit prices
   2. Construction Progress Schedules

1.3 DEFINITIONS

A. Unit Price: An amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services.

1.4 PROCEDURES FOR UNIT PRICES

A. Unit bid prices, as quoted in the Bid Form, shall be in full compensation for labor, materials, equipment, rentals, freight, applicable taxes, overhead, profit and incidentals to complete all work for each pay item; and for all risk, loss, damage, or expense of whatever nature arising from the nature of the work or the prosecution thereof.

B. Work or materials that are essential to the work, but for which there are no pay items, will not be measured and paid for separately, but shall be included in other items of work.

C. Prices include all necessary material, for a complete installation, insurance, applicable taxes, overhead, and profit. Payments will be made according to the associated bid items; no separate measurement for payment will be made for any labor, equipment, and materials required for any of the bid items. The measurement for payment will be the total number listed in the bid schedule and will include all of Contractor's costs. All bid items shall be installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by the Engineer.

D. Refer to the attached Bid Schedule for the full list of payment items. Descriptions of the payment items can be found in the City standard specifications, CDOT specifications, or are described below.

1. **Dewatering**
   a. Description:
      i) Transporting, installing, using and removing dewatering equipment as shown on drawings
      ii) Protecting all existing aboveground and underground utilities, items, materials, and surfaces not to be demolished along and around the force main
      iii) Obtaining and maintaining the necessary dewatering permits
      iv) Providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section
   b. Unit of Measurement: lump sum
   c. No payment for the dewatering allowance greater than the rate shown on the Bid Form will be made unless written prior approval is obtained from the Engineer. No measurement for payment will be made for this work. It shall be paid for at the Contract Price based upon the percentage completed and accepted of the work required by this bid item.
2. **Potholing Utilities**
   a. Description: locating and potholing all utilities necessary for the construction of the Work.
   b. Unit of measurement: each
3. **Persigo Wash Temporary Crossing**
   a. Description: install and maintain a temporary crossing across the Persigo Wash to allow for access necessary for the construction of the Work. This bid item includes all fill materials and pipe associated the temporary crossing and removal of temporary crossing.
   b. Unit of measurement: lump sum
   c. No measurement for payment will be made for this work. It shall be paid for at the Contract Price based upon the percentage completed and accepted of the work required by this bid item.
4. **Persigo Wash Temporary Diversion**
   a. Description:
      i) Furnishing and installing all labor and materials required to divert flow from the Persigo Wash from the west box culvert to the east box culvert during construction of the Work according to the Drawings
      ii) Removal of diversion structures
      iii) Providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section
   b. Unit of measurement: lump sum
   c. No measurement for payment will be made for this work. It shall be paid for at the Contract Price based upon the percentage completed and accepted of the work required by this bid item.
5. **Coffer Dam (Colorado River)**
   a. Description: all of Contractor's costs associated with constructing and demolishing one coffer dam from the south bank of the Colorado River and a second coffer dam from the north bank of the Colorado River, including any and all armoring (e.g., steel, concrete, rocks) the Contractor deems necessary for

protecting the work area and all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of measurement: lump sum
c. No measurement for payment will be made for this work. It shall be paid for at the Contract Price based upon the percentage completed and accepted of the work required by this bid item.

6. Rock Excavation

a. Description: The measurement for payment for this item will be on a cubic yard basis, complete in place, in accordance with the Drawings or Specifications or as otherwise directed by Engineer. This bid item consists of all items related to the excavation of rock material in the pipeline alignment as defined in Section 02300, including excavation, trenching, mechanical removal, loading, hauling, and disposal. This bid item also includes repair to any and all related structures, facilities, underground and above ground utilities, property, landscaping, streets, drives, and pavements that are (intentionally and unintentionally) damaged during rock excavation activities.
b. Unit of measurement: cubic yard
c. Volume measurement will be based on in situ dimensions.
    i) The horizontal rock measurement shall be three feet on center between the two force main pipes.
    ii) Contractor shall have Engineer verify that rock material, as defined by Section 02300, is present and in need of removal
    iii) Contractor shall present to Engineer accurate and detailed records delineating the horizontal and vertical extents of rock to be removed. Acceptable records shall include, but not be limited to, photographs, field survey notes and record drawings indicating where rock was present.
d. No payment for rock excavation shall be made without the prior written approval from Engineer stating where rock excavation shall be required and permitted.

7. 12” Fusible HDPE Pipe (SDR-17)

a. Description:
    i) Locating and protecting all existing above and below ground utilities and connections along and around the force main
    ii) Excavating, backfilling, and compaction of excavations with suitable material(s)
    iii) Providing and placing 4 inches of clean topsoil on top of backfill
    iv) Furnishing, transporting, and installing all pipe and materials as indicated
    v) Adjusting the location of existing small utilities and valves
    vi) Tapping and/or connecting to pipes or structures and repairing all structures as necessary
    vii) Furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and Specifications
    viii) Furnishing, transporting, and installing jointing materials including O-rings, gaskets, bolts, joint restraints, connecting bands, and other miscellaneous items
    ix) Fusing HDPE pipe as required by the Specifications
    x) Installing tracer wire and tracer wire test stations

xi) Removing and replacing surfacing materials as required
xii) Constructing the specific bedding including the furnishing, placing, and compacting sand, gravel, and rock
xiii) Supporting trenches as required
xiv) Disposing of debris, pipe, excess excavated material, and damaged materials as required
xv) Testing
xvi) Inspecting
xvii) Providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section

b. Unit of measurement: linear feet

8. 12" Fusible HDPE Pipe (SDR-17) (Dual Pipes, Common Trench)

a. Description:
i) Locating and protecting all existing above and below ground utilities and connections along and around the item
ii) Excavating, backfilling, and compaction of excavations with suitable material(s)
iii) Providing and placing 4 inches of clean topsoil on top of backfill
iv) Furnishing, transporting, and installing all pipe and materials as indicated
v) Adjusting location of existing small utilities and valves
vi) Furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and Specifications
vii) Furnishing, transporting, and installing jointing materials including O-rings, gaskets, bolts, joint restraints, connecting bands, and other miscellaneous items
viii) Fusing HDPE pipe as required by the Specifications
ix) Installing tracer wire and tracer wire test stations
x) Removing and replacing surfacing materials, as required
xi) Constructing the specific bedding including the furnishing, placing, and compacting of flowfill, sand, gravel, and rock
xii) Supporting trenches as required
xiii) Disposing of debris, pipe, excess excavated material, and damaged materials as required
xiv) Testing
xv) Inspecting
xvi) Providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of measurement: linear feet

9. Concrete Encasement

a. Description: The measurement for payment for this item will be on a linear foot basis, complete in place. The unit price will include all of Contractor's costs associated with the following:
i) Protecting all existing aboveground and underground utilities, items, materials, and surfaces along and around the force main and concrete encasement;
ii) Adjusting location of any existing small utilities and valves;

iii) Furnishing, transporting, and installing all materials including any sheeting and/or bracing required for support trenches
iv) Concrete and reinforcement for encasing force main as indicated on the drawings
v) Excavating, including exploratory excavation;
vi) Disposing of debris, excess excavated material, and damaged materials
vii) Testing
viii) Inspecting
ix) Providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section

b. Unit of measurement: linear feet

10. Manhole Corrosion Protection

a. Description: furnishing and installing protective coatings for new manholes
b. Unit of measurement: vertical feet

11. Connection to Lift Station

a. Description:
i) Exposing existing connection
ii) Removal of concrete encasement if necessary
iii) All HDPE and DIP fittings
iv) Wastewater temporary bypass
v) Cleaning
vi) Installation of adapter and thrust block
vii) HDPE butt fusion
viii) All other costs not included under other bid items.

b. Unit of measurement: lump sum
c. No measurement for payment will be made for this work. It shall be paid for at the Contract Price based upon the percentage completed and accepted of the work required by this bid item.

12. Flow Metering Manhole

a. Description: furnish and install 8-foot diameter concrete flow metering manhole, 12" magnetic flow meter, 12-inch plug valve and dismantling joint, pipe supports and link seals including all electrical conduits, wire and controls for a complete functioning flow metering manhole.
b. Unit of measurement: lump sum

E. Measurement and Payment: Refer to bid form and 1.5 (A) of this Section for establishment of unit prices

F. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor.

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 Engineer 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 for 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 Engineer'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

A. Provide a list of unit prices as indicated in Section 00310 – Bid Form

END OF SECTION

SECTION 01340

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 16

1.3 SUBMITTALS

A. Definitions
   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

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

F. Field samples and Mock-ups:
   1. Contractor shall erect, at the Project Site, at a location acceptable to the Engineer and Owner
   2. Size or area: as specified in the respective specification section
   3. Fabricate each sample and mock-up complete and finished
   4. Remove mock-ups at conclusion of Work or when acceptable to Engineer

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) Electronic – One (1) 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
   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
   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
      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 with the following stamp:

☐ NO EXCEPTIONS TAKEN ☐ EXCEPTIONS NOTED
☐ REVISE & RESUBMIT ☐ REJECTED
This review was performed only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Modifications or comments made on the shop drawings and product data during this review do not relieve Contractor from responsibility for compliance with the requirements of the plans and specifications. Contractor is responsible for: dimensions and quantities; information that pertains solely to the fabrication processes or to the means, methods, of construction; coordination of the work of all trades.

JVA, Inc.

Date_____ By_____

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 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.1 SECTION INCLUDES

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

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. USB drive or shared online storage of digital photos to 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
   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 01500

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. 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

F. 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

G. 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
   2. Comply with utility company requirements

1.4 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

1.5 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

1.6 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

1.7 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

1.8 STORMWATER MANAGEMENT

A. 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.

1.9 COFFER DAM

A. Construction within the Colorado River will require the use of a coffer dam as shown on the drawings.

B. Contractor is responsible for the design, style, materials, size, and armoring of the coffer dam used in the Colorado River.

1.10 FUGITIVE DUST PERMIT

A. Comply with all conditions of CDPHE Fugitive Dust Permit. Contractor responsible for both permit filing and any required reporting.

B. Contractor to pay for all metered water used in dust abatement

1.11 CONSTRUCTION DEWATERING

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

1.12 EROSION AND SEDIMENT CONTROL

A. Provide erosion and sediment control in accordance with Section 02370.

1.13 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

1.14 SECURITY

A. Provide security and facilities to protect Work from unauthorized entry, vandalism, or theft

B. Coordinate with Owner's security program

1.15 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 Owner

1.16 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

1.17 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

1.18 FIELD OFFICES AND SHEDS

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

B. 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.

1.19 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 01550

CUTTING AND PATCHING

PART 1 GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching

B. Work included in this Section
   1. Cutting and patching not required to be performed as part of the work of other sections
   2. Cutting and patching existing work altered or disturbed to accommodate new construction
   3. Cutting and patching existing work damaged or defaced during new construction as required to restore to existing or better condition at the time of award of Contract
   4. Cutting and patching required to:
      a. Install or correct non-coordinated work
      b. Remove and replace defective and non-conforming work
      c. Remove samples of installed work for testing

C. Contractor shall be responsible for all cutting, and patching, including attendant excavation and backfill, required to complete the Work or to:
   1. Uncover portions of the Work to provide for installation of ill-timed work
   2. Remove and replace defective work
   3. Remove and replace work not conforming to requirements of Contract Documents
   4. Remove samples of installed work as specified for testing

1.2 DEFINITIONS

A. Cutting includes cutting into nominally completed or existing construction including, but not limited to, the following, in order to provide for the coordination of Work, installation of Work, uncovering of other facilities and structures for access or inspection, or obtaining samples for testing or other similar purposes
   1. Concrete
   2. Steel
   3. Wood
   4. Miscellaneous metal structures
   5. Piping and pavement

B. Patching includes the repair required to restore cut materials to original or better condition

C. Submittals
   1. Submit a proposal describing procedures in advance of the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

a. Extent: For each occurrence, describe the cutting and patching required, show how it will be performed and indicate the reason(s) it cannot be avoided
b. In-place construction changes: Describe anticipated results and include changes to structural elements and operating components in addition to changes in building's appearance and other significant visual elements
c. Products: List products to be used and firms or entities that will perform the Work
d. Dates: Indicate when cutting and patching will be performed
e. Utility services and mechanical and electrical systems:
    i) List services and systems that cutting and patching procedures will disturb or affect
    ii) List services and systems that will be relocated and that will be temporarily out of service
    iii) Indicate how long services and systems will be disrupted
f. Structural elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with the original structure
g. Approval by Engineer:
    i) Obtain approval of cutting and patching proposal before cutting and patching
    ii) Approval does not waive right to later require removal and replacement of unsatisfactory work

D. Quality Assurance
1. Structural work requirements: Do not cut and patch structural elements in a manner that would reduce their load-carrying or load-deflection ratio
    a. Obtain Engineer approval of cutting and patching proposal before cutting and patching the following structural elements:
        i) Bearing and retaining walls, foundation construction, and structural concrete and structural steel
        ii) Lintels
        iii) Timber and primary wood framing
        iv) Structural decking and stair systems
        v) Equipment supports, piping, ductwork, vessels, and equipment
        vi) Miscellaneous structural metals
2. Operational limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance or decreased operational life or safety
    a. Obtain Engineer approval of cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
        i) Primary operational systems and equipment
        ii) Air, smoke, water, moisture, or vapor barriers
        iii) Membrane and flashings
        iv) Fire protection, control, communication, or electrical wiring systems
        v) Noise and vibration control elements and systems
3. Visual requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching

a. Retain the original installer or fabricator throughout construction phases to cut and patch the following categories of exposed work, if possible, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:
   i) Concrete finishes
   ii) Pre-formed metal panels
   iii) Painting
   iv) Wall covering
   v) HVAC enclosures, cabinets, or covers
   vi) Firestopping

E. Warranty
   1. For existing warranties, Contractor shall replace, patch, and repair material and/or surfaces cut and/or damaged by methods and with materials in order to not void any warranties required or existing

PART 2 PRODUCTS

A. Materials
   1. Use materials identical to existing materials unless not available
      a. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials matching existing adjacent surfaces to the fullest extent possible with regard to visual effect
      b. Before proceeding, Contractor shall obtain approval of the Engineer
      c. Use materials whose installed performance will equal or surpass that of existing materials

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered

B. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work

C. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with the work until the Engineer has provided further instructions

3.2 PREPARATION

A. Provide devices and methods to protect other portions of the Project from damage

B. Provide temporary support of Work to be cut where required

C. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water
   1. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations

D. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas

E. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them

F. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes

G. Restore work which has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay

B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition
   1. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations
      a. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use
      b. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces
      c. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill
      d. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting
      e. Provide fire-safe seals to maintain fire rating at all penetrations
   2. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances
      a. Where feasible, inspect and test patched areas to demonstrate integrity of the installation

b. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing
c. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance
d. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken containing the patch, after the patched area has received primer and second coat
e. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance
f. Replace concrete walkways to nearest construction joint

3. Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated

3.4 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition

END OF SECTION

SECTION 01600

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. Environmental Conditions
   4. Submittals
   5. Quality Assurance and Qualifications
   6. System Responsibility
   7. Transportation and Shipment
   8. Delivery, Storage and Handling
   9. Maintenance Materials
   10. Warranty
   11. Equipment and Product Selection and Identification
   12. Examination, Installation, Adjusting and Cleaning

1.2 RELATED SECTIONS

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 02300 – Earthwork

F. Section 02370 – Erosion and Sedimentation Control

G. Section 02530 – Sanitary Sewer System

H. Section 02740 – Flexible Paving

I. Section 02750 – Rigid Paving

J. Section 02950 – Seeding

K. Section 03300 – Cast-in-Place

L. Section 03600 – Grout

M. Section 05500 – Metal Fabrications

N. Section 09900 – Coatings

1.3 REFERENCES

A. American Bearing Manufacturers Association (AFBMA)
   1. Std 9-90 – Load Ratings and Fatigue Life for Ball Bearings
   2. Std 11-90 – Load Ratings and Fatigue Life for Roller Bearings

B. American Gear Manufacturer Association (AGMA)

C. ANSI B1.1-89 – Unified Screw Threads

D. ANSI B 1.20. 1-83-Pipe Threads, General Purpose (Inch)

E. ANSI B16.1-89-Cast Iron Pipe Flanges and Flanged Fittings, Class 125

F. ANSI B18.2.1-81-Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Log Screws

G. ANSI B18.2.2-87-Square and Hex Nuts

H. NSF/ANSI 60-2012 – Drinking Water Treatment Chemicals – Health Effects

I. NSF/ANSI 61-2012 – Drinking Water System Components – Health Effects

J. 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 ENVIRONMENTAL CONDITIONS

A. Minimum Design Criteria:
   1. Altitude: 4,500 feet above mean sea level
   2. Outdoor air temperature: 10 to 100 degrees F
   3. Relative Humidity:
      a. Summer time: 60 percent
      b. Winter time: 30 percent

1.7 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 16

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

1.8 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. 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

1.9 SYSTEM RESPONSIBILITY

A. 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

1.10 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

1.11 DELIVERY, STORAGE, AND HANDLING

A. Delivery
   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 overstressing. 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

1.12 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

1.13 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 1 year 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

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 02300

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

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. Trench Stabilization

J. Final grading

K. Slope Stabilization

L. Appurtenant work

1.3 RELATED SECTIONS

A. Section 01020 – Geotechnical Report

B. Section 02370 – Erosion and Sedimentation Control

C. Section 02950 – Seeding

1.4 REFERENCES

A. City of Grand Junction Engineering Division Standard Specification for Construction of Underground Utilities – Waterlines, Sanitary Sewers, Storm Drains, Underdrains, and Irrigation Systems

B. American Association of State Highway and Transportation Officials (AASHTO)

C. 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)

D. American Concrete Institute (ACI):
   1. 229 – Controlled Low-Strength Materials

E. Council of American Building Officials/American National Standards Institute (CABO/ANSI):
   1. A117.1 – Accessible and Useable Buildings and Facilities Standards

F. Colorado Department of Transportation (CDOT)

G. 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 City of Grand Junction 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 City of Grand Junction 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.

J. Riparian vegetation removal for construction and maintenance will be limited primarily to small trees and shrubs and clearing will be conducted outside of the breeding season for cuckoos (June 1 through August 31).

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. This includes all material that is not classified as rock excavation as described in Paragraph 2.1.B.2 Rock Excavation is included herein.
   2. Rock excavation shall be conducted according to Part 103.11 of the City Standard Specifications.
   3. Waste Materials:
      a. Waste materials are considered unacceptable materials for compaction or placement fill. Site fills will not include environmental pollutants, hazardous substances or waste, hazardous products or by-products.
      b. Transport and properly dispose of any rubble and waste materials found in excavation off the Owner's property
      c. If hazardous, transite or asbestos containing materials are found in excavation, stop work immediately and notify the Owner within one hour of discovery. Comply with special handling requirements.

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 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, No. 4 Sieve – 50-100% passing, and No. 200 Sieve – 35% passing (maximum)

b. Liquid Limit: 35 (maximum), Plasticity Index: 15 (maximum), Group Index: 10 (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 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
1. Comply with City of Grand Junction requirements for pipe bedding for public utilities.

H. Compacted Trench Backfill
1. Comply with City of Grand Junction requirements for backfilling pipe.

I. Coarse Base Rock
1. Granular material, maximum 3 inches, less than 10% passing 1-inch sieve.
2. Free of trash, clay and dust

J. Road Base
1. Will meet ASTM specification for Class II aggregate base and CDOT Class 6 gradation

Sieve Size	Percent Passing by Weight
3/4"	90-100
No. 4	30-65
No. 8	22-55
No. 200	3-12

2.2 ACCESSORIES

A. Controlled Low Strength Material (Flow Fill)
1. Comply with City of Grand Junction requirements and ACI 229 for the use of flowable fill within the right-of-way or for public utility trench backfill.
2. Product will be a lean, sand-cement slurry, “flowable fill” or similar material with a 28-day unconfined compressive strength between 50 and 200 psi.

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. Comply with requirements of City Standard Specifications for removal of structures and obstructions.

B. 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 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.

4. 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
5. Backfill all excavated depression include grub holes with approved material

C. 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 Engineer.

D. 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.

E. 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

F. 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. Comply with Section 103.13 of the City of Grand Junction Standard Specifications for dewatering trenches.
   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. 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
8. Divert surface water or otherwise prevent it from entering excavated areas or trenches to the extent practical without damaging adjacent property
9. Maintain all drainage pipes, keep clean and free of sediment during construction and final cleanup
10. 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
11. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head

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. Comply with requirements of City Standard Specifications for trenches with sloping sides.

B. 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

C. Remove all mud and muck during excavation

D. Reinforce subgrades with crushed rock or gravel if they become mucky during construction activities

E. Finished elevation of stabilized subgrades are to be at or below subgrade elevations indicated on Drawings

F. Allow no more than ½ inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon

G. Scarify trench subgrade to a depth of 6 to 8 inches before compaction

3.8 PAVEMENT OVEREXCAVATION AND SUBGRADE PREPARATION

A. Excavate subgrade for concrete pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.05 foot.

B. Overexcavate and scarify existing soil as required under pavement areas, slabs, curbs and walks to meet the moisture and compaction specifications herein to depth shown on Drawings.

C. Extend subgrade preparation a minimum of one foot beyond back of proposed pavement, slabs, curbs and walks.

D. Extend subgrade preparation a minimum of two feet beyond back of proposed structure foundation limit.

E. Proof roll with a pneumatic tire equipment with a minimum axle load of 18 kips per axle a maximum of 24 hours prior to paving to locate any soft spots that exhibit instability and deflection beyond subgrade tolerances listed above. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Geotechnical Engineer, will be ripped, scarified, dried or wetted as necessary and recompacted to the requirements for density and moisture at the Contractor's expense. After recompaction, these areas will be proof rolled again and all failures again corrected at the Contractor's expense.

F. If the Contractor fails to place the sub-base, base course, or initial pavement course within 24 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction will be performed again at the Contractor's expense.

3.9 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
Utility Trenches	95%	-2 to +2
Lawns or Unpaved Areas	90%	-2 to +2
Public Right-of-way	Per municipal 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.

3.10 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. Remove debris, junk, broken concrete, broken asphalt, rock, stones, stumps, logs, roots, and other unsuitable material from the site and dispose of it.

3.11 BLASTING

A. Blasting or other use of explosives is not permitted without City of Grand Junction approval

3.12 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. Measure pipe cover depth vertically from top of pipe to finished ground or surface elevation

E. Do not open more trench in advance of pipe laying than is necessary to expedite the work; not more than 200 feet

F. Total length of open trench will be limited to 200 feet unless otherwise approved by the Engineer

G. 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

H. 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”
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

I. 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

J. 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

K. 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 and design which can be operated to provide the following:
      a. Rough trench bottom to a controlled elevation
      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. Recompact trench bottom disturbed by bucket teeth prior to placement of embedment material

L. 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

M. 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

N. For unstable soils, provide concrete or other bedding as directed by Engineer

O. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined

P. 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

3.13 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: 8 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

3.14 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 8 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 municipal street and 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

3.15 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.

3.16 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.
   2. Reuse grubbings and surface topsoil containing plants and seeds in designated revegetation areas only.

3.17 SLOPE AND CHANNEL STABILIZATION

A. Cover channel banks, slopes, bottom and thalweg (water flowline at lowest point in channel) with erosion control fabric mat where grade is steeper than 4H to 1V and where indicated on the Drawings

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches

F. Maintain integrity of erosion control fabric

G. Prior to laying fabric, seed disturbed areas under provisions of related seeding and landscaping specification sections or as specified on Drawings.

3.18 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

3.19 FIELD QUALITY CONTROL

A. Provide under provisions of General Conditions and Division One Specifications

B. Coordinate testing with Owner. Owner will employ testing agency for 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. It is the Contractor's responsibility to initiate, coordinate and accommodate 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 48 hour advance notification to schedule tests.

D. 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

E. 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

F. 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 2,000 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

G. Inspection and approval
   1. A qualified Geotechnical Engineer will inspect the natural soil at bottom of excavations for structures

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.

H. Retesting of failed compaction will be performed by Geotechnical Engineer for Owner, but paid for the Contractor

END OF SECTION

SECTION 02370

EROSION AND SEDIMENTATION CONTROL

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 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.

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02300 – Earthwork

C. Section 02950 – Seeding

1.3 REFERENCES AND STANDARDS

A. City of Grand Junction Engineering Division Standard Specifications for Construction of Underground Utilities – Waterlines, Sanitary Sewers, Storm Drains, Underdrains, and Irrigation Systems

B. City of Grand Junction Engineering Division Standard Specifications for Road and Bridge Construction

C. CDOT – Colorado Department of Transportation

D. UDFCD – Urban Drainage and Flood Control District

E. CDPHE – Colorado Department of Public Health and Environment

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.

C. Product data: Submit on all products or materials supplied herein.

1.5 REGULATORY REQUIREMENTS

A. Obtain and comply with all requirements of City of Grand Junction and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.

B. 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 Owner and Engineer and in accordance with local regulations prior to installation.

E. Fertilizer and soil conditioners shall be approved by Owner and Engineer 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 [flow velocities between 9.5 (unvegetated) and 15 (vegetated) fps]: 5.0 pound UV-stable polypropylene top and bottom nets, 24 pound UV-stable polypropylene corrugated center net, 70% straw/30% coconut fiber matrix.
   1. North American Green SC250
   2. Or accepted substitution

L. Permanent Channel Stabilization Mat [flow velocities between 10.5 (unvegetated) and 20 (vegetated) fps]: 8.0 pound UV-stable polypropylene top and bottom nets, 24 pound UV-stable polypropylene corrugated center net, 100% coconut fiber matrix.
   1. North American Green SC350
   2. Or accepted substitution

M. Permanent Channel Stabilization Mat [flow velocities between 12.5 (unvegetated) and 25 (vegetated) fps]: 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. No work shall be performed until all permitting is approved and permit is received.

E. 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 PROPERITES

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 stablished 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.

PART 4 MEASUREMENT FOR PAYMENT

4.1 UNIT PRICE

A. Erosion control items will be paid for individually per the unit prices in the bid schedule.

B. Contractor shall include in the bid price for erosion and sedimentation control work a minimum of all items shown on the Erosion Control Plan, as required by the City and any additional items that may be needed to control erosion and water pollution throughout all phases of the project.

END OF SECTION

SECTION 02530

SANITARY SEWERAGE SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. HDPE pressure pipe for sanitary sewer force main with all jointing materials, fittings, and other appurtenances required for a complete installation

B. Precast manholes and vaults

C. Coupled Joints

D. Plug Valve

1.2 RELATED SECTIONS

A. Section 02300 – Earthwork

B. Section 03600 – Grout

1.3 REFERENCES

A. City of Grand Junction, Engineering Division: Standard Specifications for Construction of Underground Utilities - Waterlines, Sanitary Sewers, Storm Drains, Underdrains and Irrigation Systems.

B. American Society for Testing and Materials (ASTM):
1. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
2. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
3. C33 – Standard Specification for Concrete Aggregates
4. C150 – Standard Specification for Portland Cement
5. C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
6. C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
7. C497 – Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
8. C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
9. C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete manhole Structures, Pipes, and Laterals
10. C1619 – Standard Specification for Elastomeric Seals for Joining Concrete
11. C1821 – Standard Practice for Installation of Underground Circular Precast Manhole Structures

12. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
13. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
14. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
15. D2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
16. D2321 – Standard Specification for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
17. D2774 – Standard Specification for Underground Installation of Thermoplastic Pressure Piping
18. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
19. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
20. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
21. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
22. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
23. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
24. F412 – Standard Terminology Relating to Plastic Piping Systems
25. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
26. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
27. F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
28. F2164 – Standard Specification for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

C. American Water Works Association (AWWA):
1. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
3. C115 – Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges

D. Colorado Department of Transportation (CDOT)

E. Occupational Safety and Health Administration (OSHA)

F. National Association of Corrosion Engineers (NACE):

1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems

G. 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

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 under provisions of Division 1 Specifications

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1

B. Accurately record actual locations of piping mains, valves, connections, invert elevations, and any mapped or unmapped utilities.

C. The Contractor and its surveyor shall survey all fittings, bends, elbows (both vertical and horizontal), invert elevations, and elevations of existing utilities that the project exposes during the Work.

D. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with City 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 HDPE 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), City of Grand Junction, CDOT, and Mesa County

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 Mesa County, City, CDOT, 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 requirements govern over 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. The storage area should have a relatively smooth, level surface free of stones, debris or other materials that could damage the pipe or fittings. Where adequate ground conditions do not exist or when a bed cannot be prepared, the pipe may be placed on planking evenly spaced along the pipe length.
   3. Pipe stored along the trench side shall be suitably supported off the ground to avoid damage to the coating

F. 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 customers and risk to the City 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 standards and specifications.

2.2 COUPLED JOINTS

1. Dismantling joint
   a. Provided per coupling manufacturer's recommendations
   b. Determine and install dismantling joint after equipment and pipe placement
   c. Provide restrained dismantling joint where indicated
   d. Nitrile (Buna N) follower gasket
   e. 4-inches thru 24-inches
      i) Smith-Blair “971” or “975” as required
      ii) Or accepted substitution

2.1 DUCTILE IRON PIPING (DIP)

A. The following piping shall be DIP as indicated on the drawings and as specified herein

B. Shall be in accordance with AWWA C115, C150, and C151 except as otherwise specified or indicated on Drawings

C. Manufacturers
   1. U.S. Pipe
   2. American Cast Iron Pipe Company
   3. McWane Cast Iron Pipe Company
   4. Pacific States Cast Iron Pipe Company
   5. Griffin Pipe Products Company
   6. Or accepted substitution

D. Pipe
   1. ANSI A21.51/AWWA C151: As listed below except as otherwise specified or indicated on Drawings
      a. Where fitted with push-on joints, mechanical joints or mechanical joints with joint restraint device, or restrained joints: minimum pressure class wall thickness that meets project pressure and structural requirements, unless otherwise specified or indicated on the Drawings.
      b. Where fitted with flanged, grooved or restrained joints: Class 53
      c. 4-Inch to 12-Inch: Class 350
      d. Thickness (minimum) for screw-on flanges shall be in accordance with AWWA C115
      e. 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

E. Fittings
   1. Ductile iron full body fittings

a. ANSI A21.10/AWWA C110, ASTM A536
b. 24-inch and below: 350 psi rating, mechanical joint

2. Ductile iron compact fittings
   a. ANSI A21.53/AWWA C153
   b. 24-inch and below: 350 psi rating, mechanical joint
3. Fittings shall have a pressure rating no less than that of adjoining pipe
4. Fittings for pipe with mechanical or push-on joints shall have mechanical joints in accordance with ANSI A21.11/AWWA C111
5. Comply with requirements for restrained fittings as indicated on Drawings

F. Joints
   1. All joints shall be of restrained type unless otherwise indicated on Drawings
   2. Mechanical and push-on joints:
      a. Shall have a pressure rating no less than that of adjoining pipe
      b. Mechanical joints:
         i) Less than 30-inches in diameter: Shall be in accordance with ANSI A21.11/AWWA C111
      c. Push-on joints:
         i) Less than 24-inches in diameter: Shall be in accordance with ANSI A21.11/AWWA C111
         ii) Gaskets shall be neoprene or other synthetic rubber (SBR). Natural rubber is not acceptable.
      d. Push-on joints:
         i) 30-inches in diameter and greater: Shall be in accordance with ANSI A21.11/AWWA C111
         ii) Gaskets shall be neoprene or other synthetic rubber (SBR). Natural rubber is not acceptable.
      e. Lubricant: Heavy vegetable soap non-toxic solution suitable for potable water contact
   3. Mechanical joint restraint device
      a. 360° serration lock engagement type
      b. Nuts and bolts torqued to requirements of manufacturer
      c. Working pressure rated at 150 psi minimum
      d. 24-inch and below:
         i) EBBA Iron Inc., Meg-a-Lug Series 1100
         ii) Uni-Flange Corporation, 1400 Series
         iii) Or accepted substitution
   4. Push-on joint restraint device
      a. 360 degree serration lock engagement type
      b. Nuts and bolts torqued to requirements of manufacturer
      c. Working pressure rated at 150 psi minimum
      d. 24-inch and below:
         i) EBBA Iron Inc., Megalug Series 1700
         ii) Uni-Flange Corporation, 1490 Series
         iii) Or accepted substitution
   5. Restrained push-on joints
      a. 30-inch and below:

i) American Flex-Ring
ii) Griffin Snap-Lok
iii) U.S. Pipe TR-Flex
iv) Or accepted substitution

6. Restrained mechanical joints
   a. 30-inch and below:
      i) Griffin Bolt-Lok
      ii) American MJ Coupled Joint
      iii) Or accepted substitution
7. Restrained mechanical joints at fittings
   a. EBAA Iron Inc., Megalug Series 1100
   b. Uni-Flange Corporation (Ford Meter Box), 1400 Series
   c. Or accepted substitution
8. Bolts and nuts: Corrosion-resistant bolts and nuts for use with ductile iron joints shall be high strength, low alloy steel as specified in ANSI/AWWA C111/ANSI A21.11
   a. Cor-Ten
   b. Usalloy
   c. Durabolt
   d. Or accepted substitution
9. Gaskets shall be neoprene or other synthetic rubber (SBR). Natural rubber is not acceptable.

G. Couplings
1. Mechanical Couplings:
   a. Dresser Style 38
   b. Rockwell 411
   c. Romac Industries 501
   d. Smith Blair 461
   e. Or accepted substitution
2. Transition Couplings:
   a. Rockwell 415
   b. Dresser Style 39
   c. Romac Industries TC400
   d. Smith Blair 413
   e. Or accepted substitution
3. Glands color coded: Black

H. Fabrication
1. Joints
   i) Exposed: Flanged or grooved
2. Shop coating and lining
   a. Shop prime exterior surfaces of pipe and fittings to be installed in exposed interior or exterior locations
   b. Shop coat flange faces with rust preventive compound

2.2 ECCENTRIC PLUG VALVE

A. Manufacturers
   1. Valves
      a. DeZurik
      b. Flowserve
      c. Henry Pratt Company
      d. Milliken
      e. Val-Matic Valve and Manufacturing Corporation
      f. 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. Flanged: 125 lb, ANSI B16.1
      b. Screwed valve ends shall be to the NPT standard
      c. Grooved ends shall conform to AWWA C606 rigid joint specifications
   8. Minimum Working Pressure Rating:
      a. 350 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 low pressure side of valve
   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" ± 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

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

E. Actuators
    1. Manual Actuators
        a. Provide manual actuators for all valves not specified to be power actuated or designed for automatic operation
            i) Actuators shall be totally-enclosed oil or grease-lubricated worm gear or traveling nut type
                a) Worm gear actuators
                    1) Shall be totally enclosed, grease sealed, gear type
                    2) Shall be furnished with AWWA nut, crank, handwheel, or chainwheel
                    3) Shall be sized to meet the torque ratings of AWWA C504
            ii) Actuators shall have AWWA input stops. Actuator shall be self-locking at all variable opening positions
            iii) General use: Handwheel
            iv) Seven (7’- 0”) 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' of the floor or grade below valve

v) Valve box and nut operator
   a) Buried vales shall be operated through valve boxes and as indicated on drawings: Wrench nuts
   b) Non-rising stems:
      1) 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
      2) Connected to the valve by a flexible socket coupling
      3) All other connections pinned, keyed, or socket
   c) Stem guides
      1) Cast iron, bronze brushed, adjustable in two (2) directions
      2) If extension stem length exceeds 10' 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
   d) Max-spacing: Non-rising stems: 100 times stem O.D.
   e) Provide spaces to center stem in valve box
   f) Provide 2 operating keys and wrench nut
   g) Valve boxes
      1) Boxes shall consist of a cast iron cover, lid, and base castings. No slip type boxes shall be allowed
      2) Type: Cast iron or ductile iron, extension sleeve (screw) type
      3) Minimum thickness: 3/16" at any point
      4) Coating: Bituminous varnish
      5) Cast appropriate name designation of service in cover.
      6) Shaft shall be ductile iron and minimum diameter of 5-¼"
      7) An appropriate word designating the valve service case on the cover
   h) Valve box manufacturers
      1) Neenah Foundry Company
      2) Tyler Company
      3) Mueller Company
      4) Or Engineer accepted substitution

b. Rotation
   i) Valves shall open counterclockwise
   ii) The word “OPEN” and a raised cast arrow indicating the direction to open cast on each valve body or operator
   iii) Position indicator clearly visible from operating floor
c. Actuators and handwheels shall be located in positions indicated or as otherwise determined when manufacturer's drawings are submitted to Engineer

2.3 HDPE PIPING (PRESSURE)

A. Manufacturers:
   1. High Country Fusion
   2. JM Eagle
   3. Performance Pipe
   4. WL Plastics

5. ISCO Pipe
6. Or accepted substitution

B. The following piping shall be pressure HDPE pipe for force main application as indicated on the drawings and as specified herein
   1. Force main piping and fittings: 12-inch (nominal) DR-17 HDPE pipe

C. Material:
   1. The pipe shall be manufactured from a PE 4710 resin compound listed in the Plastic Pipe Institute (PPI) Technical Report 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 (i.e., Hydrostatic Design Basis) of 1600 PSI when tested in accordance to ASTM D2837.
   4. Pipe dimensions shall be in accordance with ASTM D3035 as a minimum. The interior diameter of the pipe shall not exceed 11.55 inches.
   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 and shall have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe and/or fitting
   9. The Standard Pressure Rating (SPR) and Pressure Class (PC) shall be at least 125 psi.

D. Fittings:
   1. All fittings shall be PE 4710 HDPE, minimum Cell Classification of 445574C/E as determined by ASTM D3350
   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 Heat 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.
      b. Fusion technique shall be in accordance with ASTM F2620.

E. Pipe fittings and flanged connections, to be joined by thermal butt-fusion, shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier

F. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.

G. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe

H. 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 SOURCE QUALITY CONTROL

A. Identification Marks: Clearly and permanently marked at not greater than 5 foot intervals with pipe diameter, DR classification, manufacturer, plant, shift, ASTM, date designations and service designation

B. Testing per ASTM D3034
   1. Test products not manufactured in the U.S. at an acceptable laboratory in the U.S.

2.5 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 HDPE pipe
   2. Tracer wire shall comply with Section 102.8i of the City Standard Specifications.

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. Corrosion Control
   1. Rust inhibitive primer:
      a. Tnemec "Series 77H Chem-Prime"
      b. Or accepted substitution
   2. Rust preventative compound:
      a. Houghton "Rust Veto 344"
      b. Rust-Oleum "R-9"
      c. Or accepted substitution

2.6 MANHOLES AND VAULTS

A. Precast Concrete Units:
   1. Manufacturers:
      a. Rinker Materials
      b. Old Castle Precast
      c. Forterra
      d. Or accepted substitution
   2. Specification: ASTM C478
   3. Minimum wall thickness: greater of 5 inch or 1/12 of internal diameter
   4. Reinforced
   5. HDPE grade rings as required
   6. Manhole lids located in floodplain areas must have lockable lids

B. Precast Units or Cast-in-place as shown. Use concrete that will attain a 28-day compressive strength of not less than 4500 psi with a cement content of not less than 6 sacks per cubic yd. Openings to be precast per plan. Sawcut in field only if no other option.

C. Cast-in-place Concrete Units: As shown on the drawings complying with the City and Colorado Department of Transportation drainage and design standards

D. Manhole steps are not required.

E. Manholes shall be coated in accordance with City engineering standards and in accordance with Section 09900.

2.7 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
   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 or cast-in-place base

2.8 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: ASTM C39, 4500 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. Manhole rings and covers shall be grey iron conforming to AASHTO M105, Class 30 and shall be designed to withstand HS 20 loading. The standard City of Grand Junction manhole is Castings Inc. MH-310-24 CI or an approved, fully interchangeable substitute.
2. The bearing surfaces between the ring and cover shall be machine finished or ground to assure non-rocking fit in any position and interchangeability. The cover shall have a beveled pick hole that has a width of ¾" at the top and 1" at the bottom. The length of the pick hole (along the circumference of the lid) shall be at least 1½".
3. Covers to seat at all points on ring
4. The word “SEWER” shall be cast in the cover of sanitary sewer manholes.
5. Inverted rings and covers are not allowed unless approved by the City Utility Engineer.
6. Provide type as indicated on the drawings

I. Manhole Height Adjustment: Use LadTech HDPE grade rings or an approved equal

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

2.9 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

2.10 CONCRETE MATERIALS

A. Follow requirements specified in Division 3 Specifications

2.11 SOIL MATERIALS

A. Furnish pipe bedding and cover as specified in Section 02300

PART 3 EXECUTION

3.1 INSPECTION

A. Examine pipe and fittings and do not use individual sections containing cracks, dents, abrasions, and other defects

3.2 INSTALLATION OF HDPE PRESSURE PIPE

A. Trenching, Pipe Embedment, Backfill, and Compaction: See Section 02300

B. Comply with City Standard Specifications for installation of pressure pipelines.

C. Pipe and Fittings

1. Follow pipe manufacturers installation instructions for field cutting and 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
    b. Do not bend pipe beyond the manufacturer's minimum radius of curvature for the selected 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 under provisions of Section 02300
11. Protect pipe from hot and cold thermal expansion using manufacturer and other recommended techniques

D. 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 specified on the drawings.
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, electrofusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

E. 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

3.3 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 02300 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

3.4 PLACING MANHOLE

A. Place manhole sections plumb and level, trim to correct elevations

B. Clean ends of sections and place double mastic gasket

C. Fill inside and outside of joint completely with non-shrink grout and trowel smooth

D. Cure non-shrink grout using approved methods outlined in Division 3 Specifications.

E. 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

F. Completed manholes shall be rigid and watertight

G. Coordinate with other sections of work to provide correct size, shape, and location

3.5 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

3.6 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

3.7 MANHOLE RINGS AND COVERS

A. Place rings in bed of non-shrink grout on top of manholes

B. Ensure no infiltration will enter manhole at this location

C. Carry non-shrink grout over flange of ring

D. The manhole ring and cover shall be set to match the adjacent ground or pavement surface.

E. Use precast HDPE grade rings for height adjustment of manhole ring and cover

3.8 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

3.9 FIELD QUALITY CONTROL – PIPE

A. General
1. Utilize pressures, media and pressure test durations as specified on Piping Schedules
2. Isolate equipment which may be damaged by the specified pressure test conditions
3. 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
4. Completely assemble and test new piping systems prior to connection to existing pipe systems and prior to concrete encasement.
5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance
6. Provide all necessary equipment and perform all work required in connection with the tests and inspections
7. 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. Test for pressure and leakage according to the procedures outlined in Section 105.2 of the City Standard Specifications.
2. Contractor is responsible for providing all equipment, labor, materials, fittings, gauges, and valves necessary to preform pressure testing according to the City Standard Specifications.
3. Contractor shall pressure test the force main prior to concrete encasement.

C. TV Inspection will be conducted by the Owner if the Owner deems it necessary. Contractor shall coordinate installation schedule with Owner to allow Owner to inspect pipe prior to pipe burial.

D. Contractor shall visually inspect all sewer lines 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.

3.10 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.

3.11 FINAL ACCEPTANCE

A. Comply with City 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

END OF SECTION

SECTION 02750

RIGID PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Forming, jointing, placing and curing of concrete pavements, curbs, gutters, cross pans, islands and sidewalks.

1.2 RELATED SECTIONS

A. Section 01020 – Geotechnical Report

B. Section 02300 – Earthwork

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. M171 – Sheet Materials for Curing Concrete

B. American Concrete Institute (ACI):
   1. 214 – Recommended Practice for Evaluating Compression Test Results of Field Concrete
   2. 301 – Specifications for Structural Concrete for buildings
   3. 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
   4. 305/305R – Hot Weather Concreting
   5. 306/306R – Cold Weather Concreting
   6. 308 – Standard Practice for Curing Concrete

C. American Society for Testing and Materials (ASTM):
   1. A1064 – Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete
   2. A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   3. C31 – Making and Curing Concrete Test Specimens in the Field
   4. C33 – Concrete Aggregates
   5. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens
   6. C94 – Ready Mix Concrete
   7. C143 – Test Method of Slump of Hydraulic Cement Concrete
   8. C150 – Portland Cement
   9. C260 – Air-Entraining Admixtures for Concrete
   10. C309/AASHTO M148 – Liquid Membrane-Forming Compounds for Curing Concrete
   11. C494 – Chemical Admixtures for Concrete

12. C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
13. C979 – Pigments for Integrally Colored Concrete
14. C1116 – Fiber Reinforced Concrete
15. D994 – Preformed Expansion Joint Filler for Concrete (Bituminous Type)
16. D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
17. D1752 – Preformed Sponge Rubber Cork Expansion and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
18. D6690 – Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
19. D7508 – Polyolefin Chopped Stands for Use in Concrete

D. CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

E. City of Grand Junction construction specifications, standards and details.

1.4 SUBMITTALS

A. Provide under provisions of Division One Specifications

B. Product Data: Provide sufficient information on mix design and products specified to verify compliance with specifications. Provide data on joint filler admixtures and curing compounds
   1. Existing data on proposed design mixes, certified and complete
   2. Submit reports of field quality control testing

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, Conform materials and installation to applicable portions of Colorado Department of Transportation, and the City of Grand Junction construction specifications, standards and details.

1.6 REGULATORY REQUIREMENTS

A. For work on public streets or rights-of-way conform to the requirements of City construction specifications, standards and details for the Construction of Curbs, Gutters, Sidewalks, Driveways, Street Paving, and other public right-of-way Improvements.

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 cementitious materials and aggregate from same source for all work

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division One Specifications

B. Reinforcing steel: Store on supports which will keep materials from contact with the ground and cover

C. Rubber and plastic materials: Store in a cool place, do not expose to direct sunlight

D. Prepare a delivery ticket for each load of ready-mixed concrete

E. Contractor shall submit tickets for all concrete delivered to site:
   1. Quantity delivered
   2. Actual quantity of each material in batch
   3. Outdoor temp in the shade
   4. Time at which cement was added
   5. Numerical sequence of the delivery
   6. Quantity of water that can be added in the field based on mix design
   7. Free moisture in fine and coarse aggregate in percent by weight
   8. Temperature of batch

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen

B. Protect concrete from rapid loss of moisture during hot water placement

PART 2 PRODUCTS

2.1 MATERIALS

A. Form Materials
   1. Form Materials: Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better
   2. Fiberboard: FS LL-B-810, Type IX, tempered, waterproof, screen back, concrete form hardboard
   3. Capable of supporting loads imposed by construction equipment, straight and free from warp. Clean and strong enough to resist pressure of concrete when placed and retain horizontal and vertical alignment. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete
   4. Joint filler: ASTM D1751 or D1752 type; 3/4-inch thick unless indicated otherwise

B. Reinforcement
   1. Where reinforcement is specified herein or indicated on the plans:
      a. Bars: ASTM A615, Grade 60
      b. Reinforcing Welded Wire Fabric (WWF): ASTM A1064, steel, 16 gage minimum
         i) Furnish in flat sheets
      c. Dowels: ASTM A615; 40 ksi yield, Grade 60, plain steel, unfinished finish
      d. Fibrous reinforcement: Collated, fibrillated, polypropylene fibers, tensile strength 70,000 psi

i) ASTM C1116 and ASTM D7508
ii) Use minimum of 1.5 pounds per cubic yard
iii) Fibermesh or accepted substitution

C. Weed Control: First application, “Roundup.” Second application, Casoron “W-50" or “G-10” with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.2 ACCESSORIES

A. Curing Compound: ASTM C309, AASHTO M-148, white pigmented liquid membrane

B. Joint Sealers: Polyurethane base, elastomeric, self leveling, chemical cure, handling 50% joint movement; Sikaflex-2C-SL or accepted substitutions

C. Sheet Materials: AASHTO M171, 4 mil

D. Expansion Joint Material: 0.5-inch thick, ASTM D1751, asphalt impregnated fiber board, glass fiber or sponge, or closed cell polyethylene foam; Texmastic “vinylex 3600,” Sonneborn “Sonoflex F,” or accepted substitutions

E. Traffic Control Devices
1. Signs.
   a. Comply with City standards and specifications for signs within the public right-of-way.
   b. Sign faces, posts and bases shall be in conformance with the following materials specifications. All nonstandard sign faces, posts and bases must be approved by City. Private property or nonstandard signs will be maintained by the owner. Submit shop drawings for approval prior to fabrication. All signs shall conform to current M.U.T.C.D. Standards and Colorado Supplements. All signs shall be 3M-engineer grade reflective sheeting or accepted substitute.
   c. Traffic/Parking Signs: Sign blanks shall be 6061 or 5052-H38 aluminum alloy .080 inches thick. Facing shall be specified reflective sheeting with standard sign colors based on standard graphics and as shown on the plans.
2. Sign Posts.
   a. For large signs greater than 12”W x 18”H and for multiple signs of any size mounted on the same post: sign posts shall be two (2) inch by two (2) inch galvanized telespar tube.
   b. For regular single signs 12”W x 18”H or smaller: sign posts shall be one and one-half (1-1/2) inch by one and one-half (1-1/2) inch galvanized telespar tube.
   c. Galvanized telespar tube shall have 0.120-inch wall thickness, and three-eighths (3/8) inch holes drilled on one (1) inch centers, all sides over full length, ten (10) feet in length (min).
3. Sign Post Anchor Bases (Stubs). All sign post anchor bases shall be twist resistant square galvanized telespar tube post with thickness and hole pattern the same as sign posts. Use 2-1/4” by 2-1/4” anchor for large posts and 1-3/4” by 1-3/4” anchor for

regular posts. Bases shall be embedded a minimum of 36” below finished grade and shall extend 3” above finished grade.

4. Signs Post Anchor Bases with concrete footing: Sign, post, base and compacted soil shall be rigid and able to withstand wind loads. Where predominantly clay soils are present which will not properly compact at sign base, install a 6” diameter by 36” deep concrete footing around signs post anchor base for all signs in landscaped areas.
5. All signs and posts shall be mounted and secured with municipal-approved vandal-proof type TL-3896 drive rivets with washers, or accepted substitute.
6.

2.3 CONCRETE MIX

A. Comply with ASTM C94

B. Maximum Coarse Aggregate Size: 1-inch

C. Portland Cement: ASTM C150, Type II; 555 pounds minimum per cubic yard of concrete

D. Water/Cementitious Material (Cement and Fly Ash) Ratio: Less than or equal to 0.45

E. Slump: 4-inch maximum
   1. May be increased to 4.5 inches for hand work, acceptable to Engineer
   2. As low as possible consistent with proper handling and thorough compaction

F. Volumetric Air Content: 6.0%±1% after placement for 1-inch aggregate
   1. Vary air content with maximum size aggregate, ASTM C94, Table 3.

G. Strength: Compressive strength as determined by ASTM C39, 4,500 psi minimum at 28 days

H. Consistency: Uniform slump, suitable for the placement conditions with aggregate floating uniformly throughout the concrete mass, flowing sluggishly when vibrated or spaded

I. Adjust mix as required to meet specifications

J. Approved fly ash may be substituted for ASTM C150 cement up to a maximum of 25 percent Class C or Class F by weight of the cementitious material content. Fly ash for concrete shall conform to the requirements of ASTM C618 with the following exceptions:
   1. The loss on ignition shall not exceed 3.0 percent
   2. The CaO in Class F fly ash shall not exceed 18 percent

K. Admixtures: Content, batching method, and time of introduction in accordance with the manufacturer's recommendations for compliance with this specification
   1. Include a water reducing admixture
   2. Calcium chloride content shall not exceed 0.05% of the cement content by weight

L. COLORING

1. ASTM C979 pure mineral pigments, specially formulated for concrete coloring as manufactured by Davis Colors, L.M. Scofield Co., Tamm's or acceptable substitution.
2. Colors: As shown on plans. Provide submittals, samples and 5'x5' test area for each color for approval prior to construction. Assume not less than 4 pounds of color admixture per cubic foot of Type II cement.

2.4 SOURCE QUALITY CONTROL AND TESTS

A. Provide under provisions of Division One Specifications

B. Submit proposed mix design to Engineer for review prior to commencement of work

C. Tests on cement and aggregates will be performed to ensure conformance with specified requirements

D. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads

B. Verify gradients and elevations of base are correct

C. Check completed formwork for grade and alignment to the following tolerances:
   1. Top of forms not more than 1/8-inch in 10 feet
   2. Vertical face on longitudinal axis, not more than 1/4-inch in 10 feet

3.2 PREPARATION

A. Subgrade
   1. Prepare subgrade in accordance with Section 02300
   2. Moisten subgrade to depth of 6 inches at optimal moisture not more than 12 hours prior to placement to minimize absorption of water from fresh concrete
   3. Check for soft spots by proof-rolling or other means prior to setting forms. Remove soft yielding material and replace. Compact to specifications under provisions of Section 02300
   4. Check crown and/or elevation of subgrade to assure specified thickness. Compact to specification additional material used to bring to correct elevation. Remove excess material where subgrade is too high
   5. Clean subgrade of all loose materials before placement of concrete. Do not disturb area inside forms after fine grading is complete
   6. Weed Control
      a. If weeds or vegetation exist at or on the subgrade, apply "Round-up" at rates following manufacturer's instructions. Apply "Round-up" three days prior to removal of vegetation, subgrade preparation and application of Casoron as

described below to allow "Round-up" to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.

b. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to "Round-up" and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.

c. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.

d. Do not apply within 20 feet of trees or shrubs

B. Frame Adjustment
   1. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement for concrete collars
   2. Set frames of structures in full grout bed to provide bearing. Set to final grade
   3. Form construction joints and blockouts as indicated on drawings

3.3 PERFORMANCE AND INSTALLATION

A. Transporting mixed concrete
   1. Transporting of mixed concrete shall conform to ACI 305R
   2. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during handling
   3. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Engineer. If additional water is to be incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.
   4. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Engineer
   5. Provide delivery ticket and comply with delivery requirements of this section

B. Forming
   1. Place and secure forms to correct location, dimension, profile, and gradient

2. Install sufficient quantity of forms to allow continuous progress of work so that forms can remain in place at least 24 hours after concrete placement
3. Join neatly and mechanically tamp to assure firm placement. Assemble formwork to permit easy stripping and dismantling without damaging concrete
4. Oil forms prior to concrete placement
5. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement
6. Set dowels, expansion joints, preformed construction joints and header boards as specified or indicated on the drawings
7. Low roll or mountable curbs may be formed without the use of face form by using a straight edge and template to form curb face
8. Backfill behind forms as required to prevent water from entering subgrade

C. Reinforcement
1. Add fiber reinforcement to mix at plant prior to delivery to jobsite. Mixing shall be as recommended by the manufacturer to distribute the product evenly throughout the concrete mix
2. Place bar or WWF reinforcement at mid-height of slabs-on-grade or as shown on the drawings
   a. Install in as long lengths as possible. Lap adjoining pieces at least one full mesh and lace with wire
   b. Support with metal chairs, brick or stone is unacceptable
3. Hold all tie and marginal dowels in proper position by sufficient supports or pins
4. Mechanically install dowels or place on supports if center longitudinal joint is sawed in lieu of placing plastic strip
5. Interrupt reinforcement at expansion joints
6. Place dowels to achieve pavement and curb alignment as detailed.
7. Provide doweled joints inch at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement
8. Grease dowels on one side of joints with caps on greased end

D. Placing concrete
1. Place concrete in accordance with ACI 301
2. Lightly moisten subgrade or base course immediately before placing concrete.
3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed
4. during concrete placement
5. Deposit concrete near final position. Minimize segregation and damage to subgrade
6. Place concrete continuously over the full width of the panel and between predetermined construction joints. Spread mechanically to prevent segregation and separation of materials
7. Consolidate concrete with vibrators and spade next to forms to remove air spaces or honeycombs
8. Do not place concrete in forms that has begun to set
9. Do not place more concrete in one day than can be finished before dark the same day
10. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement

must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified

11. Walks: Construct sidewalks with a minimum thickness of 4-inch. Tool edges to rounded profile and finish as specified or as shown on the drawings. Pitch walks 1/4-inch per foot for cross drainage unless otherwise indicated

E. Cold weather concreting
   1. Conform to ACI 306/306R, except as modified herein
   2. Minimum concrete temp at the time of mixing

Outdoor Temp at Placement (in shade)	Concrete Temp at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

   3. Do not place heated concrete which is warmer than 80 degrees F
   4. If freezing temp are expected during curing, maintain the concrete temp at or above 50 deg F for 5 days or 70 deg F for 3 days with forms in place
   5. Do not allow concrete to cool suddenly

F. Hot weather concreting
   1. Conform to ACI 305/305R, except as modified herein
   2. At air temp of 90 degrees F and above keep concrete as cool as possible during placement and curing. Fog sprayers or special wetting agents may be required for protection
   3. Do not allow concrete temperature to exceed 70 deg F at placement
   4. Prevent plastic shrinkage cracking due to rapid evaporation of moisture
   5. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.4

G. Joints
   1. Provide concrete joints per CDOT Standard Details
   2. Sidewalk and pavement
      a. Contraction joints: At intervals not to exceed 10 feet and 1 1/2 inches deep, tooled or sawcut
      b. Expansion joints: 1/2-inch premolded joints where sidewalks end at curb returns, against fixed objects, at points of sharp radius, and between sidewalk and driveway slabs. Place expansion joint at minimum of every 100 feet.
      c. Construction joints: At all separate pours, and around all appurtenances such as manholes, utility poles, and other penetrations extending into and through sidewalks. Place backer rod and polyurethane sealant for entire joint length
   3. Curb and Gutter
      a. Contraction joints: At intervals not to exceed 10 feet made by insertion of 1/8-inch template at right angles to curb and 1 1/2-inch deep.

b. Expansion joints: At curb returns, against fixed objects, at points of sharp radius, between adjacent sidewalk and curb at all curb returns, between sidewalk and all driveway slabs, and along straight lengths every 200 linear feet. Install expansion joint filler between concrete sidewalks and any fixed structure. Extend expansion joint material for full depth of concrete, except stop 1/2-inch below finish surface.
c. Construction joints: At all separate pours, place backer rod and polyurethane sealant for entire joint length.

4. Place expansion joint filler between paving components and buildings or other appurtenances at temperatures above 50 deg F. Clean all dust, debris and water from joint. Recess top of filler 1/2-inch for sealant placement.
5. Provide keyed joints as indicated in details.

H. Finishing
1. Run straight-edge over forms with sawing motion to fill all holes and depressions.
2. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
3. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide a continuous smooth finish
4. Finish surfaces with a wooden or magnesium float. Plastering of surfaces is not permitted
5. Immediately after float finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Engineer before application.
6. On inclined slab surfaces and steps, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic
7. Edge all outside edges of the slab and all joints with a 0.25-inch radius edging tool.
8. Work edges of gutters, back top edge of curb, and formed joints with an edging tool, and round to 0.5-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface
9. Brush with soft bristle brush to remove trowel marks and leave a uniform appearance just before concrete takes initial set.
10. Direction of Texturing:
    a. Curb and Gutter: At right angles to the curb line
    b. Sidewalk: At right angles to centerline of sidewalk.
11. Place curing compound on exposed concrete surfaces immediately after finishing. Apply under pressure at the rate of one gallon to not more than 135 square feet by mechanical sprayers in accordance with manufacturer's instructions acceptable to Engineer.

I. Joint sealing
1. Seal joints and clean concrete prior to opening to traffic.
2. Seal all expansion joints.
3. Separate concrete from other structures with 3/4-inch thick joint filler.

4. Place joint filler in concrete pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
5. Extend joint filler from bottom of pavement to within 1/4-inch of finished surface.

J. Curing and protection
1. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury
2. Have plastic sheeting, straw, burlap and/or canvas materials available at all times to protect fresh uncured surfaces from adverse weather conditions
3. Do not permit pedestrian traffic over sidewalks for 7 days minimum after finishing. Do not permit vehicular traffic over pavement for 14 days minimum after finishing or until 75 percent design strength of concrete has been achieved

3.4 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. Comply with City of Grand Junction Standard Specifications for QC and QA testing.

B. It is the Contractor's responsibility to initiate, coordinate and accommodate 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 testing agency 48 hour advance notification to schedule tests.

C. Tolerances
1. Maximum Variation of Surface Grade: 1/4- inch in 10 ft
2. Maximum Variation from True Alignment: 3/8-inch in 10 ft

D. Take cylinders and perform slump and air entrainment tests as required by City of Grand Junction's Standard Specifications. Unit weight and mix temperature will also be taken

E. Four concrete test cylinders will be taken for every 100 cu yds or less cu yds of concrete placed each day

F. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents

G. One slump and air entrainment test will be taken for each set of test cylinders taken

H. Cylinders will be tested as follows: 2 at 7 days and 2 at 28 days

I. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken

J. Thickness of fresh concrete may be checked by Owner at random. Coring will be conducted in accordance with City requirements. Where average thickness of concrete is deficient in thickness by more than 0.20-inch, but not more than 1.0-inch, payment to Contractor will be adjusted based on amount indicated in schedule of values for portland cement concrete paving as specified in the following table.

CONCRETE PAVEMENT DEFICIENCY	
Deficiency in Thickness (Determined by Cores) INCHES	**Proportional Part of Contract Price Allowed**
0.00 to 0.20	100%
0.21 to 0.30	80%
0.31 to 0.40	72%
0.41 to 0.50	68%
0.51 to 0.75	57%
0.76 to 1.00	50%
Over 1.00	NONE

Note: When thickness of pavement is deficient by more than one inch, and judgment of the Engineer is that area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

K. Failure of Test Cylinders or Coring Results: Engineer may order removal and replacement of concrete as required upon failure of 28-day tests or if thickness of pavement is less than 95% of specified thickness

3.5 SCHEDULE OF CONCRETE

A. See plans for concrete thicknesses and subgrade preparation.

3.6 SCHEDULE OF CONCRETE REINFORCEMENT

A. Fiber reinforcement required for all concrete flatwork, including curb and gutter, sidewalk and pavement

END OF SECTION

SECTION 02920

SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Soil preparation

B. Fertilization

C. Seeding methods

D. Areas to be reseeded

E. Seed Mix

F. Maintenance

G. Seed protection and slope stabilization

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02300 – Earthwork

C. Section 02370 – Erosion and Sedimentation Control

1.3 REFERENCES

A. Federal Specification (FS) O-F-241 - Fertilizers, Mixed, Commercial

B. American Association of Nurserymen - Standardized Plant Names

C. Association of Official Seed Analysts (AOSA)

D. Colorado Department of Agriculture (CDA) Seed Act

E. Colorado Department of Transportation (CDOT) Construction Specifications

1.4 SUBMITTALS

A. Submit under Division One Specifications for products related to seeding work including but not limited to seed mixes, mulches, composts, tackifiers, fertilizers and herbicides.

B. Product Data:

1. Certified Live Seed analyses not more than 6 months old by a recognized laboratory of seed testing for grass mixtures including percent of live seed (PLS), germination, all crop seeds in excess of 1 percent, inerts and weeds
2. Manufactures guaranteed chemical analysis, name, trade name, trademark and conformance to state and local laws of all fertilizers and herbicides

1.5 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging

B. Provide a certificate of the PLS test of the grass seed intended for the project, certifying that the seed furnished is from a lot that has been tested by a recognized laboratory within the last 6 months

C. All brands furnished shall be free from such noxious seeds as Russian or Canadian Thistle, Coarse Fescue, European Birdweed, Johnson Grass, Leafy Spurge, field bindweed, kochia, or any state-listed or Grand Junction noxious weed species

D. Any materials that have become wet, moldy or otherwise damaged in transit or in storage will not be used

1.6 QUALIFICATIONS

A. Applicator: Company specializing in performing work of this section with landscaping license from State of Colorado
   1. Experienced with type, elevation, topography and scale of work specified
   2. Adequate equipment and personnel to perform work

1.7 REGULATORY REQUIREMENTS

A. Comply with codes and ordinances of local regulatory agencies for fertilizer and herbicide composition and regulations of Grand Junction and the state of Colorado.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division One specifications

B. All materials and products will remain in original manufacturers shipping bags or containers until they are used. All material or products will be stored in a manner to prevent them from coming into contact with water or other contaminating substance and in a manner that product effectiveness will not be impaired

C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable

D. Commercial fertilizer or commercial herbicide: mixed in original bags or containers of the manufacturer, showing weight, chemical analysis and manufacturer name. Store in such a manner such that product effectiveness will not be impaired

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not prepare or seed frozen soils

B. Perform seeding and planting only after preceding work establishing final ground surface is completed

C. Conduct minimum of two (2) soil tests to confirm fertilizer type and application rates

1.10 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition

1.11 WARRANTY

A. All plant material and work accomplished under this section shall be guaranteed to provide a uniform stand of grass acceptable to the Owner at the end of a one (1) year time period from the completion of the Seeding and Erosion Control work

PART 2 PRODUCTS

2.1 SEED

A. In conformance with State and Federal regulations and subject to the testing provisions of the Associate of Official Seed Analysts (AOSA)

B. Seed Suppliers: Licensed Seed Dealer with Colorado Department of Agriculture

C. Provide the latest crop available in accordance with Colorado Department of Agriculture Seed Laws, Chapter 35, Article 27

D. Compensate for percentage of purity and germination by furnishing sufficient additional seed to equal the specified pure live seed product. The formula for determining the quantity of pure live seed (PLS) is as follows:

Pounds of Seed (Bulk) x Purity x Germination = Pounds of Pure Live Seed (PLS)

2.2 SEED MIX

A. Permanent seed mixes per tables below:

1. Low Elevation Semi/Salt-Desert Grass/Shrubland, Basin big Sagebrush, (8”-10” annual precipitation, grasses only

Common Name	Scientific Name	Pounds/Acre
Indian Ricegrass	*Achnatherum [Oryzopsis] hymenoides*	3.7
Sand Dropseed*	*Sporobolus crytandrus*	0.1
4-Wing Saltbush	*Atriplex conescens*	2.7
Shadscale	*Atriplex confertifolia*	2.0
And at least two of the following:		
Salina Wildrye	*Leymus salinus*	1.0
Alkali Sacaton*	*Sporobolus airoides*	1.0
Western Wheatgrass	*Pascopyrum [Agropyron] smithii*	1.5
And at least one of the following:		
Bottlebrush squirreltail	*Elymus elymoides, Sitanion hystrix*	2.0
Galleta	*Pleuraphis jamesii*	1.0
Purple Three-Awn	*Aristida purpurea*	1.0
	Total	**Min – 11.5 Max – 13.0**

2.3 SOIL MATERIALS

A. Select onsite topsoil: Earth material of loose friable clay loam reasonably free of admixtures of subsoil, refuse stumps, roots, rocks, brush, weeds or other material which can be detrimental to the proper development of site revegetation

2.4 ACCESSORIES

A. Soil Additives (Fertilizer)
   1. Dry fertilizers: Primary element composition by weight of 6-10-5
      a. Nitrogen (N) six (6%) percent of which fifty (50%) per-cent inorganic, phosphoric acid (P_2O_5) ten (10%) percent, and potash (K_2O) five (5%) percent
   2. Commercial fertilizer: Primary element composition by weight of 18-46-0
      a. Nitrogen, eighteen (18%) percent, of which fifty (50%) percent is organic, and phosphoric acid (P_20_5), forty-six (46%) percent
      b. These elements may be organic, inorganic, or a combination and shall be available according to the methods adopted by the Association of Official Chemists
   3. Dry, pelletized or granular, uniform in composition and a free flowing product. Do not use material which has caked, segregated, exceeded the expiration date of application, or be otherwise damaged
   4. Thoroughly mixed by the manufacturer. Clearly identify the contents of each container. Do not use materials and containers previously opened, exceeding the expiration date for application or otherwise damaged
   5. Minimum requirements for all disturbances to receive seeding:

Biological nutrient organic fertilizer (lbs/acre)*	Humate (lbs/acre)	Compost (cys/acre) All areas <2:1 [1/2 inch depth]	Spray on Amendment (lbs/acre) >2:1 slopes only
300	200	65	3,500
*Biological nutrient shall not exceed 8-8-8 (N-P-K)			

B. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass

C. Mulching Material: Straw or onsite grasses from grubbing operation, dry, free from foreign matter detrimental to plant life
   1. Must be certified weed free.

PART 3 EXECUTION

3.1 GENERAL

A. Seed all areas disturbed by construction, including all areas along the roadside ditches

B. Pattern for seeding and fertilization as required by field conditions. In no case shall revegetation occur within 30 days of the application of any chemical weed control substance

C. Engineer to review grading prior to seeding

3.2 SOIL PREPARATION

A. Uniformly place and spread topsoil removed during grubbing and stored on site. Provide minimum thickness of 4 inches to meet finished grade. Key topsoil to the underlying and surrounding material by the use of harrows, rollers or other equipment suitable for the purpose

B. Apply water to the topsoil for compaction purposes in a fine spray by nozzles in such a manner that it will not wash or erode the newly placed soil

C. Exercise care during soil preparation on all embankments so as not to disturb established ground cover. Areas disturbed during the soil preparation will be fertilized and seeded at the discretion of the Engineer in accordance with these documents

3.3 FERTILIZATION

A. Do not proceed with fertilization in adverse weather and unsuitable ground conditions. Examples of these respective conditions may be wind, precipitation, frozen and untillable ground or conditions detrimental to the effectiveness of the application

B. Apply fertilizer in a manner to assure uniform distribution, light watering is acceptable for dispersion

C. In cases where work progress is stopped due to the above conditions, fertilization will begin again, when appropriate conditions exist. The application will begin again with a reasonable overlapping of the previously applied area

3.4 SEEDING METHODS

A. All seeding shall be installed by drilling method. Small areas of restoration may be broadcast seeded if directed by Engineer.
   1. Hydroseeding is not acceptable for this project.

B. Drill seed 0.25 inch to 0.5 inch into the soil. In small areas not accessible to a drill, hand broadcast at double the rate and rake 0.25 inch to 0.5 inch into the soil per CDOT subsection 212.

C. Do not proceed with seeding in adverse weather and unsuitable ground conditions. Examples of these respective conditions may be wind, precipitation, frozen or untillable ground or conditions detrimental to the effectiveness of the application. Per CDOT section 212.03, seeding shall be restricted according to the following time table:
   1. If seeding is conducted in the spring, all seeding shall be performed after the spring thaw but before May 1 of the calendar year of construction.
   2. If seeding is conducted in the fall, all seeding shall be performed after August 1 but before consistent ground freeze in the calendar year of construction.

D. Drilling:
   1. Accomplish seeding by means of an approved power drawn drill, followed by drag chains. The grass drill should be equipped with a satisfactory feeding mechanism, agitation, and double disk furrow openers. Equip drills with depth bands set to maintain a planting depth of approximately 3 to 2 inch and shall be set to space rows not more than 7 inches apart
   2. If inspections indicate that strips wider than the specified space between the rows planted have been left or other areas skipped, the Engineer will require immediate resowing of seed in such areas at the Contractor's expense. The seeding mixture shown in the Materials Section applies at a pure live seed rate per acre
   3. Immediately following seeding apply straw mulch at a rate of one (1) ton per acre
   4. Apply water with a fine spray immediately after each area has been mulched. Saturate to four (4) inches of soil depth
   5. Provide additional watering weekly until revegetation seed has germinated

E. Mulching application:
   1. Apply a minimum of 2 tons of certified weed free hay or 2 ½ tons of certified weed free straw per acre and in accordance with CDOT Section 213, and mechanically crimp into the soil in combination with an organic mulch tackifier.
      a. Prior to winter shutdown or the summer seeding window closure: Uncompleted slopes shall be mulched with 2 tons of mulching (weed free) per acre,

mechanically crimped into the topsoil in combination with an organic mulch tackifier per CDOT subsections 208 and 213.

F. Soil retention covering:
   1. One slopes and ditches requiring a blanket or turf reinforcement mat (trm), the blanket/trm shall be placed in lieu of mulch and mulch tackifier and placed after seeding (native).

3.5 AREAS TO BE RESEEDED

A. Seed all disturbed areas that are damaged or disturbed by the Contractor's activities during the entire project scope

B. Additional areas as requested by the Owner and approved by the Engineer

C. All seeded areas shall be reviewed during the 14 day inspections by the Erosion Control Inspector for bare soils caused by surface or wind erosion. Bare areas caused by surface or gully erosion, blown away mulch, etc. shall be re-graded, seeded, and have the designated mulching applied as necessary, at no additional cost to the project.

3.6 MAINTENANCE

A. Fertilize the seeded areas once a uniform stand of grass has been established

B. Maintain seeded areas until there is an acceptable uniform plant growth. Reseed areas that are not producing a uniform plant growth within five (5) weeks following seeding. Acceptable uniform plant growth shall be defined as that time when the scattered bare spots, not greater than 1 square foot in area, do not exceed three percent (3%) of the seeded area

C. Maintenance period - 1 year

D. Areas that are seeded late in the fall planting season which are not producing acceptable uniform plant growth, as described above, shall be reseeded during the following spring planting season. If such a condition exists, and the Contractor has diligently, in the opinion of the Engineer, pursued the performance of his work, the Owner at his option, may extend the contract completion date and reduce contract retainage. Retainage may be reduced to less than five percent (5%) of the total contract amount, but shall be at least two (2) times the estimated cost of obtaining the required growth in the indicated areas, plus areas which are susceptible to damage by winter kill, washout or other causes

E. Contractor shall control perennial weeds, thistle, spotted and napweed, spurge and other weeds during the maintenance period

3.7 SEED PROTECTION AND SLOPE STABILIZATION

A. Cover seeded slopes with erosion control fabric where grade is 4 to 1 or greater and where indicated on the Drawings and/or Section 02300 and Section 02730. Cover seed with mulch in all other areas

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches

F. Maintain integrity of erosion control fabric until seed germination. If seed is washed out before germination, fertilize, reseed and restore affected areas

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cast-in-place concrete

B. Reinforcing steel

C. Forms

D. Concrete accessories

1.2 RELATED SECTIONS

A. 03600 - Grout

1.3 REFERENCE STANDARDS AND GUIDES

A. Comply with the following except as modified by supplementary requirements of this Project Specification.

B. American Concrete Institute – ACI:
1. 117 – Standard Specifications for Tolerances for Concrete Construction and Materials
2. 214 – Recommended Practice for Evaluating Compression Test Results of Field Concrete
3. 301 – Specifications for Structural Concrete
4. 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete
5. 305 – Hot Weather Concreting
6. 306 – Cold Weather Concreting
7. 308.1 – Guide to Curing Concrete
8. 309 – Guide for Consolidation of Concrete
9. 315 – Details and Detailing of Concrete Reinforcement
10. 318 – Building Code Requirements for Structural Concrete
11. 347 – Guide to Formwork for Concrete
12. 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary

C. American Standards and Testing Materials (ASTM)
1. A615 – Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
2. C31 – Practice for Making and Curing Concrete Test Specimens in the Field
3. C33 – Concrete Aggregates
4. C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
5. C94 – Specification for Ready-Mixed Concrete

6. C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
7. C150 – Specification for Portland Cement
8. C173 or C231 – Test Methods for Air Content of Freshly Mixed Concrete
9. C260 – Air Entraining Admixtures for Concrete
10. C309 – Liquid Membrane-Forming Compounds for Curing Concrete
11. C452 – Standard Test Method for Potential Expansion of Portland-Cement Mortars Exposed to Sulfate
12. C494 – Chemical Admixtures for Concrete
13. C618 – Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral admixture in Portland Cement Concrete
14. D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

D. Concrete Reinforcing Steel Institute (CRSI)
1. DA4 – Manual of Standard Practice
2. P1 – Placing Reinforcing Bars

E. National Institute of Standards and Technology (NIST)
1. PS 1 – Structural Plywood

1.4 PERFORMANCE TOLERANCES

A. Confirm to ACI 117, ACI 301, and ACI 347 as modified herein. In case of conflict, ACI 117 governs.

1.5 SUBMITTALS

A. Submit under provisions of Division 1 specifications

B. Shop Drawings: Reinforcing bar lists, fabrication and placement drawings
1. Indicated bar sizes, spacing, locations, and quantities of reinforcing steel. Bending and cutting schedules shall be included in all shop drawings.
2. Indicate pertinent dimensions, materials, bracing, arrangement of joints and ties, and exact location of openings, framing, and special conditions affecting work
3. All shop drawings shall be original drawings produced by the supplier and shall not be reproductions of the Contract Documents

C. Product Data: Provide sufficient information on products specified to verify compliance with specifications. Provide data on
1. Attachment accessories
2. Admixtures and mixes
3. Curing Compounds

D. Test Reports
1. Submit reports of tentative concrete mix designs and testing prior to placing any concrete, including
   a. Slump range on which the design is based
   b. Total gal of water per cu yd

c. Brand, type, composition, and quantity of cement with manufacturer and plant location identified
d. Brand, type, composition and quantity of fly ash
e. Specific gravity and gradation of each aggregate
f. Ratio of fine to total aggregates
g. Surface-dry weight of each aggregate per cu yd
h. Brand, type ASTM designation, active chemical ingredients and quantity of each admixture
i. Air content and tolerance
j. Water/cementitious material ratio and tolerance
k. Compressive strength based at 7- and 28-day compression tests
l. Submit reports of field quality control testing
m. Time of initial set

2. Submit suppliers certified fly ash test reports for each shipment delivered to concrete supplier
   a. Physical and chemical characteristics
   b. Certification of compliance with the specifications
   c. Signed by Contractor and concrete supplier
3. Existing data on proposed design mixes are acceptable if certified and complete

1.6 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305 when concreting in hot weather.

C. Follow recommendations of ACI 306 when concreting in cold weather.

D. Acquire cement and aggregate from same source for all work

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division 1 Specifications

B. Cement and fly ash: Store in moisture proof enclosures, do not use if caked or lumpy

C. Aggregate: Store to prevent segregation and inclusion of foreign materials, do not use the bottom 6-inch of piles in contact with the ground

D. Reinforcing steel
   1. Store on supports 6” minimum off of ground, which will keep it from contact with ground and protected from oil or other materials detrimental to steel or bonding capability. Cover to prevent unacceptable surface corrosion and contamination.
   2. Tag bundles of reinforcing bars and wire spirals with metal tag showing specification, grade, size, quantity and suitable identification to permit checking, sorting and placing.

E. Rubber and plastic materials: Store in a cool place, do not expose to direct sunlight

F. Prepare a delivery ticket for each load of ready-mixed concrete

G. Truck operator shall hand ticket to Geotechnical Engineer or Third Party Inspector at the time of delivery with ticket to show:
   1. Quantity delivered
   2. Actual quantity of each material in batch
   3. Outdoor temp in the shade
   4. Time at which cement was added
   5. Numerical sequence of the delivery
   6. Quantity of water that can be added in the field based on mix design
   7. Free moisture in fine and coarse aggregate in percent by weight
   8. Temperature of batch

PART 2 PRODUCTS

2.1 FORMS

A. Prefabricated: Symons "Steel-Ply" or accepted substitution

B. Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better

C. Lumber: Straight, uniform width and thickness; free from knots, offsets, holes, dents, and other surface defects

D. Chamfer strips: Clear, white pine, surface against concrete planed

E. Form coating: Colorless biodegradable oil or water based release agent that will not stain concrete and is VOC compliant. Acceptable products: Nox-Crete "Nox-Crete Form Coating", L & M "Debond", or accepted substitution

F. Form Coating where exposed to potable water: Meets NSF Standard 61, Dayton Superior “Clean Strip J1EF”, Hill and Griffith Company “Grifcote LV-50-Plus”

G. Form ties: Removable end, permanently embedded body types with waterstops not requiring auxiliary spreaders, with cones on both ends, embedded portion 1-inch minimum back from concrete face. If not provided with threaded ends, constructed for breaking off ends without damage to concrete.

2.2 REINFORCING STEEL

A. Bars: ASTM A615, Grade 60

B. Bar supports: CRSI Class 1, fabricated from galvanized wire having PVC coated legs

C. Tie wire: 16 ½ gage or heavier, black annealed wire

D. Form and fabricate reinforcing steel in accordance with ACI 315 and 318 and CRSI DA4 except as specified or indicated on Drawings, free from rust, scale and contaminants which will reduce bond.

E. Dowel Adhesive: Hilti “HIT-RE 500 V3”, Powers “PE 1000+”, Simpson “SET-XP”, or accepted substitution.

2.3 CONCRETE

A. Cement: ASTM C150, Type I/II modified cement tested to meet type V for sulfate resistance per ASTM C150 Table 4 and ASTM C452. Cement should have a tricalcium aluminate content of not more than 8 percent.

B. Fly ash: ASTM C618, Class F

C. Fine aggregate: Clean, natural sand, ASTM C33; no manufactured or artificial sand

D. Coarse aggregate: Crushed rock, natural gravel, or other inert granular material, ASTM C33 except clay and shale particles no more than 1%.
   1. Alkali Silica Reactivity: Aggregate shall be considered non-reactive with a documented satisfactory service record for a minimum ten year period used in concrete with similar cementitious material or with an alkali (Na_2O eq.) content in concrete equal or higher than that in the proposed mixture. In the absence of service record the aggregate shall be tested and will be considered non-reactive if it complies with a) or b)
      a. ASTM C1260 14-day expansion less than or equal to 0.1%, or
      b. ASTM C1293 1-year expansion less than or equal to 0.040%

E. Water: Clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or steel.

F. Admixtures
   1. Air entraining agent: ASTM C260; Grace "Darex AEA", Master Builders "MB-VR", Sika Chemical "AEA", or accepted substitution
   2. Chemical Admixtures: ASTM C494, non-corrosive and chloride free.

2.4 ACCESSORIES

A. Membrane Forming Curing Compound: ASTM C309, L&M Construction Materials “Dress & Seal WB30”, BASF "MasterKure CC 200WB”, Euclid “Super Diamond Clear VOX”, Dayton Superior “Cure & Seal 1315 EF”, or accepted substitution.

B. Curing Compound for surfaces in contact with potable water: Meets NSF Standard 61, Dayton Superior “Clear Cure VOC J7WB”, Atlas Tech Products “Atlas Quantum-Cure NSF”, W.R. Meadows “VOCOMP-25”.

C. Epoxy Bonding Agent: ASTM C881, Sika “Sikadur 32 Hi-Mod”, Dayton Superior “Sure Bond J58”, L&M Construction Materials “Epobond”, Dayton Superior “Sure Bond J58”, or accepted substitution. Use when joining new to existing concrete.

D. Non-Epoxy Bonding Agent: ASTM C1059 Type II, Larson Products "Weld-Crete", BASF "MasterEmaco A 660", L&M Construction Materials "Everbond", Dayton Superior "Acrylic Bonding Agent J40", or accepted substitution. Use when joining new to existing concrete when bonding agent cannot be placed immediately prior to placement of new concrete.

E. Patching Mortar: Sika "Sikatop", L&M Construction Materials "Durapatch VOH", or accepted substitution.

2.5 CONCRETE MIX DESIGN

A. Concrete Mix: Measure and combine cement, aggregate, water, and admixtures in accordance with ASTM C94 and ACI 211.1.
   1. Cement: When used in exposed concrete shall be one brand from one source. Do not mix different cements in same element of Work.
   2. Water-Cement Ratio (if fly ash used, water-cement plus fly ash ratio): 0.45 maximum for 4000 psi or 4500 psi concrete, 0.52 maximum for 3000 psi concrete.
   3. Air-Entrainment: Air-entrain concrete exposed to exterior or exposed to liquids. See Table below for requirements.
   4. Chemical Admixtures: Use is optional to aid concrete properties and allow for efficient placement. Manner of use and amount shall be in accordance with manufacturer's written recommendations and as approved by Engineer. Do not use admixtures that increase early shrinkage or negatively affect finishing.
   5. Fly Ash: Use is optional unless otherwise noted. Combine fly ash with cement at a rate of 1 pound fly ash for each pound reduction of cement. Amount of fly ash shall not be less than 15% or more than 25% of weight of cement plus fly ash. When fly ash used, minimum amount of cement designated may be proportionately reduced.
   6. Use no admixtures other than specified, unless approved by Engineer.

B. Class of Concrete:
   1. Furnish in accordance with table. Cement contents listed are minimum values and shall be increased as required to attain other specified characteristics.
   2. Slumps listed are maximum, except when high range water reducer is used. Maximum slump when high-range water reducer is used, 5 inches.
   3. Chloride ion content shall not exceed values listed in ACI 318, Table 19.3.2.1.

Use	28-Day Compressive Strength (psi)	Coarse Aggregate (size no.)	Minimum Cement Content (bags/cu yd)	Air Content (%)
Pipe Encasement	3000	67	4.75	2±1.5

2.6 FABRICATION

A. Reinforcing Steel: Accurately formed, fabricated in accordance with ACI 315 and 318 and CRSI DA4 except as specified or indicated on drawings, free from rust, scale and contaminants which will reduce bond

2.7 SOURCE QUALITY CONTROL

A. Test the proposed concrete mix for each size and gradation of aggregates and each consistency intended for use in the project

B. Aggregates
   1. Sample and test according to ASTM C33
   2. Determine bulk specific gravity in accordance with ASTM C127 and C128

C. Fly Ash: Supplier's chemical composition and physical analysis test

D. Initial set test
   1. In accordance with ASTM C403
   2. Test at 70 degrees F and 90 degrees ambient
   3. Test at 70 degrees F on mix including specific plasticizing and entraining admixtures
   4. Test at 90 degrees F on mix including specified retarding and air entraining admixtures
   5. Fly ash: Supplier's chemical composition and physical analysis test

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions in field or under provisions of Division 1 Specifications

B. Verify requirements for concrete cover over reinforcement

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions

B. Subgrade and bedding shall be compacted and free of frost. If placement occurs at temperatures below freezing, provide temporary heat and protection to remove frost. Do not place concrete on frozen material.

C. Remove standing water, ice, mud, and foreign matter before placing concrete

D. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels with dowel adhesive system.

3.3 FORMS

A. Formwork design, detailing, and installation shall be Contractor's responsibility and shall conform to ACI 347R.

B. Type of forms used is Contractor's option, except as otherwise indicated or shown. Plywood and other wood forms shall have smooth level surfaces treated with form oil or sealer to produce clean release of concrete from forms.
   1. Where wall remain exposed use plywood, prefabricated metal or wood forms; do not use boards. Lay forms out in a uniform pattern with the long dimension of the form placed vertically and joints aligned.
   2. Form ties shall be plastic cone snap ties. Cone shall be min ¾ inch diameter by 1 inch deep. Taper tie through-bolt form ties may be used as an alternate to plastic cone snap ties; conform to details shown. Do not use wire ties on exposed concrete.
   3. Provide ¾ inch chamfer on external corners of exposed concrete.

C. Coat plywood and wood forms with non-staining form release agent. Apply release agent before reinforcement is placed.

D. Clean, patch, and repair form material before reuse.

E. Formwork shall prevent leakage of mortar, shall not deflect under weight of concrete and workmen, and shall withstand fluid pressure of concrete. Maximum deviation from a true plane: 1/8 inch within 6 feet

F. Brace or tie forms to maintain desired position, shape, and alignment during and after concrete placement

G. Design to produce hardened concrete to the shape, lines, and dimensions indicated on the drawings

H. Plywood or lined forms are not required for surface normally submerged or not normally exposed to view

I. Other type of forms may be used for surfaces not restricted to plywood or lined forms as backing for form lining

J. Flat segmental forms, 2 foot maximum width, may be used for curved surfaces 25 feet minimum diameter

K. Provide polyethylene film to protect concrete from water loss when placing concrete against gravel or crushed rock not containing 25 percent minimum material passing a No. 4 sieve, lap joint 4 inches

L. When placing concrete against rock, remove all loose pieces of rock and clean exposed surface with high pressure hose

M. Size and space wailers, studs, internal ties and other form supports so proper working stresses are not exceeded

N. Locations to be finished to a specified elevation, slope, or contour, bring form to true line and grade and provide a wooden guide strip at the proper location in the forms for finishing the top surface with a screed or template

O. Provide temporary opening at the bottom of columns and wall forms and wherever necessary for cleaning and inspection

P. Install form ties on exposed surfaces in uniformly spaced vertical and horizontal rows

Q. Do not remove or disturb until concrete has attained sufficient strength to safely support all dead and live loads

R. Maintain forms in place for a minimum of 40 hours for length of curing time in accordance with ACI 306/306R when temperature is 45 deg F and below

S. Remove forms carefully to prevent surface gouging, corner or edge breakage and other damage

3.4 REINFORCING STEEL

A. Accurately position reinforcing steel on supports, spacers, hangers, or other reinforcing steel at maximum intervals of 4 feet on center

B. Secure with wire ties or suitable clips. Tie 50 percent of all reinforcement and reinforcement at intersections for wall and floor construction

C. Except at contact splices, minimum clear distances between bars, the greater of
   1. Nominal diameter of bars
   2. 1.5 times max size of coarse aggregate

D. Splices
   1. As specified or indicated on the drawings
   2. Splices at other locations will be acceptable, if approved by the Engineer
   3. Do not weld or tack weld reinforcing steel
   4. Remove and replace steel upon which any unauthorized welding has been performed

3.5 EMBEDMENTS

A. Accurately position and securely anchor in forms, anchor bolts, steel shapes, conduit, sleeves, masonry anchorages, and other materials to be embedded in concrete

B. Cast pipe and other embedded items into concrete as placement progresses. Do not provide blockouts.

C. Place items constructed of dissimilar metals to avoid physical contact with reinforcing. Secure item and reinforcing to ensure they will not shift and come into contact during

concrete placement. Contact between reinforcing steel and other metal, other than bare, coated, or plated carbon steel not permitted.

D. The following restrictions shall be adhered to, unless otherwise noted
   1. No duct, conduit, pipe, or fitting placed vertically shall be larger in cross-sectional area than 4% oc column into which it is placed.
   2. Duct, conduit, pipe, and fittings, when placed within slabs or walls
      a. Shall not be larger than 1/3 thickness of slab or wall
      b. Shall be placed within the middle 1/3 of slab or wall where possible
      c. Shall not be placed closer than 3 outside diameters clear from each other when parallel
      d. Shall cross each other at right angles
      e. Shall be secured to prevent shifting of "floating" during concrete placement
      f. Multiple conduits shall not cross each other at the same location
      g. Except for conduits that must run up a column, keep conduits a minimum of 2 to 3 feet away from columns
      h. Where conditions require conduit to be tied to the inside face of the reinforcing mat, the conduit shall be galvanized steel or PVC, shall be placed 3 outside diameter clear away from the parallel reinforcement bar.
   3. Reinforcing steel shall be in place before embedded items placed and reinforcing cut or removed shall be replaced with additional reinforcing as indicated.
   4. Do not pass sleeves through columns or beams without Engineer's approval.

E. Anchor bolts
   1. Unless installed in pipe sleeves, provide sufficient threads on anchor bolts to permit a nut on the concrete side of the form or template
   2. Install a second nut on the other side of the form or template
   3. Adjust the nuts to hold the bolt rigidly in the proper position

F. Clean embedments before installation

3.6 TRANSPORTING MIXED CONCRETE

A. Transporting of mixed concrete shall conform to ACI 304R.

B. Maximum delivery time from batch plant is 90 minutes

C. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

D. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Engineer. If additional water is to be incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.

E. Notify Special Inspector of any water added to the concrete mixture

F. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Engineer

G. Provide delivery ticket to Special Inspector or Owner and comply with delivery requirements of this section

3.7 PLACING CONCRETE

A. Place concrete in accordance with ACI 304, ACI 301, and ACI 318

B. Schedule and attend pre-pour meeting with Owner at least 7 days before first pour to review requirements of this specification

C. Notify Engineer and Owner not less than 48 hours in advance of the times and places at which contractor intends to place concrete

D. Predetermine limits at each pour and place all concrete within limits of pour in one continuous operation

E. Rigidly secure forms, reinforcing steel, embedment, and anchor bolts in proper position

F. Remove all mud, water, ice, snow, frozen material, and debris from space to be occupied by concrete

G. Clean surfaces encrusted with dried concrete from previous concrete operations

H. Convey to the point of final deposit by methods which will prevent separation or loss of ingredients

I. Place concrete in final position without being moved laterally more than 5 feet

J. Place concrete in horizontal layers not more than 2 feet of depth to allow for proper consolidation

K. Place subsequent layer while the preceding layer is still plastic

L. Top finish concrete when thoroughly settled

M. Remove all laitance, debris, and surplus water from the tops of the forms by screeding, scraping or other effective means

N. Overfill the forms for walls whose tops will be exposed to the weather and screed off the excess after the concrete has settled

O. Allow concrete in walls and columns to settle at least 2 hours before concrete is placed in structural systems to be supported by the walls and columns

P. Clean concrete spatter and other foreign substances from surfaces not in contact with concrete.

3.8 BONDING TO HARDENED CONCRETE

A. Place new concrete on rough, clean, damp faces of existing concrete

B. Roughen concrete to be bonded to future concrete to 1/4 inch amplitude

C. Remove surface mortar of smooth surfaces to expose aggregate

D. Clean hardened concrete of all foreign substances, including curing compound, washed with clean water, and keep saturated for 24 hrs preceding placement of fresh concrete

E. Apply epoxy bonding agent for bonding to hardened concrete

3.9 CONSOLIDATION

A. Thoroughly consolidate concrete during and immediately after placement

B. Work concrete around all reinforcements and embedments and into the corners of the forms

C. Use mechanical vibrators which will maintain 9,000 cycles per minutes when immersed in the concrete, 1 ½ hp motor minimum

3.10 COLD WEATHER CONCRETING

A. Conform to ACI 306, except as modified herein

B. Minimum concrete temp at the time of mixing

Outdoor Temp at Placement (in shade)	Concrete Temp at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

C. Do not place heated concrete which is warmer than 80 degrees F

D. If freezing temp are expected during curing, maintain the concrete temp at or above 50 deg F for 5 days or 70 deg F for 3 days with forms in place

E. Do not allow concrete to cool suddenly

3.11 HOT WEATHER CONCRETING

A. Conform to ACI 305, except as modified herein

B. At air temp of 90 degrees F and above keep concrete as cool as possible during placement and curing

C. Do not allow concrete temperature to exceed 80 deg F at placement

D. Prevent plastic shrinkage cracking due to rapid evaporation of moisture

E. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.5

3.12 CONSTRUCTION JOINTS

A. Unless otherwise noted, construction joints shown are optional. Joints not shown on Drawings shall be approved by Engineer. Locate to miss splices in reinforcement.

B. Limit size on concrete pours. Maximum length of wall and slab pours shall not exceed 60 feet.

C. Before concrete placed, construction joints shall be cleaned, laitance removed, and surface wetted. Remove standing water.

D. Construction joints shall have keys or roughened surfaces. Where roughened surfaces are used, surface shall have amplitude of ¼ inch minimum.

E. Install construction joints in slabs perpendicular to the planes of their surfaces

3.13 FINISHING SLABS AND FLATWORK

A. Slab Finishes:

Description	Concrete Finish
Surfaces to Receive Grout or Topping	Float
Submerged and Buried Slabs	Float
Exterior Exposed Slabs	Float and Broom Finish
Exterior Stairs and Walks	Float and Broom Finish

B. After placement, screed concrete with straightedges, power strike-offs or vibrating screeds.

C. After screeding, bull float or darby surfaces to eliminate ridges and to fill in voids left by screeding.

D. Float:
1. Use magnesium or aluminum hand floats or power floats with slip on float shoes.
2. Float finish shall result in uniform smooth granular texture.

E. Broom Finish: Use fine, soft-bristled broom and broom at right angles to direction of traffic to give nonskid finish approved by Engineer.

3.14 FINISHING FORMED SURFACES

A. Remove fins and other surface projections from all formed surfaces except exterior surfaces that will be in contact with earth backfill and are not specified to be dampproofed

B. Use a power grinder, if necessary, to remove projections and provide a flush surface

C. Remove fins and fill all tie holes on surfaces exposed to view
   1. Clean, dry and fill plastic cone snap tie holes with Patching Mortar. Fill taper tie through-bolt form tie holes with Non-Shrink Grout.
   2. Finish flush to match the texture of adjacent concrete

3.15 CURING AND PROTECTION

A. Protect concrete from frost and keep moist for min curing period of 7 days after placement in accordance with ACI 308.
   1. Formed Surfaces:
      a. Wet cure by spraying surfaces as frequently as drying conditions may require to keep concrete surfaces moist.
      b. Surfaces may be cured by leaving forms in-place. For vertical surfaces, apply water to run down inside of forms, if necessary, to keep concrete moist.
      c. After forms are removed, wet cure for remainder of curing period or apply curing compound.
      d. Do not use curing compound where mortar, grout, concrete, or other coatings or adhesives will be applied.

B. Flatwork:
   1. Cure using curing compound or wet cure.

C. Curing Compound:
   1. Apply curing compound at uniform rate sufficient to comply with requirements for water retention as specified and as measured in accordance with ASTM C156.
   2. Cover areas subjected to direct sunlight with ambient temperature expected to exceed 80°F with white pigmented compound, other surfaces may be covered with fugitive dye compound.

D. Water curing
   1. Begin water saturation as quickly as possible after initial set
   2. Regulate water application to provide complete surface coverage with minimum runoff
   3. Interrupt the application of water to walls for grout cleaning only over the area being cleaned at the time and do not permit the surface to become dry during such an interruption

E. Protect from damaging mechanical disturbances, load stresses, heavy shock, and excessive vibration.

F. Protect finished concrete surfaces from damage caused by construction equipment, materials, and methods, and from rain or running water.

3.16 REMOVAL OF FORMING AND SHORING

A. Do not remove forming or shoring until member supported has acquired sufficient strength to safely support own weight and any imposed loads. Forming shall remain in place for at least min time recommended by ACI 347R. In addition, forming for

horizontal members shall remain in place minimum 7 days. In no case shall forming for horizontal members be removed before concrete has reached 70% of specified design strength.

B. Reshore areas as required to carry additional imposed loads.

3.17 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. General:
1. Prior to starting repair work, obtain Engineer's approval of proposed repair techniques and materials.
2. Method of repair shall not adversely affect the appearance of the finished structure.
3. Develop repair techniques on portion of as-cast surface selected by Engineer. Surface of repair remaining exposed to view shall match color and texture of adjacent surfaces.
4. Prepare surfaces, apply and install materials, and cure as recommended by material manufacturers.

C. Defective Areas:
1. Remove honeycombing, stone packets, spalls, and other defective concrete down to sound concrete. If chipping required, make edges perpendicular to surface. Do not feather edges.
2. Fill defective area with patching mortar

3.18 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. Field inspection and testing will be performed in accordance with City of Grand Junction testing requirements and frequencies for concrete in the City's Standard Specifications

B. Owner's geotechnical consultant provide field and compressive strength tests to determine compliance of concrete materials in accordance with the City's Standard specifications.

C. The Owner shall pay for Quality Assurance compressive strength tests to determine compliance of concrete material in accordance with the specifications. The Owner is responsible for all Quality Assurance testing.

D. The Contractor shall pay for Quality Control compressive strength tests, air content, slump and temperature. The Contractor is responsible for all Quality Control testing.

E. Concrete Field Tests
1. Tests by ACI certified technician
2. Concrete Test Samples: Samples for acceptance tests on concrete shall be obtained in accordance with ASTM C172 at the point of placement or discharge.
3. Provide all equipment, supplies, and the services of one or more employees, as required

4. The test frequencies specified are minimum. Additional tests may be performed as required by the job conditions

F. Slump: Comply with the City of Grand Junction Standard Specifications for slump testing frequencies.

G. Air Content: Comply with the City of Grand Junction Standard Specifications for air content.

H. Compression Tests
   1. Provide one set of 4 cylinders each day when up to 50 cu yds have been placed
   2. Make one additional set of 4 cylinders for each additional 50 cu yds or each major pour placed in one day
   3. Test two cylinders in each set at 7 days
   4. Test two cylinders in each set at 28 days
   5. Engineer will evaluate in accordance with ACI 214 and 318
   6. Make, cure, store, and deliver cylinders in accordance with ASTM C31
   7. Test in accordance with ASTM C39
   8. Mark or tag each set of test cylinders with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders was placed, the delivery truck or batch number, the air content, and the slump

I. Storage Facilities for Concrete Test Cylinders
   1. Including water necessary, a specially prepared box with high-low thermometer and thermostatically controlled heating devices in accordance with ASTM C31

J. Failure of Test Cylinder Results: Evaluation of concrete structures where laboratory-cured cylinders fail to meet 28-day concrete strength requirements of the contract documents will be subject to, but not limited to, the following measures.
   1. Upon failure of 28-day test cylinder results, the Engineer may require the Contractor, at his expense, to obtain and test at least three 4-inch diameter cored samples from area in question
   2. Concrete will be considered adequate if average of three core tests is at least 85 percent of, and if no single core is less than 75 percent of, the specified 28-day strength. Where concrete durability is a concern due to freeze thaw or sulfate exposure the Engineer may reject concrete that passes ACI 318 core testing criteria for strength, but fails to meet acceptance criteria for cylinder testing.
   3. In the event an area is found to be structurally unsound, the Engineer may order removal and replacement of concrete as required. The cost of the core tests and removal and replacement of defective concrete shall be borne by the Contractor
   4. Fill all core holes as specified for repairing defective concrete

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Patching cavities in concrete

B. Other grouting specified or indicated on Drawings

1.2 RELATED SECTIONS

A. Section 03300 – Concrete

1.3 REFERENCES

A. ASTM C109 – Test Method for Compressive Strength of Hydraulic Cement Mortar

B. ASTM C157 – Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete

C. ASTM C191 – Time of Setting of Hydraulic Cement by Vicat Needle

1.4 SUBMITTALS

A. Submit under provisions of Section 01340

B. Product Data: Provide manufacturer's catalog sheet for material indicating test data and physical properties

1.5 QUALITY ASSURANCE

A. Conform to applicable industry standard, Corps of Engineers, Specification CRD-C 621 - Specification for non-shrink grout

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Non-Shrink, Non-Metallic Grout
   1. Master Builders - Masterflow 928
   2. M.R. Meadows - Sealtight 588
   3. Sonneborn - Sonogrout 10K
   4. Euclid - Tammsgrout Supreme
   5. Sika - SikaGrout 212
   6. Or accepted substitution

B. Epoxy Grout
   1. L&M Inc. - Epogrout
   2. Sika - Sikadur 42, Grout Pack
   3. Or accepted substitution

2.2 MATERIALS

A. Non-Shrink, Non-Metallic Grout: Factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 4000 psi in one day and 8000 psi in 7 days
   1. Cement mortar used in construction or maintenance of manholes, inlets, vaults, etc., shall be a non-shrink grout conforming to ASTM C-109 and ASTM C-191.
   2. Grout used for setting/adjusting cast iron manhole rings shall be QUIKRETE® Rapid Road Repair (No. 1242) or an approved an equal.

B. Epoxy Grout: Three Component Epoxy Resin System
   1. Two liquid epoxy components
   2. One inert aggregate filtered component
   3. Each component furnished in separate package for mixing at job site

C. Water: Clean and free from deleterious substances

PART 3 EXECUTION

3.1 PREPARATION

A. Non-Shrink, Non-Metallic Grout
   1. Clean concrete surface to receive grout
   2. Saturate concrete with water for 24 hrs prior to grouting and remove excess water just prior to placing grout
   3. Cold weather conditions
      a. Warm concrete, substrate and base plate to 40 deg F, or above; store grout in warm area
      b. Follow manufacturer's recommendations for cold weather application
   4. Hot weather conditions
      a. Use cold mixing water and cool base plate if possible; store grout in cool area
      b. Follow manufacturer's recommendations for hot weather application
   5. Apply to clean, sound surface
   6. Apply latex bonding agent to hardened concrete, mix-in-grout, or as directed by Engineer

B. Epoxy Grout: Apply only to clean, dry, sound surface

3.2 APPLICATION

A. Non-Shrink, Non-Metallic Grout
   1. Mix in a mechanical mixer
   2. Use no more water than necessary to produce flowable grout

3. Provide air vents where necessary to eliminate air pockets
4. Place in accordance with manufacturer's instructions
5. Where exposed to view finish grout edges smooth
6. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound
7. Wet cure grout for 7 days, minimum
8. Maintain the temperature at a minimum of 40 deg F until grout reaches 3000 psi
9. After placement of grout, eliminate excessive external vibration

B. Epoxy Grout
1. Mix and place in accordance with manufacturer's instructions
2. Completely fill all cavities and spaces around dowels and anchors without voids
3. Obtain manufacturer's technical assistance as required to insure proper placement

3.3 SCHEDULE

A. Non-Shrink, Non-Metallic Grout: General Use
1. Grouting of manhole covers, pipe inlets, and precast manholes and vaults

B. Epoxy Grout
1. Patching cavities in concrete including, but not limited to, tie holes, and structural and equipment support

END OF SECTION

SECTION 09900

COATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Coating of surfaces as noted on the Drawings and as specified herein, including:
   1. Interior surfaces of the riser, cone and other exposed concrete surfaces of manholes.

1.2 REFERENCES

A. MSDS: Material Safety Data Sheets

B. ASTM: American Society for Testing and Materials

C. SSPC: The Society for Protective Coatings

D. OSHA: Occupational Safety and Health Administration

E. NSF: National Sanitation Foundation

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's literature including application recommendations and generic makeup for each coating scheduled.
   2. Factory or shop-applied primer manufacturer's literature including application recommendations and generic makeup shall be submitted with all material and equipment submittals. All primers shall conform to the requirements of this Section.

B. Samples:
   1. Actual color samples available for each coating scheduled.

C. Miscellaneous:
   1. Schedules:
      a. Schedule of proposed coating systems within 60 days after Notice to Proceed.
      b. Schedule of proposed coating systems shall contain all information as indicated in Coating Schedule included herein.
   2. Submit one copy of manufacturer's MSDS, for each type of coating, to Engineer's field office for information. Contractor shall post copy of MSDS on Site at all times coating is in progress.

D. Submit in accordance with Section 01340.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. All coatings shall conform to OSHA requirements for allowable exposure to lead and other hazardous substances.

B. Applicator Qualifications:
   1. Engage an experienced field applicator with a minimum of 5 yrs successful experience and who has successfully completed coating system applications similar in material and extent to those indicated.

C. Single-Scource Responsibility:
   1. Provide coating material produced by same manufacturer for each system.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to site in original containers with labels intact and seals unbroken.

B. Protect and heat or cool material storage location to maintain temperature ranges recommended by coating manufacturers, but not less than 55° F.

C. Avoid danger of fire. Oily rags and waste must be removed from buildings each night or kept in appropriate metal containers. Provide fire extinguishers of type recommended by coating manufacturer's in areas of storage and where finishing is occurring. Allow no smoking or open containers of solvent.

D. Empty containers shall have labels canceled and clearly marked as to use.

1.6 PROJECT / SITE CONDITIONS

A. Environmental Requirements:
   1. Dry-heat and ventilate areas to obtain conditions recommended by coating manufacturer.
   2. Relative humidity conditions as specified by coating manufacturer shall be adhered to.
   3. No unprotected, unheated exterior coating shall be undertaken when cold, damp, foggy, or rainy weather appears probable, nor when the temperature of the substrate is below 55° F, unless approved in writing by coating manufacturer.
   4. Maintain manufacturer's environmental requirements until coating is fully cured.
   5. Apply no coating in areas where dust is being generated.
   6. Testing and disposal of any waste and coating shall be the responsibility of the Contactor.

B. Upon Substantial Completion, remaining unused material will become property of Owner. Seal material as required for storage, mark contents with color, type, location, and shelf life, and store on Site where required by Owner. Provide minimum of two gallons of each system component and color used.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers:
   1. Sherwin Williams
   2. Tnemec
   3. Sauereisen

2.2 MATERIALS

A. Sherwin Williams “Dura-Plate 6100”

B. Sauereisen “Sewergard 210 XHB

C. Tnemec Series G435 Perma-Glaze

D. All drop manholes (manholes with fall greater than 0.40’ fall through the manhole), force main outlet manholes, and lift station wet wells shall be coated on the interior surfaces of the riser, cone and other exposed concrete surfaces with a minimum 100 mil dry film thickness, haze grey color, (Part A B62-450, Part B B62V450); Tnemec Perma-Glaze Series 435; Sauereisen SewerGard 210 XHB; or an approved equal.

2.3 THINNING, MIXING, AND TINTING

A. Where thinning is necessary, only the products of the manufacturer furnishing the coating will be allowed. All such thinning shall be done in strict accordance with coating manufacturer’s recommendations.

B. Mixing shall be accomplished using a low speed drill with a jiffy mixer or paddle. Epoxy shall be mixed in a clean dry container free of foreign matter or debris. Mixing rates shall be as recommended by the manufacturer.

C. Each coat shall be slightly darker than preceding coat, unless otherwise noted. Tint undercoats similar to finish coat.

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.

B. Provide the Engineer with a minimum of 3 days advance notice of completion of surface preparations and start of applications.

C. Engineer inspection of the manhole is required prior to application of the product to ensure proper surface preparation has been accomplished.

3.2 SURFACE PREPARATION

A. All surfaces to be coated shall be prepared as specified herein and in accordance with coating manufacturer's recommendations. The object shall be to obtain a uniform, clean, and dry surface.

B. The surface of the concrete to be coated shall be free of bug holes or other imperfections that may allow for porosity in the coating.

C. Quality of surface preparation described herein is considered a minimum. If coating manufacturer requires a higher degree of preparation, comply with coating manufacturer's recommendations.

D. Where surface dryness is questioned, test with dampness indicating instrument. Do not apply coatings over surfaces where moisture content exceeds that permitted by coating manufacturer.

E. If recoat time between application of primer and second coat or between top coats is exceeded, scarify surface before applying coatings. Conform to top coat manufacturers recommendations.

F. Concrete:
   1. The epoxy coating shall be applied to concrete after concrete has cured 28 days or steam cured over 24 hours or as required to meet the 28-day strength requirements.
   2. Repair surface defects/voids as recommended by coating manufacturer.
   3. The surface of the concrete to be coated shall be free of bug holes or other imperfections that may allow for porosity in the coating.
   4. After cleaning, surfaces shall be washed and all dust, sand, and loose particles removed by vacuuming. If Contactor elects to blow off the surfaces with air, it shall be oil-free air and the method shall conform to OSHA requirements.

3.3 APPLICATION

A. Surfaces shall be dry at time of application.

B. Air surface temperature during application and curing shall be 50 Degrees F or above.

C. The minimum surface temperature shall be 55°F and rising. Some coatings are modified so that they may be applied at lower temperatures, conform to manufacturer's recommendations.

D. Apply at a minimum of 100 mils dry film thickness (DFT) in one or two coats. Apply in strict accordance with manufacturer's recommendations by brush, roller, spray, or other application method. The number of coats and thickness required is the same regardless of application method.

E. Each coat shall be allowed to dry in accordance with manufacturer's requirements. Drying time shall be construed to mean "under normal conditions". Where conditions other than normal exist, because of weather or because of confined space, longer times will be necessary. Units shall not be put in service until coatings are thoroughly dry and cured.

F. Surfaces to be coated that will be inaccessible in the completed work shall receive the final coat before enclosure.

G. Coatings shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Areas cut-in by brush prior to rolling shall have uniform appearance in comparison with adjoining surfaces.

H. Make edges of coating adjoining other materials or colors sharp and clean without overlapping.

I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of field applied prime coat or intermediate coat. This includes, but is not limited to: between pipe flanges, pipe flange/barrel joints, equipment fittings, and other narrow openings.

J. Manufacturer-Applied Coatings:
   1. Repair abraded areas on factory-finished items in accordance with equipment manufacturer's recommendations.
   2. Blend repaired areas into original finish.

3.4 FIELD QUALITY CONTROL

A. Check applications for required dry film thickness (DFT)

B. For manholes, after the structure is installed and backfilled, all surfaces covered with an epoxy coating shall be tested with an electric Holiday detector. The voltage and specific methods of testing shall be as recommended by the manufacturer of the coating material. The Contractor and applicator are responsible for completing Holiday testing. The Onwer and/or Engineer shall be present during Holiday testing.

C. Examination of Work on Site by coating manufacturer's representative shall be performed when requested by Engineer.

D. Coverage:
   1. 2. If coverage fails to meet DFT requirements, Engineer reserves the right to require additional application of coating at no extra cost to Owner.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

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. Grounding Materials

B. Related Sections:
   1. Section 01340 – Shop Drawings and Product Data
   2. Section 01500 – Construction Facilities and Temporary Controls
   3. Section 01600 – Materials and Equipment
   4. Section 01730 – Operation & Maintenance Data
   5. Section 02300 – Earthwork
   6. Section 03300 – Cast-In-Place Concrete
   7. 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 wastewater lift station. 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: ¾ inch unless otherwise specified, or ½ 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 rigid steel conduit or aluminum 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 (RGC).
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. 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.
3. 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.
4. 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.

5. Flexible Sealing Compound
a. "Duxseal" as Manufactured by Johns-Manville.
b. "Permagum" as Manufactured by In mount.
6. Coal Tar Epoxy Paint
7. 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.

8. 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.
9. 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

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 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.
    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. 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, de-burred, 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 ¾", except ½" 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. Direct buried – installed per detail on the drawings
   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. On PVC conduit runs, RGC 90 degree angles shall installed where the conduit turns up out of the ground.
   g. Isolate intercommunication and milliampere level instrumentation circuits from all power wiring raceways, conduits, boxes, vaults, manhole and handhole.
   h. 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.

G. 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.

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 16900

INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the furnishing and installation of metering and control equipment which shall include the following principal items:
   1. Metering and Control Systems. Principal components of the metering and control systems shall be as listed on the "Instrument List" at the end of this section and shall include the PLC system as is shown on the Drawings.
   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 panels and instruments, and provide functional diagrams and schematics regarding connection and interaction with other equipment.

B. Related Sections
   1. Section 01600 – Materials and Equipment
   2. 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, interdevice 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 in a CD-ROM or DVD. All AutoCAD drawings shall be provided in PDF and DWG formats.

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 Materials and Equipment – Section 01600, Electrical – Section 16050, 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% percent of measured span.
        ii) Flow Rate: magnetic or transit time ultrasonic metering: 1.5 percent of full scale between 1.0 and 100 percent 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.

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. 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 AEGISPowerline 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% percent 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 percent 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 120vac power that have the signal from the instrument going to a panel, shall be provided 120vac from that panel. The 120vac circuit to these instruments shall be individually fused.

2. 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.

3. 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.

4. 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 indicted on the "Instrument List" at the end of this specification.

2.4 MATERIALS & EQUIPMENT

A. 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 percent. 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 +/- 2.0 percent 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.

B. 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 two (2) grounding rings. Flange diameter and bolt drilling pattern shall comply with ANSI/ASME B16.5, Class 150. Meters shall be suitable for the maximum range of working pressures of the adjacent piping. Electrode 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 below grade shall be IP68/NEMA 6P protected.
      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. Meters shall be Rosemount Type 8750W, Endress+Hauser Promag W 400, Krohne or approved equal.

   2. Magnetic Flow Meter Signal Converters
      a. Magnetic Flow Meter Signal Converters shall be compact or separately mounted, microprocessor-based signal converters. They shall be provided for the magnetic flow meters. The signal converters shall include output dampening, self-testing, integral digital indicator, built-in calibration capability, and an "empty pipe zero" contact input. The overall accuracy of the magnetic flow meter transmitter and signal converter shall be +/-1.0 percent of actual flow rate for full-scale settings of

0.3 to 30 fps. The signal cable between the converter and the magnetic flow meter shall be furnished by the meter manufacturer. The signal converter shall be housed in NEMA Type 4X housing and shall be suitable for operation over an ambient temperature range of -30° to +140°F, and relative humidity of 10 to 100 percent. The converter shall provide HART communication protocol.

b. The signal converter shall have a seven-digit, non-reset totalizer on the face of the enclosure. Local electronic indicators shall be provided. Indicators shall be mounted on or near the flow meter signal converters in weatherproof NEMA Type 4 housings. Indicators shall be four-digit LCD type and shall read in engineering units.

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 2-hour session, and the schedule shall be arranged and coordinated with the Engineer.

3.3 INSTRUMENT LIST

Grand Junction Tiara Rado Force Main
Instrument List

Tag #	Description	Service	Scale	Provided Under Specification
FE/FIT-102	12" FORCE MAIN FLOW	MAGNETIC FLOW METER		16900

END OF SECTION

SECTION 16950

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.1 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. HMI software
   3. Programming

B. Related Sections
   1. Section 01600 – Materials and Equipment
   2. Section 16050 – Electrical
   3. Section 16900 – Instrumentation & Controls

1.2 REFERENCES

A. ISA 5.1 – Instrumentation Symbols and Identification

B. NEMA ICS 1 – General Requirements for Industrial Control and Systems

C. DEMA ICS 3 – Industrial Control and Systems: Factory Built Assemblies

D. NEMA ICS 6 – Industrial Controls and Systems: Enclosures

1.3 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

1.4 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

1.5 SUBMITTALS

A. Submittals shall be required as noted in Section 16900.

1.6 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.

1.7 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 2 PRODUCTS

2.1 GENERAL REQUIREMNTS

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.
3. Acceptable Manufacturers.
   a. PLC – Siemens Simatic 1212C 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

2.2 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/Output Modules
         i) Analog Input Modules
            a) Number of Inputs: 4
            b) Signal Range: 4-20mA
            c) Module shall be Allen Bradley SM1234.
         ii) Analog Output Modules
            a) Number of Inputs: 2
            b) Signal Range: 4-20mA
            c) Module shall be Allen Bradley SM1234.

B. PLC Programming Software
   1. The PLC programming software shall be Siemens S7-1200 CPU firmware, no equal.

C. HMI Computer
   i) Existing SCADA computer shall be used at WWTF.

D. HMI Software
   a. Existing software shall be reused to add tag.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
   1. It shall be the Contractor'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 and HMI Programming.
1. The Contractor shall be responsible for all PLC and HMI programming.

3.2 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 one 4-hour session, and the schedule shall be arranged and coordinated with the Engineer.

3.3 I/O LIST

Tag #	Description	DI	DO	AI	AO	Scale	Notes
LSL100	WETWELL LOW LEVEL	1					
LSH100	WETWELL LEAD PUMP ON	1					
LSH101	WEWELL LAG PUMP ON	1					
FE/FIT-102	FORCE MAIN FLOW			1			
	TOTAL	3	0	1	0		

END OF SECTION

SECTION 16951

CONTROL DESCRIPTIONS

PART 1 GENERAL

1.1 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. General Programming Requirements
   2. PLC Programming
   3. HMI Programming

B. Related Sections
   1. Section 16900
   2. Section 16950
   3. I/O list

C. PLC programming services shall be provided by a single firm with sufficient experience to complete this scope of work.

D. HMI programming shall be completed by system integrator (SI) as outlined below. SI shall utilize existing SCADA system to add signal to:
   1. Existing Lift Station Screen

E. Scope of work shall also include, but is not limited to:
   1. Review of vendor supplied control panels for coordination with PLC and HMI programming.
   2. Develop and test new PLC program based on control descriptions provided in this specification section.
   3. Develop and test HMI screens and add new screens to the SBR manufacturer provided system
   4. Loop test all PLC input and output points for proper operation. The electrical contractor will terminate I/O points based on control panel drawings.
   5. Verify new instrument setup and calibration.
   6. Verify Ethernet communication between all PLCs and switchboard power meter.
   7. Provide training to City of Grand Junction personnel on new system.

1.2 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

1.3 SYSTEM DESCRIPTION

A. All the programming performed under this section shall be done in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the software manufacturer, unless exceptions are noted by engineer.

1.4 SUBMITTALS

A. Submittals shall be required as noted in section 16900.

1.5 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The entire system shall be programmed under this agreement
   2. These control descriptions are provided for informational purposes and for coordination between the system supplier and the programmer.

PART 2 EXECUTION

2.1 SYSTEM DESCRIPTION

A. The network diagram found in the drawings shall provide a basic overall description of the PLC system.

2.2 GENERAL PROGRAMMING REQUIREMENTS

A. Tag database structure and configuration.
   1. The process control system tag naming convention shall include the definition of all devices, derived and soft tags, and the required alarm processing and data logging definitions for each tag.
   2. Tag naming convention.
      a. The tag naming convention shall be:
         i) Tag numbers shall be grouped as follows:
            a) 100's – Lift Station
         ii) Tag names shall minimally consist of two distinct components. The leading component shall be an abbreviated description of the associated process variable or the function of the tag it represents. The trailing component shall be the tag equipment number.
   3. All logic and control shall be done in the PLC

B. PLC Programming standards.
   1. General Considerations
      a. Program Documentation
         i) Documentation for all PLC programs shall include comments, tag/register descriptions, or any other programming tags. All PLC programs shall be documented with comments provided for each subroutine, function and/or section. Use of abbreviations in comments and subroutine/section titles should be avoided. At the completion of the project, copies of programming,

I/O list, memory map and communications map shall be provided in both printed and electronic format.

b. Motors
   i) All motors shall have runtime totalizers and start counters. Both values shall be totalized regardless of whether the motors are in auto and manual control modes.
   ii) Every motor that has PLC control shall have a manual or automatic operation for the motor. If manual is selected then the operator shall be able to start or stop the motor. If the motor is controlled from a VFD then the operator shall be able to enter a speed set point for the VFD. In automatic operation the control logic shall start and stop the motor as well as control the speed.
   iii) The following signals shall be determined for all motors.
      a) HOA switch in Auto
      b) Run Indication
      c) Fault Indication.
      d) Motor fail to start. PLC calling the motor to run but no run signal report for 20 sec. if the motor is in auto.
      e) Motor fail to stop. PLC not calling the motor to run but a run signal report for 20 sec. if the motor is in auto.

c. Analog signals
   i) All analog inputs shall be scaled in Engineering units to be used in the logic.
   ii) A low level and high level alarm shall be generated for each analog signal. Each alarm shall have separate alarm and reset set points that shall be operator programmable from the HMI screen.

d. All control to any devices will be stopped if there is a phase failure condition. After a time delay when the phase failure is normal, then normal operation shall proceed.

C. Human Machine Interface (HMI) standards.

1. General Considerations
   a. In general, when the term HMI is used it indicates the local operator terminal displays.
   b. All alarms will be displayed and logged on the HMI.
   c. All analog signals will be trended and logged and displayed on the HMI in engineering units.
   d. Motors
      i) All motors shall be displayed on the HMI and have dynamic graphical indication whether they are on or off. The motors shall be green for running and red for off.
      ii) All motors shall have runtime totalizers and start counters displayed near the motor's graphical display.
      iii) Every motor that has PLC control shall have the associated set points and control criteria entered at the local operator terminal displays. This shall also allow the operator to select manual or automatic operation for the motor. If the motor is controlled from a VFD then the operator shall be able to enter a speed set point for the VFD when the motor is in the manual control mode.

e. The control signals for all motors shall be displayed on the HMI. They shall include but not limited to:
   i) HOA Switch status: "In Auto", "In Hand" or "Off"
   ii) Run Indication
   iii) Fault Indication
   iv) Motor fail to start. PLC calling the motor to run but no run signal report for 20 sec while the HOA is in Auto.
   v) Motor fail to stop. PLC not calling the motor to run but a run signal report for 20 sec while the HOA is in Auto.

f. Alarming
   i) All alarms shall be displayed and logged on the HIM screens.
   ii) All alarms shall be displayed on the local operator terminal at the WWTP.
   iii) Selected alarms shall have a visual and audible alarm.

2.3 SPECIFIC DEVICE CONTROL CRITERIA

A. Flow Monitoring
   1. Effluent flow shall be monitored on a continuous basis.
   2. Flow display shall include current flow rate and daily flow total.
   3. Flow total shall be reset at midnight every night.
   4. Record previous day flow total in PLC. Display previous day flow total on HMI screen.

END SECTION