T E C H N I C A L S P E C I F I C A T I O N S

CONTINENTAL DAM REHABILITATION PROJECT

HINSDALE COUNTY, COLORADO

WATER DIVISION 3
WATER DISTRICT 20

DAM ID 200110
SEO FILE C-259C

Prepared for

Santa Maria Reservoir Company
PO Box 288
Monte Vista, CO 81144

March 2013

URS
8181 East Tufts Avenue
Denver, Colorado 80237

TECHNICAL SPECIFICATIONS

CONTINENTAL DAM REHABILITATION PROJECT

HINSDALE COUNTY, COLORADO
WATER DIVISION 3, DISTRICT 20
DAMID: 200110

I hereby state that the accompanying specifications for the Continental Dam Rehabilitation Project were prepared under my direction for the Santa Maria Reservoir Company.

E[illegible] Toms, PE 27078

State Engineer's Approval

Approved On The _____ Day Of _____, 20____

_____
State Engineer

By _____
Deputy

Continental Dam Rehabilitation Project

TECHNICAL SPECIFICATIONS

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SECTION 01110
SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Project description, work summary, and work by Owner.

1.2 BACKGROUND

A. Continental Reservoir is located in Hinsdale County in southwest Colorado. The dam is located approximately 8 miles southeast of the town of Lake City, Colorado. The reservoir is primarily fed by North Clear Creek and direct runoff. Initially designed in 1911, the dam was re-designed and constructed between May, 1925 and December, 1928.

B. Continental Reservoir is impounded by an embankment dam along the northeast side of the reservoir. The dam is an earthen structure, approximately 310 feet long and 92 feet high. The spillway consists of a 140-foot long, side channel spillway with a lined discharge chute and dissipation basin. The State Engineer's Office (SEO) classifies the dam as a large, high-hazard structure. The upstream slope of the dam varies from 2.5H:1V (horizontal:vertical) to 4H:1V, and the downstream slope is approximately 2H:1V. The spillway consists of a 140-ft long, side channel spillway with a lined discharge chute and dissipation basin. The dam and reservoir are owned and operated by the Santa Maria Reservoir Company.

1.3 PROJECT DESCRIPTION

A. Major work items associated with the Continental Dam Rehabilitation include:

1. Base Bid - Spillway

a. Mobilization and preparatory work,
b. Demolishing a portion of the existing spillway,
c. Installing a new spillway underdrain system,
d. Constructing a new concrete spillway including a spillway chute, drain, and stilling basin;
e. Reclamation; and
f. Demobilization

2. Bid Option 1 – Filter Blanket

a. Erosion and sediment controls,
b. Clearing and grubbing,
c. Stripping and stockpiling topsoil,
d. Installing a new filter blanket on the downstream slope of the embankment;
e. Placing fill on top of the filter blanket on the downstream slope of the embankment;

f. Installing a toe drain at the downstream toe of the embankment including filter sand, drain gravel, drain pipes, cleanouts and metering manhole; and

g. Installing two sets of nested piezometers, four movement monuments, four structural survey points, raising existing piezometers.

1.4 OWNER OCCUPANCY

A. The Owner will occupy the premises full time during the period of construction to conduct normal operations.

B. Cooperate with Owner to minimize conflicts, and to facilitate Owner's operations.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01120
CONTRACTOR WORK PLAN

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the Contractor Work Plan.

1.2 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Prepare and submit a project-specific Work Plan to the Engineer for approval within 14 days after Award. Include the following topics in the Work Plan:

1. Construction implementation plan to include work approach, equipment to be used for each item of construction, methods, and management.
2. Key personnel names and qualifications, list of subcontractors, including an organizational chart and project directory with contact information.
3. Health and Safety Plan. See Section 01145: Health and Safety.
4. Environmental Protection. See Section 01350: Environmental Protection.
5. Waste Handling and Disposal Procedures. See Section 01575: Disposal of Waste Materials.
6. Spill prevention and control procedures. See Section 01350: Environmental Protection.
7. Fire prevention and protection. See Section 01350: Environmental Protection.
8. Dust control. See Section 01350: Environmental Protection. (BMPs to be used).
9. Construction sequence and schedule. See Section 01320: Construction Progress Schedule.
10. Construction Quality Control Plan (CQCP). See Section 01450: Quality Control.
11. Other applicable items to describe work approach.

1.3 WORK PLAN REQUIREMENTS

A. The Work Plan shall be carefully thought out, prepared in accordance with all applicable Federal, state, and local laws and regulations, these specifications, and good engineering and construction practices. The Work Plan shall include a complete discussion of conformance with applicable laws, regulations, guidelines, and other applicable procedures, and shall be approved by the Engineer before beginning field activities.

B. A statement in the Work Plan that “all applicable laws will be followed” is not sufficient detail for the Work Plan submittal. Repetition of specification wording and requirements shall only be used to present the elements of the work plan, not as a substitute for the detail that is expected to present the Contractor’s work approach.

C. The Work Plan shall be developed in accordance with the requirement of the individual specifications indicated and other requirements in this specification.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01145
HEALTH AND SAFETY

PART 1 GENERAL

1.1 REFERENCES

A. Williams - Steiger Occupation Safety and Health Act of 1970 (OSHA).

B. All other applicable Federal, State, and Local Safety and Health requirements.

1.2 CONTRACTOR'S RESPONSIBILITY

A. Provide and implement a Health and Safety Plan (HSP) that conforms to all applicable regulations.

B. The HSP shall include the possibility of encountering hazardous or controlled waste at the site, worker protection, actions to be taken, and responsible parties for managing such waste streams.

1.3 OWNER AND ENGINEER'S RESPONSIBILITY

A. Owner and Engineer will have no responsibility for enforcing the Contractor's Health and Safety program.

1.4 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Prepare and submit the Contractor's Project Health and Safety Plan in accordance with the General Conditions. The plan is for informational purposes only.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01200
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.6 SECTION INCLUDES

B. Measurement and payment criteria applicable to work performed under a unit price payment method.

C. Measurement and payment criteria applicable to work performed under a lump sum payment method.

D. List of unit price and lump sum pay items.

E. Schedule of value requirements for lump sum pay items.

F. Defect assessment and non-payment for rejected work.

1.7 AUTHORITY

B. Measurement methods delineated in the individual Specification Sections are intended to complement the criteria of this Section. In the event of conflict, the requirements of the individual Specification Section shall govern.

C. Take all measurements and compute quantities for unit price pay items. The Engineer will verify measurements and quantities of work performed by the Contractor for payment purposes.

D. Assist the Engineer in the taking of measurements by providing necessary equipment, workers, and survey personnel as required.

1.8 QUANTITIES OF UNIT PRICE ITEMS

B. Quantities indicated in the Bid Form are for bidding and contract purposes only. Actual quantities and measurements supplied or placed in the work and verified by the Engineer shall determine payment.

1.9 MEASUREMENT OF QUANTITIES FOR UNIT PRICE ITEMS

B. Measurement Devices:

23. Weigh scales: inspected, tested, and certified by the appropriate Colorado Weights and Measures Division within the past year.
24. Platform scales: of sufficient size and capacity to accommodate the conveying vehicle.
25. Metering devices: inspected, tested, and certified by the appropriate Colorado Weights and Measures Division within the past year.

C. Measurement by volume: Measured by cubic dimension using mean length, width, and height or thickness.

D. Excavation quantities will be based on the calculated volume between the baseline survey, as defined in Section 01720: Layout of Work and Surveying and the excavation limits shown on the Drawings or described in these Specifications, or to the most

practicable lines, grades and dimensions as prescribed by the Engineer, and will include only material that is actually removed within the prescribed pay lines.

E. Fill quantities will be based on the calculated volume between the approved excavation limits or the approved base surface and the fill limits shown on the Drawings or described in these Specifications, or to the most practicable lines, grades and dimensions as prescribed by the Engineer, and will include only material that is actually placed within the described pay lines.

F. Compute excavation and fill quantities in accordance with the requirements of Section 01720: Layout of Work and Surveying.

G. Where concrete for structures is to be placed directly upon or against the excavations and the character of the material cut into is such that the material cannot be trimmed efficiently to accurate dimensions by ordinary excavation finishing methods, as determined by the Engineer, measurement for payment thereof will be made to the prescribed average dimension lines. The prescribed average dimension lines shall be considered as 6 inches outside the neat lines of the concrete for the purposes of measurement, for payment.

H. Measurement, for payment, of excavations upon or against which concrete is not required to be placed will be limited to the neat lines shown on the Drawings, to the most practicable lines, grades, and dimensions as established by the Engineer.

I. Measurement by area: Measured by square dimension using mean length and width or radius. Items which are measured by the acre, such as revegetation, shall be measured horizontally.

J. Linear measurement: Measured by linear dimension, at the item centerline or mean chord. Items which are measured by the lineal foot, such as pipes, culverts, underdrains, fence, etc., shall be measured parallel to the base or foundations upon which the items are placed, unless otherwise specified or shown on the Drawings.

K. Stipulated sum/price measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed items or units of the Work.

L. Lump sum items will not be measured for payment. However, measurements may be made to monitor work progress.

1.10 PAYMENT

B. Payment includes: Full compensation for furnishing all required labor, materials, products, tools, equipment, plant, transportation, services, incidentals; erection, application or installation of an item of the work, and all other costs of whatsoever nature for the items of work complete, will be included in the various bid items; overhead and profit.

C. Contractor shall submit a Schedule of Values for all lump sum bid items listed in the Bid Schedule within 30 days of the Notice to Proceed. The Schedule of Values will be used to help assess the intermediate value of work completed for the purpose of making progress payments

D. Payment for unit price items will be made on the basis of the actual measurements and quantities accepted by the Engineer multiplied by the unit price.

E. Payment for lump sum price items will be made on the basis of the contract lump sum prices in the Bid Form. If the Contractor requests progress payments for lump sum items, such progress payments will be made in accordance with a detailed program of payment apportioning in the schedule of values, prepared by the Contractor and submitted to the Engineer for approval.

1.11 DEFINITION OF BID ITEMS

B. Bid Items – Spillway Base Bid:

1. Mobilization, Preparatory Work and Demobilization (Lump Sum Item)

a. This item includes the mobilization of personnel, equipment and temporary construction facilities to the project site and their subsequent removal; providing temporary utilities; safety fence; traffic control signage and barricades; and other miscellaneous items required to begin construction and closeout the Contract. The cost of all work specified in Division 1 - General Requirements, unless specifically covered in other bid items, will not be paid separately, but shall be included in the lump sum price bid in the Schedule for Mobilization and Preparatory Work.

b. Measurement: This item will not be measured for payment.

c. Payment will be made for Mobilization and Preparatory Work as follows, subject to acceptable construction progress:

1) Thirty percent of the bid price for this Bid Item with the first monthly progress payment.

2) Twenty-five percent of the bid price for this Bid Item with the second monthly progress payment provided, in the Owner's assessment, the work is progressing reasonably towards scheduled completion.

3) The remainder shall be equally prorated over each remaining payment request for the balance of the construction schedule.

d. Mobilization, Preparatory Work and Demobilization is limited to maximum of ten percent (10%) of the total Bid Price.

2. Selective Demolition (Lump Sum Item)

a. This item includes all work associated with the demolition, salvage, and disposal of items designated on the Drawings as salvage, demolish, remove, or similar terms. This item does not include demolition or salvage associated with the piezometer modifications.

b. Measurement: Measurement shall be based on the approved Schedule of Values.

c. Payment: Payment will be made at the Contract Lump Sum Price.

3. Erosion and Sediment Control (Lump Sum Item)

a. Erosion and Sediment Control includes installation, maintenance, and removal of all sediment control devices required for the Work, including hay bales, silt fence, sedimentation ponds, and associated compliance work required by Federal, State, and County permits.

b. Measurement: Measurement shall be based on the approved Schedule of Values.

c. Payment: Payment will be made at the Contract Lump Sum Price.

4. Dewatering (Lump Sum Item)

a. This item includes dewatering all construction areas including installing, maintaining and removing all pumps, piping, drains, well points, wells, and other facilities required to effectively control, collect, and dispose of groundwater or surface water to permit safe and proper construction of all contract work. This item also includes removing the dewatering facilities at the end of construction.
b. Measurement: Measurement shall be based on the approved Schedule of Values.
c. Payment: Payment will be made at the Contract Lump Sum Price.

5. Unclassified Excavation Spillway (Unit Price Item)

a. This item includes excavation of unclassified materials as defined in Section 02315: Excavation required for construction within the existing spillway extents in the area shown on the Drawings and hauling the material to stockpiles or placement areas. Item also includes all work necessary to characterize and segregate excavated materials as necessary for use as common fill and select fill.
b. Measurement: Measurement shall be by volume (cubic yards) of unclassified excavation outside the existing spillway extents, measured from the existing ground surface to the neat excavation lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

6. Rock Excavation (Unit Price Item)

a. This item includes excavation of rock materials as defined in Section 02315: Excavation, required for construction in the areas shown on the Drawings. This item does not include excavation of existing riprap from the downstream dam slope.
b. Measurement: Measurement shall be by volume (cubic yards) of rock excavation to the neat lines and grades on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

7. Riprap Excavation (Unit Price Item)

a. This item includes excavating riprap from the surface of the downstream dam slope. Item includes hauling the excavated riprap to the stockpile area and stockpiling it. Re-location of the stockpiled riprap to a new stockpile location is considered incidental and will not be paid for separately.
b. Measurement: Measurement shall be by volume (cubic yards) of riprap in the stockpile.
c. Payment will be made at the Contract Unit Price per cubic yard.

8. Riprap Bedding (Unit Price Item)

a. This item includes material procurement from offsite sources, transporting, placing, spreading, moisture conditioning, and grading riprap bedding materials to the lines and grades shown on the Drawings.
b. Measurement: Measurement for payment will be made by volume (cubic yards) of riprap bedding material placed to the neat lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

9. Riprap (Unit Price Item)

a. This item includes all work required to screen and process onsite riprap that has been excavated and stockpiled, and haul and place riprap meeting the required gradation in the stilling basin and on the dam slope.
b. Measurement for payment will be made by volume (cubic yards) of riprap placed in the stilling basin to the neat lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

10. Foundation Preparation (Unit Price Item)

a. This item includes shaping and cleaning bedrock foundation surfaces, protecting the bedrock foundation surface, wetting the clean bedrock foundation surface before concrete materials are placed over the foundation.
b. Measurement for payment will be made in square yards of foundation area cleaned and prepared based on surveys made by Contractor and approved by the Engineer. Re-cleaning the foundation surface due to the Contractor not adequately protecting the cleaned foundation will not be measured for payment.
c. Payment: Payment will be made at the Contract Unit Price per square yard.

11. Foundation Anchors (Unit Price Item)

a. This item includes procuring and transporting anchor bar grout and anchor bar materials, and drilling, installing, grouting, and testing the anchor bars at the locations in the spillway shown on the drawings and at locations approved by the Engineer.
b. Measurement for payment will be made by length (linear feet) of the drilled portion of anchor bar in place which has been placed at the locations shown on the Drawings. Portions of reinforcement extending above the drilled and grouted anchor are considered incidental to the work and shall not be measured for payment.
c. Payment: Payment will be made at the Contract Unit Price per linear foot.

12. Wall Anchors (Unit Price Item)

a. This item includes furnishing and installing threaded rod, grout, bearing plates and nuts for the wall anchor systems, and drilling, installing,

grouting, and testing the anchor systems in the spillway at locations shown on the Drawings and as directed by the Engineer.

b. Measurement for payment will be made by each wall anchor installed.

c. Payment will be made at the Contract Unit Price per each.

13. Micropile Anchors (Unit Price Item)

a. This item includes furnishing and installing threaded rod, grout, bearing plates, and nuts for the micropile shoring system anchors, and drilling, installing, grouting, and testing the micropile anchors along the existing spillway stilling basin at locations shown on the Drawings and as directed by the Engineer.

b. Measurement for payment will be made by length (linear feet) of anchors installed measured form the tip of the cutting bit to the bottom of the end plate embedded in the micropile concrete cap. The end plate, nut and portion of the threaded rod above the measured length is considered incidental to this item and will not be measured separately for payment.

c. Payment will be made at the Contract Unit Price per linear foot.

14. Micropile Concrete Cap (Unit Price Item)

a. This item includes procuring, batching, transporting, forming, placing, vibrating, finishing, and curing reinforced structural concrete for the micropile cap. Also includes procuring transporting, and installing reinforcing steel, accessories (such as waterstop), and joint preparation.

b. Measurement: Measurement for payment shall be by volume (cubic yards) of concrete placed to the neat lines and grades shown on the Drawings.

c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

15. Existing Spillway Surface Preparation (Lump Sum Item)

a. This item includes all work associated with preparing the existing spillway surfaces to receive new spillway concrete, including removing unstable concrete, . Item also includes the specified test section to demonstrate the acceptability of the preparation methods to be used.

b. Measurement for payment will be made in square yards of existing spillway surface area cleaned and prepared acceptingly as determined by the Engineer. Re-cleaning the surface or additional surface preparation due to the Contractor not adequately protecting the prepared surface will not be measured for payment.

c. Payment: Payment will be made at the Contract Unit Price per square yard.

16. Backfill Concrete (Unit Price Item)

a. This item includes procuring, batching, transporting, forming, placing, vibrating, finishing, and curing the unreinforced concrete for rock foundation surface leveling, micropile working pad, and other locations as directed by the Engineer.

b. Measurement: Spillway - Backfill Concrete shall be measured in place by volume (cubic yards) to the limits approved by the Engineer.

c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

17. Spillway Foundation Drains (Unit Price Item)

a. This item includes procuring, transporting, installing spillway foundation components including drain pipe, cleanouts and vent pipes, plates and screens, pipe fittings, couplers, cap, placed to the neat lines and grades as shown on the Drawings. This item also includes the required camera surveys.
b. Measurement: Measurement for payment shall be by length (in feet) of piping installed under the spillway slab measured along the centerline of the piping. Accessories such as plates and screens, pipe fittings, couplers, annular grout, are considered incidental to this item and will not be measured separately for payment.
c. Payment: Payment will be made at the Contract Unit Price per linear foot.

18. Spillway Concrete Slabs (Unit Price Item)

a. This item includes procuring, batching, transporting, forming, placing, vibrating, finishing, and curing reinforced structural concrete for the spillway approach, chute, and stilling basin slabs, cutoff walls, chute blocks and end sill. Also includes procuring transporting, and installing reinforcing steel, accessories (such as waterstop), and joint preparation.
b. Measurement: Measurement for payment shall be by volume (cubic yards) of concrete placed to the neat lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

19. Spillway Concrete Walls (Unit Price Item)

a. This item includes procuring, batching, transporting, forming, placing, vibrating, finishing, and curing reinforced structural concrete for the spillway approach, chute, and stilling basin walls, including the bridge corbels. Also includes procuring transporting, and installing reinforcing steel, accessories (such as waterstop), and joint preparation.
b. Measurement: Measurement for payment shall be by volume (cubic yards) of concrete in the spillway walls from the top of the slab to the top of the walls, and the bridge corbel to the neat lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

20. Fabricated Steel Bridge (Lump Sum Item)

a. This item includes designing, procuring, transporting, unloading, rigging, and installing the prefabricated bridge across the spillway at the location shown on the Drawings, including all bridge rails, plates, anchors and all accessories.
b. Measurement: Measurement shall be based on the approved Schedule of Values.

c. Payment: Payment will be made at the Contract Lump Sum Price.

21. Chain Link Fence and Gates (Unit Price Item)

a. This item includes furnishing and installing chain link fence and gates including posts, mounting brackets, tension wires, and all associated hardware at the locations shown on the Drawings.
b. Measurement: Measurement shall be by length (in feet) of installed fence including gates as approved by the Engineer.
c. Payment: Payment will be made at the Contract Unit Price per linear foot.

C. Bid Option 1 – Filter Blanket

22. Clearing and Grubbing (Unit Price Item)

a. This item includes clearing and grubbing within the limits of site disturbance for required excavations, staging and stockpile areas, disposal areas and borrow areas. Includes removal, cutting, grubbing, mowing, etc.
b. Measurement: Measurement shall be based on the acres cleared and grubbed within the disturbed areas.
c. Payment will be made at the Contract Unit Price per acre.

23. Stripping and Stockpiling Topsoil (Unit Price Item)

a. This item includes stripping all topsoil as defined in the Specifications to the depths approved by the Engineer and within the limits of the disturbed areas approved by the Engineer. Item includes hauling the stripped topsoil to the stockpile area and stockpiling the topsoil. Re-location of the stockpiled topsoil to a new stockpile location is considered incidental and will not be paid for separately.
b. Measurement: Measurement shall be in cubic yards of topsoil in the stockpile.
c. Payment will be made at the Contract Unit Price per cubic yard.

24. Unclassified Excavation Dam (Unit Price Item)

a. This item includes excavation of unclassified materials as defined in Section 02315: Excavation required for construction outside the existing spillway extents in the area shown on the Drawings and hauling the material to stockpiles or placement areas. Item also includes all work necessary to characterize and segregate excavated materials as necessary for use as common fill and select fill.
b. Measurement: Measurement shall be by volume (cubic yards) of unclassified excavation outside the existing spillway extents, measured from the existing ground surface after topsoil stripping and riprap removal to the neat excavation lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

25. Common Fill (Unit Price Item)

a. This item includes processing materials obtained from onsite excavation areas and reservoir bottom to meet common fill requirements, and transporting, placing, spreading, grading, moisture conditioning, and compacting fill in accordance with Section 2330: Earthwork, at the locations shown on the Drawings.
b. Measurement: Measurement for payment will be made by volume (cubic yards) of common fill placed to the neat lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

26. Filter Sand (Unit Price Item)

a. This item includes procurement from offsite sources, stockpiling, transporting, placing, spreading, grading, moisture conditioning, and compaction of filter sand at the locations shown on the Drawings.
b. Measurement: Measurement for payment will be made by volume (cubic yards) of filter sand placed to the neat lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

27. Drain Gravel (Unit Price Item)

a. This item includes procurement from offsite sources, stockpiling, transporting, placing, spreading, grading, moisture conditioning, and compaction of drain stone at the locations shown on the Drawings.
b. Measurement: Measurement for payment will be made by volume (cubic yards) of drain stone placed to the neat lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

28. Toe Drain (Unit Price Item)

a. This item includes furnishing and installing toe piping components including drain pipe, pipe fittings, couplers, cleanout concrete pad and locking cap, placed to the neat lines and grades as shown on the Drawings. This item also includes the required camera surveys.
b. Measurement: Measurement for payment shall be by length (in feet) of piping installed for the toe drain, measured along the centerline of the toe drain piping. Vent pipes, plates and screens, pipe fittings, couplers, locking steel cap, concrete pad, annular grout, are considered incidental to this item and will not be measured separately for payment.
c. Payment: Payment will be made at the Contract Unit Price per linear foot.

29. Metering Manhole (Unit Price Item)

a. This item includes furnishing and installing the toe drain metering manhole and concrete slab.
b. Measurement: Measurement shall be based on the approved Schedule of Values.

c. Payment: Payment will be made at the Contract Lump Sum Price.

30. Piezometer Modifications (Lump Sum Item)

a. This item includes all work associated with modifying, extending and protecting the existing piezometers at the locations and to the details shown on the Drawings including obtaining required permits, completion survey, and required regulatory construction documentation.
b. Measurement: Measurement shall be based on the approved Schedule of Values.
c. Payment: Payment will be made at the Contract Lump Sum Price.

31. Instrumentation (Lump Sum Item)

a. This item includes furnishing and installing piezometers, movement monuments and structural survey points at the locations and to the details shown on the Drawings.
b. Measurement: Measurement shall be based on the approved Schedule of Values.
c. Payment: Payment will be made at the Contract Lump Sum Price.

32. Excavated Waste Material Placement (Unit Price Item)

a. This item includes transporting excavated waste materials as defined in the specifications to the spoils disposal areas shown on the Drawings, and placing, spreading, grading, moisture conditioning, and compacting the materials.
b. Measurement: Measurement for payment will be made by volume (cubic yards) of compacted excavated waste materials placed in the spoils disposal area as approved by the Engineer.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

33. Aggregate Base Course (Unit Price Item)

a. This item includes procuring from offsite sources, transporting, placing, spreading, grading, moisture conditioning, and compaction of aggregate base course at the locations shown on the Drawings.
b. Measurement: Measurement for payment will be made by volume (cubic yards) of aggregate base course placed to the neat lines and grades shown on the Drawings.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

34. Topsoil Placement (Unit Price Item)

a. This item includes loading and hauling topsoil from stockpiles, spreading, and grading topsoil evenly over the areas to be reclaimed.
b. Measurement: Measurement shall be by volume (cubic yards) of topsoil placed as measured in the stockpiles after stripping.
c. Payment: Payment will be made at the Contract Unit Price per cubic yard.

35. Seeding and Reclamation (Unit Price Item)

a. This item includes procuring, transporting, and placing materials required for reclamation in disturbed areas, including seeding, and hydraulically applied tackified mulch where shown on the Drawings or as specified.
b. Measurement: Measurement shall be by area (acres) of areas seeded, measured to the nearest hundredth of an acre.
c. Payment: Payment shall be made at the Contract Unit Price per square acre.

1.12 SCHEDULE OF VALUES

B. The Contractor shall submit Schedule of Values for lump sum items listed in this Section within 15 days after date of Notice to Proceed.

C. The Schedule of Values will be used to assess the intermediate value of Work for pay applications.

1.13 DEFECT ASSESSMENT

B. The Contractor shall replace the work, or portions of the work, not conforming to the Drawings or the Specifications.

C. If, in the opinion of the Engineer, it is not practical to remove and replace the work that does not conform to the Drawings or the Specifications, the Owner will direct one of the following remedies:

23. The defective work will remain, but the corresponding unit or lump sum price of the work will be adjusted to a new unit or lump sum price at the discretion of the Owner.
24. The defective Work will be partially repaired at the instruction of the Owner, and the corresponding unit or lump sum price of the work will be adjusted to a new unit or lump sum price at the discretion of the Owner.
25. The individual Specification Sections may modify the options specified in this Section or may identify a specific formula or percentage unit or lump sum price reduction. In the event of conflict, the requirements of the individual Specification Section shall govern.
26. The authority of the Owner to assess the defect and identify payment adjustment is final.

1.14 NON-PAYMENT FOR REJECTED PRODUCTS

B. Payment shall not be made for any of the following:

23. Products wasted or disposed of in a manner that is not acceptable.
24. Products determined as unacceptable before or after placement.
25. Products not completely unloaded from the transporting vehicle.
26. Products placed beyond the lines and grades of the required Work.
27. Products remaining on hand of the Contractor after completion of the Work.
28. Loading, hauling, and disposing of rejected products.
29. Rejected materials including, but not limited to, overly wet or frozen earth material.

30. Excavation or fill made for the convenience of the Contractor for any purpose or reason.
31. Overexcavation and replacement materials.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01310
PROJECT COORDINATION AND MEETINGS

PART 1 GENERAL

1.1 WORK INCLUDED IN THIS SECTION

A. The work of this section includes, but is not limited to: coordination; preconstruction meeting; progress meetings; and task start-up meetings.

1.2 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Coordinate all work with progress meetings to explain unique features of the work to the work forces. The Engineer will attend such meetings. Meet daily with the Engineer to explain work progress, quality control, and any issues affecting successful completion of the work.

C. Coordinate completion and clean up of work of separate sections in preparation for Substantial Completion.

D. After the Owner occupancy of premises, coordinate access to site for correction of defective work and the work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

A. Within ten days after Notice to Proceed and prior to starting the Work except mobilization, the Contractor, accompanied by a representative from each principal subcontractor, shall meet with the Owner and the Engineer for a Preconstruction Meeting. The Preconstruction Meeting will be scheduled by the Owner. The principal features of work will be reviewed and any questions regarding the Contract and work site will be addressed.

B. Attendance Required: the Owner, the Engineer, and the Contractor's Superintendent, the Contractor's Safety and Health Officer, principal subcontractors, and other key personnel as requested by the Contractor or Owner.

C. Unless previously submitted to the Owner, the Contractor shall bring to the conference a schedule for each of the following:

1. Preliminary Progress Schedule.
2. Procurement schedule.
3. Shop Drawings and other submittals schedule.
4. Schedule of Values

D. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:

1. Distribution of Contract Documents, including Contractor’s executed bond, certificate of insurance, and Contract.
2. Submission of list of Subcontractors, list of Products, schedule of values, and preliminary progress schedule.
3. Designation of personnel representing the parties in the Contract, and the Engineer.
4. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
5. Contractor's schedules.
6. Critical Work sequencing.
7. Processing Applications for Payment.
8. Field decisions and Change Orders.
9. Use of premises by the Owner, the Engineer and the Contractor.
10. Owner's requirements.
11. Construction facilities and controls provided by the Owner.
12. Use of premises, office and storage areas, security, housekeeping, and Owner's needs.
13. Survey and layout.
14. Security and housekeeping procedures.
15. Contractor's assignments for safety and first aid.
16. Quality Control and Inspection Program.
17. Procedures for maintaining record documents.
18. Major equipment deliveries and priorities.
19. Requirements for start-up of equipment.
20. Inspection and acceptance of equipment put into service during construction period.
21. Record drawings.

E. The Engineer will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

1.4 PROGRESS MEETINGS

A. The Engineer will schedule and hold regular progress meetings at least weekly and at other times as requested by the Owner or required by progress of the Work. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

B. Additional meetings may be called by the Owner, the Engineer, or the Contractor during any stage of the project when it is deemed necessary to raise any significant questions, establish new guidelines, introduce a new aspect to the project, or any other items that will affect the progress of work.

C. Meetings may take place at the project site or some other location that is satisfactory to the Owner, the Engineer and the Contractor.

D. The Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

E. Attendance Required: The Contractor and all Subcontractors active on the site shall be represented. The Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.

F. All expenses associated with attending the meetings that are incurred by other than the Owner and the Engineer shall be born by the Contractor.

G. Proposed Agenda:

1. Review and approval of minutes of previous meetings.
2. Review of Work progress of minutes of previous meeting.
3. Field observations, problems, conflicts, and decisions.
4. Identification of problems which impede the schedule and proposed corrective actions.
5. Review of submittals schedule and status of submittals; expedite as required.
6. Requests for information status.
7. Review of off-site fabrication and delivery schedules.
8. Revisions to project schedule.
9. Maintenance of progress schedule.
10. Corrective measures and procedures to regain projected schedules.
11. Planned progress during succeeding Work period.
12. Coordination of project schedules and projected progress. Review of three week look-ahead schedule provided by Contractor to ensure proper coordination with Owner, Engineer, and subcontractors.
13. Maintenance of quality, and Safety and Work standards.
14. Pending changes and substitutions.
15. Effect of proposed changes on progress schedule and coordination, and effect on other contracts of the project.
16. Other business relating to Work.

H. The Engineer shall record minutes; include significant proceedings and decisions and distribute copies after meeting to participants and those affected by decisions made.

1.5 TASK START-UP MEETING

A. Before the start of any significant site activity, as determined by the Engineer, conduct a start-up meeting to discuss procedures, quality control, inspections, and related activities. Attendance at the meeting should include the Contractor project manager, site supervisor, representatives of key Subcontractors, and the Engineer and his designated representatives. Notify Engineer at least 72 hours in advance of meeting to allow the Engineer to invite necessary offsite personnel.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01320
CONSTRUCTION PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SUMMARY

A. Construction Progress Schedules developed in accordance with this Section and the General Conditions.

1.2 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. With each Progress Schedule submission provide the following:

1. Contractor certification that progress schedule submission is the actual schedule being utilized for execution of the Work and certification by all Subcontractors with 10 percent or more of Work that they concur with Contractor progress schedule submission.
2. Five legible copies of the progress schedule.

C. Preliminary Progress Schedule:

1. Within 10 days following the effective date of the Agreement, the Contractor shall prepare and submit a preliminary Critical Path Method (CPM) Gantt progress schedule covering all Work to be done on the Project. The schedule shall include the major construction activities and their durations and start/finish dates.
2. The Gantt schedule and subsequent revisions shall be submitted to the Owner and shall reflect the actual progress of the Project to within 5 days prior to submittal.
3. If the schedule or any subsequent revision is not acceptable to Owner, the schedule shall be revised and resubmitted as many times as necessary until the schedule is acceptable. Acceptance of the schedule will not be unreasonably withheld.
4. The initial progress schedule, when accepted by the Owner, will be the project baseline schedule.

D. Shop Drawings and Engineering Data Schedule.

1. At the time the preliminary Gantt progress schedule is submitted, a schedule shall be submitted of the items of materials, equipment, qualifications, plans, and data for which Shop Drawings and/or engineering data are required by the Specifications. For each required submittal item, the date shall be given for intended submission of the item to Engineer for review and the date required for its return to avoid delay in any activity beyond the scheduled start date. Sufficient time shall be allowed for initial review, correction and resubmission, and final review of all submittals.

E. Bi-weekly Progress Reports:

1. At the end of each two week period, the activities that have been completed, with their actual start and completion dates, and a list of the activities on which Work is currently in progress and the number of working days required to complete each, shall be submitted to Owner.

F. Submit adjusted schedule or confirm validity of current schedule with each monthly Application for Payment in accordance with this Section and the General Conditions, and at such other times as necessary to reflect the following:

1. Progress of Work to within 5 days prior to submission.
2. Changes in Work scope and activities modified since submission.
3. Delays in Submittals or resubmittals, deliveries, or Work.
4. Adjusted or modified sequences of Work.
5. Other identifiable changes.
6. Revised projections of progress and completion.

G. Narrative Progress Report: Submit with each monthly submission of progress schedule.

1.3 PROGRESS OF THE WORK

A. If Contractor fails to complete activity by its latest scheduled completion date and this failure may extend Contract Times (and/or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to the acceptable current progress schedule. Actions by Contractor to complete Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

B. Engineer may request a schedule recovery or mitigation plan if Contractor fails to: (i) complete a critical scheduled activity by its latest Milestone completion date, or (ii) satisfactorily execute Work as necessary to prevent delay to the overall completion of the Work.

C. Owner may require Contractor, at Contractor's expense, to add to its plant, equipment, or construction forces, as well as increase the working hours, if operations fall behind schedule.

1.4 PRELIMINARY PROGRESS SCHEDULE

A. As a minimum, submit two computer generated CPM schedules as follows:

1. The Gantt schedule shall be sufficiently detailed to indicate such activities as shop drawing submittal and review, equipment manufacture and delivery, installation of equipment, earthwork, demolition activities, concrete placements, and subcontractor’s items of work. Construction activities of less than 1 day's duration or more than 5 days' duration shall be kept to a minimum. Each activity on the diagram shall be labeled with the following information: description, duration, start date, and finish date

B. Planned durations and start dates shall be indicated for each Work item subdivision. Work item durations for any activity shall not exceed thirty (30) working days. Each major component and subdivision component shall be accurately plotted on time scale

sheets 11 inches by 17 inches or 24 inches by 36 inches in size. Not more than four sheets shall be employed to represent this overview information.

1.5 PROGRESS SCHEDULE

A. General:

1. Schedule(s) shall reflect Work logic sequences, restraints, delivery windows, review times, Contract Times, and Milestones set forth in the Agreement, and shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
2. The schedule requirement herein is the minimum required. Contractor may prepare a more sophisticated schedule if such will aid Contractor in execution and timely completion of Work.
3. Submit assumptions for base schedule describing work week duration, numbers of shifts, hours per shift, holidays, assumed weather days, assumed productivity, crew size, etc.
4. Adjust or confirm schedules in accordance with this Section and the General Conditions on a monthly basis.
5. The update of the Project Schedule shall be an integral part of the estimate upon which progress payments will be made. If, in the judgment of the Owner, the Contractor fails or refuses to provide information required to accomplish a complete Project Schedule Update or revision as specified hereafter, the Contractor shall be deemed to have not provided the required estimate upon which progress payments may be made, and shall not be entitled to progress payments until it has furnished the information necessary for a complete schedule update to the satisfaction of the Owner.
6. Float time is a Project resource available to both parties to meet contract Milestones and Contract Times.
7. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited, and use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of Owner and Contractor.
8. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs which (i) impacts Project's critical path, (ii) consumes available float or contingency time, and (iii) extends Work beyond contract completion date.
9. If Contractor provides an accepted schedule with an early completion date, The Owner reserves the right to reduce Contract Times to match the early completion date by issuing a deductive Change Order at no change in Contract Price.

B. Format:

1. Computer generated baseline schedule, on maximum 11-inch by 17-inch or 24-inch by 36-inch sheet size to include at least:

    a. Identification and listing in chronological order of those activities reasonably required to complete Work, including, but not limited to, subcontract work, fabrication, and delivery dates including required lead times, move-in and other preliminary activities, Project closeout and cleanup, and specified Work sequences, constraints, and Milestones,

including Substantial Completion date(s). Listings to be identified by Specification section number.

b. Identify: (i) horizontal time frame by year, month, and week, (ii) duration, early-start, and completion for each activity and subactivity, and (iii) critical activities and Project float, (iv) assumed weather allowances, (v) planned holidays, (vi) production rates and (vii) assumed work hours per day and number of work days per week.

c. Subschedules to further define critical portions of the Work.

d. Monthly Schedule Submissions: Show overall percent complete, projected and actual, and completion progress by listed activity and subactivity.

1.6 NARRATIVE PROGRESS REPORT

A. Include, as a minimum:

1. Summary of Work completed during the past period between Narrative Progress Reports.
2. Work planned during the next period.
3. Explanation of differences between summary of Work completed and Work planned in previously submitted Narrative Progress Report.
4. Current and anticipated delaying factors and their estimated impact on other activities and completion Milestones.
5. Corrective action taken or proposed.

1.7 CLAIMS FOR ADJUSTMENT OF CONTRACT TIMES

A. Reference the General Conditions.

B. Where Engineer and Owner has not yet rendered formal decision on Contractor claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in progress schedule, Contractor shall reflect that amount of time adjustment in progress schedule as Engineer and Owner may accept as appropriate for the interim. It is understood and agreed that such interim acceptance by Engineer and Owner will not be binding and will be made only for purpose of continuing to schedule Work, until such time as formal decision as to an adjustment, if any, of the Contract Times acceptable to the Engineer and Owner has been rendered. Contractor shall revise progress schedule prepared thereafter in accordance with Engineer and Owner formal decision.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01330
SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal requirements. Submittals shall be in accordance with this Section and the General Conditions.

1.2 DEFINITIONS

A. Work-related submittals of this Section are categorized for convenience as follows:

1. Product Data: Product Data includes standard printed information on materials, products and systems not specifically prepared for the Work, other than designation of selections from among available choices printed therein.
2. Shop Drawings: Shop Drawings include specially prepared technical data for the Work, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to other contracts.
3. Samples: Samples include both fabricated and unfabricated physical examples of materials, products and units of Work; both as complete units and as smaller portions of units of Work; either for limited visual inspection or (where indicated) for more detailed testing and analysis.
4. Miscellaneous Submittals: Miscellaneous Submittals related directly to the Work (non-administrative) include construction permits, Stormwater Pollution Prevention Plan (SWPPP) requirements, Spill Prevention Control and Countermeasures Plan (SPCC), Work Plan, Health and Safety Plan, warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical Work records, quality testing and certifying reports, copies of industry standards, records, drawings, field measurement data, operation and maintenance materials, overrun stock; and similar information, devices and materials applicable to the Work and not processed as Product Data, Shop Drawings or Samples.

1.3 QUALITY ASSURANCE

A. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment. When an item consists of components from several sources, Contractor shall submit a complete initial submittal including all components.

1.4 SUBMITTAL SEQUENCING AND SCHEDULING

A. Coordinate preparation and processing of submittals with performance of the Work so that Work will not be delayed by submittal review process.

B. Coordinate and sequence different categories of submittals for the same Work, and for interfacing units of Work, so that one will not be delayed for coordination with another.

C. The Contractor shall make all submittals far enough in advance of scheduled installation dates to provide all time required for reviews, for possible revisions and resubmittals, and for placing orders and securing delivery. Submittals shall be received at least 21 calendar days prior to any scheduled work for the activity covered by the submittal unless otherwise noted in individual specification Sections or agreed to in writing by the Engineer.

D. Timing of submittals shall allow for review time by the Engineer.

E. Contractor scheduling shall include preparation of a submittal schedule to be coordinated with the Contractor's construction sequencing and scheduling, including allowance for Engineer review time.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SUBMITTAL PROCEDURES

A. All submittals, regardless of origin, shall be stamped with the approval of Contractor and identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data. The forms shall be sequentially numbered.

B. The Contractor shall certify by signing the submittal that review, verification of products required, field dimensions and coordination of information is in accordance with the Work as specified in the Contract Documents.

C. Process submittals in accordance with this section.

D. Identify specific variations from the Contract Documents and Product or system limitations which conflict or may be detrimental to successful performance of the completed Work.

E. Provide space for the Contractor's and Engineer's review stamps. Submittals shall contain Contractor's executed review and approval marking. Submittals which are received from sources other than through Contractor's office or do not contain the Contractor's approval marking will be returned without action.

F. Revise and submit resubmittal as required and identify all changes made since the previous submittal. Submission of resubmittals shall be performed in a similar manner as that of the submittals described in Paragraph 3.1 of this section.

G. Distribution:

1. Six copies of each drawing and necessary data shall be submitted. Engineer will return two marked copies to Contractor. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.
2. Distribute copies of reviewed submittals to all subcontractors whose work will interface with the subject of the submittal.
3. Provide additional distribution of submittals (not included in other copy submittal requirements specified in this Section) to subcontractors, suppliers, fabricators, installers, governing authorities and others as necessary for performance of the Work.
4. Include such additional copies in transmittal to Engineer where required for status before final distribution, and show such distribution on transmittal form.

H. The Engineer will review submittals only for general conformance with the Contract Documents. Such review by the Engineer shall not relieve the Contractor or any subcontractor of responsibility for full compliance with Contract requirements; for correctness of dimensions, clearances and material quantities; for proper designing of details; for proper fabrication and construction techniques; for proper coordination with other trades; and for providing all devices required for safe and satisfactory construction and operation.

I. Submittals reviewed by the Engineer and returned to the Contractor will be marked with one of the following designations:

1. No Exceptions Taken
2. Furnish As Noted
3. Revise and Resubmit

J. Processing of Revise and Resubmit Submittals

1. When the drawings and data are returned marked “Revise and Resubmit” Contractor shall not proceed with manufacture and the corrections shall be made as noted thereon and as instructed by Engineer and six corrected copies resubmitted.
2. Resubmissions will be handled in the same manner as first submissions. Direct specific attention, in writing or on the resubmittal, to revisions other than the corrections requested by the Engineer on previous submittals using the notation specified in this Section.

K. Processing of Furnish As Noted Submittals

1. When the drawings and data are returned marked "Furnish As Noted”, Contractor may proceed with manufacture at its own risk on the basis of incorporating all comments noted on the returned drawings and data, and six corrected copies submitted.
2. Resubmissions will be handled in the same manner as first submissions. Direct specific attention, in writing or on the resubmittal, to revisions other than the corrections requested by the Engineer on previous submittals using the notation specified in this Section.

L. Processing of No Exceptions Taken Submittals:

1. Each copy of the submittal so designated by the Engineer will be identified accordingly by being so stamped and dated.
2. Construction shall be carried out in accordance therewith and no further changes made therein except upon written instructions from the Engineer. Final drawings (paper, mylar, or electronic) and/or microfilms shall be submitted to the Engineer.

3.2 RESUBMITTAL OF DRAWINGS AND DATA

A. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by Engineer are provided on the resubmittal.

B. Promptly notify the Engineer, if any correction or notation indicated on submittals constitutes a change of the Contract requirements.

C. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) to indicate the sequence of the resubmittal.

D. Resubmittals shall be made within 7 days of the date of the letter returning the material to be modified or corrected.

E. Any need for more than one resubmission, or any other delay in obtaining Engineer review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is directly caused by a change in the Work authorized by a Change Order or by failure of Engineer to review any submittal within the submittal review period specified herein and to return the submittal to Contractor.

3.3 PROPOSED PRODUCT LIST

A. Within 30 days from execution of the Agreement between Owner and Contractor, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product, and the lead time for procurement, fabrication and delivery of all products with a lead time of more than 30 days.

B. For products specified only by reference standards, give manufacturer, trade names, model or catalog number, and reference standard.

3.4 PRODUCT DATA, SHOP DRAWINGS, AND SAMPLES

A. Product Data:

1. Collect required data into one submittal for each unit of Work or system; and mark each copy to show which choices and options are applicable to the Work. Include manufacturer's standard printed recommendations for application of labels and seals, notation of field measurements which have been checked, and special coordination requirements.
2. Maintain one set of Product Data (for each submittal) at project site, available for reference by Engineer and others.
3. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide all information unique to this Project.

4. After review, distribute in accordance with paragraph 3.1 of this section.

B. Shop Drawings:

1. Reproduce and distribute in accordance with Paragraph 3.1 of this section and for Record documents described in Section 01770: Contract Closeout.

C. Samples:

1. Provide units identical with final condition of proposed materials or products for the Work.
2. Include "range" samples (not less than three units) where unavoidable variations must be expected, and describe or identify variations that must be expected, and describe or identify variations between units of each set.
3. Provide full set of optional samples where Owner's selection is required. Prepare samples to match Owner's sample where so indicated.
4. Include information with each sample where so indicated. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliance with standards. Samples are submitted for review and confirmation of color, pattern, texture, and "kind" by Owner.
5. Engineer will not "test" samples (except as otherwise indicated) for compliance with other requirements. Conformance with the Contract Documents is the exclusive responsibility of the Contractor.

3.5 MISCELLANEOUS SUBMITTALS

A. Construction Permits:

1. Acquire, maintain, and submit copies of all construction permits that are required by agencies to execute the Work.

B. Manufacturers' Instructions:

1. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting and finishing in quantities specified herein.
2. Identify any conflicts between manufacturers' instructions and Specifications

C. Manufacturers' Certificates:

1. When specified in individual specification Sections, submit manufacturers' certificates to Engineer, in quantities specified herein.
2. Indicate that a material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
3. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer. If these are outdated and/or not acceptable to Engineer, the Contractor shall submit to the Engineer the new certificates and test results on materials or product.

D. Tests and Test Reports:

1. Classify each as either "project related" or Product Data, depending upon whether report is uniquely prepared for project or a standard publication of workmanship control testing at point of production, and process accordingly.
2. All test equipment used shall be verified to be in calibration at the time of each test and test reports shall so indicate. No test shall be made without such verification.

E. Standards:

1. Where copy submittal is indicated, and except where specified integrally with Product Data submittal, submit a single copy for Engineer's use.
2. Where workmanship at project site and elsewhere is governed by standards, furnish additional copies to fabricators, installers and others involved in performance of the work.

END OF SECTION

SECTION 01350
ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Landscape preservation; prevention of water pollution; abatement of air pollution; abatement of noise; and temporary drainage provisions.

1.2 LANDSCAPE PRESERVATION

A. Exercise care to preserve the existing landscape outside of specified limits of areas of site disturbance. Conduct construction operations to prevent any unnecessary destruction, scarring, or defacing of the natural or man-made surroundings in the vicinity of the work.

B. Shape irregularly the edges of clearings and cuts through trees, shrubbery, and vegetation to soften the undesirable visual impact of straight lines. Perform movement of crews and equipment within the right-of-way, within easements, and over routes provided for access to the work in a manner to prevent damage to vegetation and property.

C. Destruction, scarring, damage, or defacing of the landscape resulting from the Contractor's operations shall be repaired, replanted, reseeded, or otherwise corrected as directed by the Owner and at the Contractor's expense.

D. The locations, alignments, and grades of construction roads are subject to approval of the Owner. Site clearing shall be conducted in accordance with Section 02230: Clearing and Grubbing. When no longer required by the Contractor, areas of construction roads and staging, stockpiling/disposal and storage areas shall be restored to the original topographic contours except as otherwise specified for excess excavation materials. All areas disturbed by construction shall be reclaimed in accordance with Section 02920: Reclamation. All contouring and reclamation work completed in disturbed areas shall be conducted in such a manner as to provide for proper drainage and to prevent erosion.

E. Except where clearing is required for permanent works or excavation operations, all trees, shrubbery, vegetation, and wetlands shall be preserved and protected from damage by the Contractor's construction operations and equipment.

F. Exercise special care where trees or shrubs are exposed to injuries by construction equipment, excavating, dumping, chemical damage, or other operations. Adequately protect such trees by use of protective barriers or other methods approved by the Owner. Removal of trees and shrubs shall be permitted only after approval by the Owner.

G. The layout of the Contractor’s construction facilities such as shops, trailers, storage areas, and parking areas; location of access and haul routes; and operations in the stockpile areas shall be planned and conducted in such a manner that all trees and shrubbery not approved for removal by the Owner shall be preserved and adequately protected from either direct or indirect damage by the Contractor’s operations.

H. No equipment shall be allowed to operate within the dripline of any tree to be protected.

I. Trees shall not be used for anchorages.

J. The Contractor shall be responsible for injuries to trees and shrubs caused by their operations. The term injury shall include, without limitation, bruising, scarring, tearing, and breaking of roots, trunks, or branches. All injured trees and shrubs shall be repaired or treated without delay, at the Contractor's expense. If injury occurs, the Owner shall determine the repair method or treatment to be used for injured trees and shrubs as recommended by an experienced horticulturist or a licensed tree surgeon provided by and at the expense of the Contractor. All repairs or treatment of injured trees shall be performed under the direction of an experienced horticulturist or a licensed tree surgeon provided by and at the expense of the Contractor.

K. Injured trees or shrubs that, in the opinion of the Owner, are beyond saving shall be removed and replaced early in the next planting season. The replacements shall be the same species, or other approved species, and of the maximum size that is practicable to plant and sustain growth in the particular environment. Replacement trees and shrubs shall be guyed, watered, and maintained for a period of one month. Any replacement tree or shrub that dies shall be removed and replaced, as directed by the Owner, with such replacements being maintained for a period of one month from the replacement date. Replacement of injured trees and shrubs not required to be cleared or removed for construction shall be at the Contractor's expenses.

1.3 SPILL PREVENTION AND CONTROL

A. Prepare and provide spill prevention and control procedures in the Work Plan submittal, See Section 01120: Contractor Work Plan. Prepare and implement spill prevention and control procedures and appropriate containment and diversionary structures, materials, and equipment to prevent and control the maximum spillage of any specific item within the scope of work. This includes the materials and equipment used in connection with this project. The procedures shall ensure that sufficient inspections and tests are performed on a continuing basis. All qualified personnel, appropriate facilities, instruments, equipment, and testing devices necessary for quality spill prevention and control shall be furnished. The spill prevention and control procedures shall be carefully thought out and prepared in accordance with all applicable Federal, State, and local laws and regulations, and good engineering practices. The necessary resources for procedures, methods, and equipment operations shall also be addressed.

B. Provide spill prevention and control procedures in the Work Plan as appropriate for the material being handled and hauled by the Contractor. Design, construct, operate and maintain preparedness and prevention facilities to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to the air or surface water which could threaten human health or the environment.

C. Implement special measures to prevent chemicals, fuels, oils, greases, bituminous materials, waste washings, herbicides, insecticides, harmful materials, biological materials, and concrete materials from entering the air, waters of the State, utilities, and storage areas.

D. Laws and Regulations: Do not pollute any area with any manmade or natural harmful materials. It is the sole responsibility of the Contractor to investigate and comply with

all applicable Federal, State, county, and municipal laws and regulations concerning spill prevention and control procedures.

E. Communications: Provide internal communications or an alarm system to provide immediate emergency instruction to facility personnel if necessary. Provide a device, such as a telephone immediately available at the scene of operations, capable of summoning emergency assistance from local police departments, fire departments, State or local emergency response teams. A project telephone directory shall be included in the Work Plan.

F. Dispose of all materials off site in accordance with applicable Federal, State, and local laws and regulations. See Section 01575: Disposal of Waste Materials for additional requirements.

G. Required inspections and documentation shall be in accordance with written procedures developed by the Contractor. These written procedures shall be part of the Work Plan. A record of the inspections, signed by the appropriate supervisor or inspector, shall be maintained during the project and submitted to the Engineer for final close-out.

H. If materials are released provide a written description of the event, corrective action taken, and plans for preventing recurrence, as well as a written document of manpower, equipment, and materials required to expedite control and removal of any harmful quantity of materials released.

I. The Contractor IS responsible for properly instructing Contractor personnel regarding applicable pollution control laws, rules, and regulations and in the operation and maintenance of equipment and BMPs to prevent the discharge of materials. Schedule and conduct spill prevention briefings for its operating personnel at intervals frequent enough to assure adequate understanding of spill prevention and control procedures for this project. Such briefings shall highlight and describe known spill events or failures, malfunctioning components, and recently developed precautionary measures.

J. Designate a person who is responsible for environmental protection to include but not limited to material spill prevention, BMPs maintenance, recordkeeping, permit condition compliance and who reports to management.

K. All facility communication systems and spill control equipment, shall be maintained by the Contractor as necessary to assure proper operation in time of emergency.

1.4 PREVENTION OF WATER POLLUTION

A. Comply with all project permit requirements, and all other applicable federal, state, and local laws, orders, regulations, permits, and water quality standards concerning the control and abatement of water pollution.

B. Perform construction activities by methods that shall prevent entrance or accidental spillage of solid matter, contaminants, debris, and other pollutants and wastes into streams, flowing or dry water courses, rivers, lakes, and underground water sources.

C. Such pollutants and wastes include, but are not restricted to, refuse, garbage, sediment from erosion of construction areas, concrete wash-out, sanitary waste, industrial waste,

radioactive substances, oil and other petroleum products, aggregate processing tailings, mineral salts, and thermal pollution.

D. O not allow wastewater from construction operations to enter streams, water courses, wetlands, or lakes without passing through suitable sedimentation ponds or treatment facilities approved by the Engineer.

E. Where the location of a construction site is such that oil or gas from an accidental spillage could reasonably be expected to enter into or upon the navigable waters of the United States or adjoining shorelines, and the aggregate storage of oil or gas at the site is over 1,320 gallons, or a single container has a capacity in excess of 660 gallons, prepare a Spill Prevention Control and Counter Measure Plan (SPCC) reviewed and certified by a registered professional engineer in accordance with 40 CFR, Par 112, as required by Public Law 92-500 as amended by Public Law 95-217 and Public Law 95-576.

F. Submit to the Engineer a certified statement that the SPCC, if required, was reviewed and certified by a professional engineer registered in the State of Colorado.

1.5 ABATEMENT OF AIR POLLUTION

A. Comply with applicable federal and state laws and County ordinances and regulations concerning the prevention and control of air pollution.

B. In conducting construction activities and operation of equipment, utilize such practicable methods and devices as are reasonably available to control, prevent, and otherwise minimize atmospheric emissions or discharges of air contaminants.

C. The emission of dust into the atmosphere shall be minimized during handling and storage of construction materials, and use such methods and equipment as are necessary to minimize or prevent dust during these operations. Earth surfaces subject to dusting shall be kept moist with water or by application of a chemical dust suppressant. When practicable, dusty materials in piles or in transit shall be covered to prevent blowing dust.

D. Do not operate equipment and vehicles that are found to have emissions of exhaust gases or particulates that exceed applicable limits established by federal, state, or local laws or authorities until corrective repairs or adjustments are made. If required by the Engineer, the Contractor shall provide acceptable evidence that equipment and vehicles have been tested for exhaust emissions and have been found to be in compliance with applicable limits.

E. Carry out proper and efficient measures wherever and as often as necessary to reduce the dust nuisance, and to prevent dust from damaging crops, orchards, cultivated fields, and dwellings, or causing a nuisance to persons. The Contractor will be held liable for any damage resulting from dust originating from his operations under these Specifications.

1.6 ABATEMENT OF NOISE

A. Comply with applicable federal and state laws and County ordinances, orders, and regulations concerning the prevention, control, and abatement of excessive noise.

B. Take reasonable measures to avoid unnecessary noise. Such measures shall be appropriate for the normal ambient sound levels in the area during working hours. All

construction machinery and vehicles shall be equipped with practical sound-muffling devices, and operated in a manner to cause the least noise consistent with efficient performance of the Work.

1.7 TEMPORARY DRAINAGE PROVISIONS

A. Provide for the drainage of storm water, and such water as may be applied or discharged on the site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the site, and adjacent property.

B. Existing drainage channels and conduits shall be cleaned, enlarged, or supplemented as necessary to carry all increased runoff attributable to the Contractor's operations. Construct dikes as necessary to protect the Owner's facilities and the Work, and to direct water to drainage channels or conduits.

C. See also Section 01570: Sediment and Erosion Control.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01410
REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Responsibilities for obtaining permits in accordance with federal, state, and local agencies.

1.2 GENERAL PERMIT REQUIREMENTS

A. Comply with the conditions and requirements of all permits required by federal, state, county, and local governing agencies in the performance of this Contract. If the Contractor fails to comply with the conditions and requirements of any permit and such failure to comply results in fines, penalties, and/or suspension of Work by a regulatory agency, all liability for such fines, penalties and delays are the sole responsibility of the Contractor.

B. The Contractor is responsible for obtaining all permits necessary to complete the Work. The Contractor is also responsible for all monitoring, testing, and corrective measures necessary to maintain the permits throughout the duration of the Project, including modification of or renewal of the permits as necessary. Applicable permits may include, but are not limited to, the following:

1. Colorado Department of Health and Environment (CDPHE), Water Quality Control Division (WQCD) Construction Stormwater General Permit (includes preparation of a Stormwater Management Plan [SWMP] and a Storm Water Pollution Prevention Plan [SWPPP].
2. CDPHE, WQCD Construction Stormwater Dewatering Permit.
3. CDPHE, Air Pollution Control Division (APCD), Construction Permit (regulates fugitive dust).
6. Haul permits.

1.3 OWNER OBTAINED PERMITS

A. The Owner is responsible for obtaining certain permits that pertain to the Work. These permits may include:

1. United States Army Corps of Engineer's (USACE) Clean Water Act Section 404 Nationwide Permit (will include compliance with U.S. Fish and Wildlife Service and State Historic Preservation Officer regulations).
2. CDPHE, WQCD Clean Water Act Section 401 Water Quality Certification.

B. The Contractor shall be responsible for implementing and coordinating the terms and requirements of all environmental permits obtained by the Owner.

C. A copy of the permits obtained by the Owner will be provided with the Bid Documents

1.4 RESPONSIBILITY AND COORDINATION

A. Accept full responsibility for contacting all Federal, State, and local agencies to obtain permitting requirements for construction related activities on lands under jurisdiction by

those agencies, and be fully responsible to research and become familiar with regulatory requirements that must be met for the performance of the Contract work.

B. Perform all coordination and documentation, and engineering to obtain the required permits including providing a registered professional engineer for engineering to obtain permits where required.

C. Be fully responsible and solely accountable for meeting the requirements of all permits.

D. Unless otherwise specified by an agency, the Contractor shall be the sole permittee for all contractor-obtained permits.

1.5 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Contractor-Obtained Permits: Copies of all permits obtained by the Contractor.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01415
STATE ENGINEER REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Authority of the State of Colorado Office of the State Engineer.

1.2 REFERENCES

A. Dam Safety Project Review Guide September 13, 1994, Third Revision June 1, 2000. Dam Safety Branch, Division of Water Resources, Office of the State Engineer, Department of Natural Resources.

B. Rules and Regulations for Dam Safety and Dam Construction, January, 2007, Division of Water Resources, Office of the State Engineer, Department of Natural Resources.

1.3 QUALITY CONTROL

A. Plans and Specifications

1. Construct the work in accordance with the approved plans and specifications. Approved plans and specifications cannot be significantly changed without the prior written approval of the State Engineer in accordance with Rule 9.1.8 of the Rules and Regulations for Dam Safety and Dam Construction, January, 2007.

B. Quality of Work

1. The State Engineer shall have authority to require the material used and the work of construction to be accomplished in accordance with regulations which the State Engineer may establish. No work shall be deemed complete until the State Engineer furnishes to the owners of such structures a written statement of acceptance, The State Engineer may also conduct periodic inspections of the Work. Provide State Engineer access to the work at all reasonable times.
2. The Owner's Engineer will monitor the quality of construction as specified in Rule 9 of the Rules and Regulations for Dam Safety and Dam Construction, January, 2007.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01450
QUALITY CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Contractor quality control requirements.

1.2 QUALITY ASSURANCE/CONTROL

A. Provide a quality control system to perform inspections, tests, and retesting in the event of failure of items of work, including that of subcontractors, to ensure compliance with the Contract provisions. Quality control will be established for all work.

B. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

C. Comply fully with manufacturers' instructions, including each step in sequence.

D. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. Perform work by persons qualified to produce workmanship of specified quality.

G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. For Products or workmanship specified by association, trades, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

I. Obtain copies of standards when required by Contract Documents.

J. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

K. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.3 INSPECTION PROCEDURES

A. Preparatory inspection shall be performed by the Contractor before beginning any work, and, in addition, before beginning each segment of work. Preparatory inspection shall include a review of the Contract requirements, the review of shop drawings and other submittal data, a check to ensure that required control testing will be provided, a physical examination to ensure that materials and equipment conform to approved shop drawings and submittal data, and a check to ensure that required preliminary work has been completed.

B. An initial inspection shall be performed as soon as a representative segment of the particular item of work has been accomplished. Initial inspection shall include performance of scheduled tests, examination of the quality of workmanship, a review for omissions or dimensional errors, and approval or rejection of the initial segment of the work.

C. Follow-up inspections shall be performed as necessary, and shall include continued testing and examinations to ensure continued compliance with the Contract requirements.

D. Test results provided shall cite the Contract requirements, the test or analysis procedures used, and the actual test results, and shall include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously noted in large letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. Test reports shall be signed by a testing laboratory representative authorized to sign certified test reports. The Contractor shall arrange for immediate delivery of the signed original of all test reports, certifications, and other documentation to the Engineer.

1.4 INDEPENDENT INSPECTION AND TESTING LABORATORY SERVICES

A. Conduct quality control testing for each item of Work to confirm work is in accordance with the contract documents.

B. Retain an independent geotechnical inspection and testing firm to perform the Contractor's specified quality monitoring and testing. Submit the name of the independent testing firm and laboratory and a statement of its qualifications. The firm shall have at least 5 years of experience in soil, and concrete inspection and testing, and shall be equipped to perform all field and laboratory tests specified that are the Contractor’s responsibility.

C. Submit names and resumes of the laboratory's key personnel and field testing personnel. Field personnel shall have at least 3 years experience in soil and concrete testing, and cannot be changed without prior approval of the Engineer.

D. Make available written results of all completed tests and inspections performed by the Contractor’s independent testing firm to the Engineer by the end of the next working day following completion of the tests. Provide verbal results to the Engineer upon test completion. Results of all completed tests shall be submitted to the Engineer.

E. Reports will indicate observations and results of tests and indicate compliance or non-compliance with Contract Documents.

F. Retesting required because of non-conformance to specified requirements is the Contractor’s responsibility and shall be performed by the Contractor’s approved testing agency.

1.5 ENGINEER TESTING

A. Engineer may perform and pay for quality assurance inspection and testing at their discretion, independent of testing and inspections performed by Contractor.

B. Cooperate with Engineer; furnish samples of materials, equipment, tools, storage, access, and assistance as requested.

C. Notify Engineer 24 hours prior to QC testing or sampling.

D. Engineer may obtain samples of material for testing. Contractor shall provide Engineer access and assistance in obtaining samples.

E. Engineer may inspect Contractor off-site producers of materials and products. Contractor shall provide access to these off-site facilities to the Engineer at all times during the Work.

1.6 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Quality Control Plan. Prepare and submit a Construction Quality Control Plan (CQCP) within 30 calendar days after receipt of the Notice of Award. The CQCP shall identify personnel, procedures, controls, instructions, tests, records, reports and forms to be used. Describe quality control for each work element. Submit as part of the Work Plan specified in Section 01120: Contractor Work Plan. Unless specifically authorized by the Engineer in writing, construction shall not be started and no requests for payment will be processed until the CQCP is approved. This plan shall include, as a minimum:

1. Names and qualifications of personnel responsible for quality control on the Contract.
2. Area of responsibility and authority of each individual in the quality control system.
3. A description of the services the Contractor will have provided by outside organizations such as testing laboratories, manufacture representatives architects, and consulting engineers.
4. Procedures for reviewing shop drawings, samples, certificates, or other submittals for contract compliance, including the name of the person(s) authorized to sign the submittals for the Contractor, as complying with the Contract.
5. A test and inspection schedule, keyed to the construction schedule and following the order of the specification technical sections, indicating inspections and tests, the names of persons responsible for the inspection and testing for each segment of work, and the time schedule for each inspection and test.
6. The procedures for documenting quality control operation, inspection, and testing, with a copy of forms and reports to be used for this purpose. The Contractor shall also include a submittal status log listing submittals required by the specifications and drawings and stating the action required by the Contractor or the Engineer.

C. Independent Laboratory Qualifications. Name of the independent laboratory, a statement of qualifications (SOQ), the most recent certification by state/federal or other appropriate independent testing services, and names, resumes, and experience of the laboratory and field key personnel. Include a statement indicating the laboratory and field key personnel meet the requirements of this specification.

D. Daily Quality Control Reports.

E. Results of all completed testing.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities: Electricity, lighting, heating ventilation and air conditioning (HVAC), telephone service, water, and sanitary facilities.

B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, project signage, and water control.

C. Construction Facilities: Access roads, parking, field offices.

1.2 TEMPORARY ELECTRICITY

A. Provide all power for HVAC, lighting, operation of Contractor's plant or equipment, or for any other use by Contractor.

B. Provide and pay for power service from utility sources as required.

C. Provide temporary electric feeder and electrical service as required.

D. Provide separate metering for cost of energy used as required.

1.3 TEMPORARY LIGHTING

A. Provide and maintain lighting for construction operations.

1.4 TEMPORARY HEAT

A. Provide HVAC devices and heat or cool as required to maintain specified conditions for construction operations.

1.5 TEMPORARY TELEPHONE AND INTERNET SERVICE

A. Make all necessary arrangements and pay all installation and monthly service charges for telephone and internet connection lines in engineer’s field offices at the site and provide all telephone instruments and modems.

1.6 TEMPORARY WATER SERVICE

A. Provide, maintain and pay for suitable quality water service required for construction operations.

1.7 TEMPORARY SANITARY FACILITIES

A. Furnish temporary sanitary facilities at the site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the Project.

B. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each

20 persons. Contractor shall enforce the use of such sanitary facilities by all personnel at the site.

1.8 CONSTRUCTION AIDS

A. Furnish, install, maintain, and operate all construction aids required by Contractor and its Subcontractors in the performance of the Work. Such construction aids shall include, but not be limited to, the following:

1. Cranes and hoists
2. Temporary enclosures
3. Scaffolding
4. Temporary stairs
5. Drainage provisions

1.9 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

A. Protect, shore, brace, support, and maintain all underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by his construction operations. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, fences, and other surface structures affected by construction operations, shall be restored to their original condition. All replacements shall be made with new materials.

B. Contractor is responsible for all damage to streets, roads, highways, shoulders, ditches, embankments, culverts, bridges, and other public or private property, regardless of location or character, which may be caused by transporting equipment, materials, or workers to or from the Work or any part or site thereof, whether by him or his Subcontractors. Contractor shall make satisfactory and acceptable arrangements with the Owner of, or the agency or authority having jurisdiction over, the damaged property concerning its repair or replacement or payment of costs incurred in connection with the damage.

1.10 DAMAGE TO EXISTING PROPERTY

A. Contractor will be held responsible for any damage to existing structures, Work, materials, or equipment because of his operations and shall repair or replace any damaged structures, Work, materials, or equipment to the satisfaction of, and at no additional cost to, the Owner.

B. Protect all existing structures and property from damage. Provide bracing, shoring, or other work necessary for such protection.

1.11 BARRIERS AND FENCING

A. Provide barriers or fencing to protect adjacent properties from damage from construction operations and demolition.

B. Provide barriers around all excavations or obstructions to prevent accidents and protect Work, apparatus, equipment, and material from theft and accidental or other damages, and make good any damages thus occurring at no cost to the Owner.

C. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

D. Provide measures to protect Owner’s personnel and public from Work activities including, but not limited to, safety fence surrounding the work and staging, storage and stockpile areas.

1.12 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers, as required, to protect site from soil erosion.

1.13 DUST CONTROL

A. Provide all labor, equipment, machinery and other means to control dust emissions throughout the site for the duration of the project.

B. Abate dust nuisance by cleaning, sprinkling with water or other means as necessary.

C. The use of water, in amounts which result in ponding, is not acceptable as a substitute for other methods.

1.14 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification Sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

1.15 SECURITY

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

B. Contractor is responsible for protection of the site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

C. No claim shall be made against the Owner by reason of any act of an employee or trespasser, and Contractor shall make good all damage to Owner's property resulting from his failure to provide security measures as specified.

D. Security measures shall be at least equal to those usually provided by the Owner to protect the existing facilities during normal operation, but shall also include such additional security fencing, barricades, lighting, and other measures as required to protect the site and the public.

E. Keep all watershed access gates locked except during the time when they are attended. Key privileges will be defined in the Preconstruction meeting.

1.16 ACCESS ROADS

A. Conduct work to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways, and

walks, whether public or private, provide and maintain suitable and safe detours, or other temporary expedients for the accommodation of public and private travel.

B. As approved and based on the site location, construct and maintain temporary roads accessing public thoroughfares to serve construction area. Locations and methods of construction proposed for temporary access roads must be submitted for approval in the Contractor’s work plan.

C. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

D. Provide means of removing mud from vehicle wheels before entering streets.

1.17 PARKING

A. Provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic, Owner's operations, or construction activities. The location of the Contractor's parking areas shall be as acceptable to, and approved by, the Owner

1.18 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Brush clean or wash roadway near construction entrance(s) regularly.

B. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

C. Remove waste materials, debris, and rubbish from site and dispose off-site.

D. Maintain all construction areas and adjacent sites in a dust free condition.

E. Do not allow any condition to exist during construction which creates a nuisance; a fire hazard; an environment injurious to water quality, air quality, health or safety; or an attraction for children, animals, birds, rodents, etc.

F. Failure to comply with this provision after due and proper notice has been given by the Owner or representative will be sufficient grounds for the Owner to proceed to clean up such material and debris, make repairs and charge same to the Contractor.

1.19 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition as specified in the Specifications. Restore permanent facilities used during construction to specified condition.

1.20 PROJECT CONTROLS

A. Provide signs along access roads to direct subcontractors, vendors etc to the construction site along approved access roads.

1.21 CONTRACTOR’S FIELD OFFICE

A. During the performance of this Contract, maintain a suitable office at or near the site of the Work which shall be the headquarters of its representative authorized to receive drawings, instructions, or other communication or articles. Any communication given to the said representative or delivered at the Contractor's office at the site of the Work in its absence shall be deemed to have been delivered to Contractor.

B. Copies of the Drawings, Specifications, and other Contract Documents shall be kept at the Contractor's office at the site of the Work and available for use at all times.

1.22 ENGINEER’S FIELD OFFICE

A. In addition to the Contractor’s trailer, furnish and maintain a temporary field office for the Engineer at designated location at the site.

B. The Engineer’s field office shall be a portable frame building or office trailer, as approved, and shall provide not less than 200 square feet of floor space with an enclosed office room. The office shall be watertight and weatherproof, shall have screened windows and solid door with a lock and 2 keys.

C. The office shall be provided with electrical and telephone services (as specified below), for the duration of the Contract, and shall have the necessary equipment to maintain a temperature of 72 degrees F under all conditions.

D. Provide sanitary facilities, and a water cooler with bottled drinking water (with adequate supplies maintained during the construction period). The office shall have linoleum or tile floor and shall be furnished with:

1. 1 30-inch by 60-inch desk with drawers and chair
2. 1 36-inch by 72-inch table
3. 1 42-inch by 72-inch drafting table with stool
4. 1 2-drawer file cabinet with lock and 2 sets of keys. Cabinets shall be fire resistant, meeting the requirements for "Filing Devices, Insulated (36E9) Class D Label" of UL Specifications.
5. 4 Office chairs
6. 8 folding chairs for meetings
7. 1 7-foot 3-inch by 3-foot steel utility shelving assembled.
8. 1 4-foot by 6-foot bulletin board, mounted
9. 1 clothes rack
10. 1 first aid kit
11. 2 Fire extinguishers, non-toxic, dry chemical, meeting U.L. for Class A, B and C fires
12. 2 Steel wastepaper baskets
13. 1 Telephone service and telephone with messaging capability.
14. 1 Bottled water dispenser
15. 1 Color printer/copier/fax with multi sheet feeder, 11 inch x17 inch capability, and operating software.

16. 1 Internet access hookup from a provider having the maximum speed available at the site

E. The office shall be set up, equipped, and made ready for use prior to the beginning of other Work on the Project and shall remain for at least seven (7) days after final acceptance of the Work or until all field records pertinent to the Project have been completed. It shall be maintained in good condition and appearance by the Contractor for the duration of the Project and shall then be removed and disposed of by him and the site cleaned up and left in a neat and acceptable condition within fifteen (15) days after final use. The Engineer will not approve any payment requests until the Contractor has erected the field office and it has been approved by the Owner Representative.

F. The Contractor shall provide specified telephone lines with long distance service and local services at no cost to the Engineer for duration of time described above. The Contractor may submit to the Engineer monthly itemized telephone charges for long distance telephone services made from field office. The Engineer will reimburse the Contractor for long distance charges made by the Owner or the Engineer from field office.

1.23 TEMPORARY FACILITIES

A. The Contractor shall remove temporary facilities as approved by the Engineer when no longer required.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01515
RESERVOIR CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control of reservoir level by Owner, reservoir elevation restrictions, and predicted reservoir elevation changes from precipitation events.

1.2 COORDINATION

A. The Owner will be responsible for coordinating operation of the dam, reservoir, and outlet works.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 RESERVOIR CONTROL AND DRAWDOWN

A. Under existing conditions, the reservoir is primarily supplied from upstream inflows and precipitation.

B. The reservoir is currently restricted by the State Engineer's Office (SEO) to a maximum elevation (El.) of 10,267.8 feet.

C. The Owner will control the water level in the reservoir at or below the maximum restricted El. of 10,267.8 feet using the existing outlet works during construction except for temporary fluctuations that may occur during or after precipitation events.

D. The reservoir level may fluctuate during construction due to varying inflows into the reservoir, precipitation events in areas upstream from the dam, and the outlet works operations.

E. Based on inflows, including precipitation events, with the outlet works closed and a starting water surface El. 10,267.8 feet, reservoir levels may be expected to change as follows:

TABLE 01515-1
PRECIPITATION EVENTS AND RESERVOIR LEVEL CHANGES
(STARTING EL 10,267.8 feet)

	100-Year	50-Year	25-Year	10-Year	5-Year	2-Year
Peak Inflow (cfs)	4579	3989	3310	2345	1682	753
Inflow Volume (ac-ft)	3571.4	3090.4	2583.1	1822.3	1320.5	608.9
Max. Reservoir Level (ft)	10273.8	10273.1	10272.2	10271	10270.1	10268.9

F. In the event that the reservoir level rises above El. 10,267.8, the Contractor shall promptly notify the Engineer and Owner.

END OF SECTION

SECTION 01550
CONSTRUCTION ACCESS ROADS AND PARKING AREAS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for construction access roads and parking areas.

1.2 GENERAL

A. Access the construction area using only established roads.

B. Contractor is responsible for all snow removal on roads when required for access to the Work and shall furnish all required equipment and labor necessary to remove snow. Owner will only remove snow if and when necessary for Owner operations.

C. All construction traffic shall stay on approved access roads.

D. Dust mitigation measures shall include at a minimum, control of vehicle speed on roads, and furnishing a water truck and operator for road dust control when required. Other dust mitigation measures such as palliatives may be considered and will require submittal approval.

E. Obtain any applicable federal, state, or Local County permits for hauling on state, county, or local roads.

1.3 PROTECTION OF EXISTING ROADS

A. When legal load limits are exceeded, the Contractor may be fined by the County or State at no additional cost to the Owner. Repair damage to County or State roads caused by construction activity to meet the applicable County or State roadway standards.

B. Before using any existing roads for moving construction equipment or hauling materials and supplies to the site, the Contractor, Owner and Engineer will jointly perform a condition survey of roads in the vicinity of the project. Notify the Engineer at least 10 days in advance of hauling any equipment or materials to the site. A representative of the County may also be present for the condition survey.

C. Contractor is responsible for maintaining access roads in their preconstruction condition until all construction activities are complete. Roads degraded by Contractor operations shall be repaired/regraded in a timely manner.

1.4 CONSTRUCTION ACCESS ROADS

A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area, with the Owner’s approval and in accordance with all Federal, state, and local requirements.

B. Maintain public roadways free of mud and other construction debris. Install gravel tracking pad or other means to prevent tracking debris or mud onto public roads.

C. Extend and relocate as Work progress requires.

D. Construct, maintain, and reclaim temporary construction roads for access to borrow and disposal areas, and for other purposes required for the Work, in accordance with the requirements of the Specifications.

E. Indiscriminant construction of roads and travel will not be permitted.

1.5 PARKING

A. Provide temporary gravel surface parking areas at Engineer's field office and at Contractor use areas to accommodate construction personnel, as approved by the Engineer.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01555
STAGING AND STOCKPILE AREAS

PART 1 GENERAL

1.1 STAGING AND STOCKPILE AREAS

A. Establish Contractor and Engineer offices in the staging and stockpile areas as approved by the Engineer.

B. Any clearing, grubbing, or grading in the staging and stockpile areas performed by the Contractor for setting up and maintaining this area requires the approval of the Engineer.

C. Strip and stockpile topsoil from the staging and stockpile areas in accordance with Section 02235: Stripping and Stockpiling Topsoil.

D. Reclaim staging and stockpile areas in accordance with Section 02920: Reclamation.

E. Stockpile earthfill, topsoil, and other construction materials in the Contractor staging and stockpile areas, and disposal and borrow areas shown on the drawings or as approved by the Engineer.

F. Stockpiling of materials outside the limits of the designated areas requires the approval of the Engineer.

1.2 SECURITY OF STAGING AND STOCKPILE AREAS

A. The Contractor is responsible for securing the staging and stockpile areas. Provide any security measures Contractor deems necessary to protect these work areas. All security fences and gates, if used by the Contractor, shall be removed by the Contractor at the end of construction.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01570
SEDIMENT AND EROSION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing all labor, materials, equipment, and incidentals necessary to perform all installation, maintenance, removal, and cleanup related to erosion and sedimentation control work as specified herein and as required by local authorities and permit to prevent erosion and/or transport of silt or sediment outside the limits of disturbance.

B. The work includes, but is not necessarily limited to, installation of temporary access ways and staging areas, silt fences and sediment barriers, sediment removal and disposal, device maintenance, removal of temporary devices, temporary stabilization, best management practices (BMPs), and final cleanup.

1.2 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Technical product literature for all commercial products to be used for sedimentation and erosion control.

C. Contractors Sedimentation and Erosion Control Plan: (BMPs) in accordance with Local, State and federal regulations.

1.3 QUALITY ASSURANCE

A. The Contractor is responsible for the timely installation, maintenance, and removal of all sedimentation control devices necessary to prevent the movement of slurry or sediment from the construction site to offsite areas or into the stream or wetland system or preservation/ conservation areas via surface runoff or underground drainage systems. Measures, in addition to those shown on the Drawings, necessary to prevent the movement of sediment outside the limits of construction shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the Owner will be considered for the Work under this Section.

B. Sedimentation and erosion control products shall conform to the Drawings, this Section, County requirements, or CDOT standards as applicable.

C. The Contractor's means and methods for excavations and soil disturbing activities shall be conducted to minimize the risk of sediment transport downstream. Sediment control measures will be required to meet strict project and permit standards.

PART 2 PRODUCTS

2.1 MATERIALS

A. Silt Fence:

1. Posts: 2" x 2" wood, min. 4'-6" length as approved by the Project Manager.

2. Silt fence fabric shall be a woven, polypropylene, ultraviolet resistant material such as Mirafi 100X as manufactured by Mirafi, Inc.
3. Prefabricated commercial silt fence may be substituted for built-in-field fence. Pre-fabricated silt fence shall be "Envirofence" as manufactured by Mirafi Inc.

B. Erosion Bales:

1. Consisting of Certified Weed Free hay or straw certified under the Colorado Department of Agriculture Weed Free Forage Certification Program and inspected as regulated by the Weed Free Forage Act, Title 35, Article 27.5., CRS. Each certified weed free erosion bale shall be identified by one of the following:

a. One of the ties binding the bales shall consist of blue and orange twine, or
b. One of the ties binding the bale shall consist of specially produced shiny
c. galvanized wire, or
d. The bale shall have a regional Forage Certification Program tag indicating the
e. Regional Forage Certification Program Number.

2. Erosion bales shall be inspected for and Regionally Certified as weed free based on the Regionally Designated Noxious Weed and Undesirable Plant List for Colorado, Wyoming, Montana, Nebraska, Utah, Idaho, Kansas, and South Dakota. The Contractor shall not unload certified weed free erosion bales or remove their identifying twine, wire or tags until the Engineer has inspected and accepted them. The Contractor shall provide a certificate of compliance showing the transit certificate number or a copy of the transit certificate as supplied from the forage producer.

C. Erosion Logs: Curled aspen wood excelsior with a consistent width of fibers evenly distributed throughout the log and a seamless casing comprised of a photodegradable tube netting. The curled aspen wood excelsior shall be fungus free, resin free and shall be free of growth or germination inhibiting substances. Furnish logs with the minimum diameter and length shown on the Drawings.

PART 3 EXECUTION

3.1 LOCATION OF SEDIMENT/EROSION CONTROL DEVICES

A. Provide sediment/erosion control barriers as needed to control the transport of silt and sediments outside of the limits of construction.

B. Install around the base of all soil stockpile areas. All nonworking faces of soil stockpiles, which will be in place longer than three months, shall be seeded and mulched or otherwise stabilized as acceptable to the Engineer.

3.2 INSTALLATION

A. Silt Fence Installation:

1. Positioned as necessary to prevent movement of sediment produced by construction activities outside of the limits of construction or as approved.

2. Install pre-fabricated silt fence according to Manufacturer's instructions and Drawing details.

B. Hay bale Barrier:

1. Bales shall be either wire-bound or string-tied with the bindings oriented around the sides rather than over and under the bales.
2. Bales shall be placed lengthwise in a single row with the ends of adjacent bales tightly abutting one another.
3. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4-inches. After bales are staked and chinked, the excavated soil shall be backfilled against the barrier. Backfilled material shall conform to the ground level on the downhill side and shall be built up to 2 inches against the uphill side.
4. Each bale shall be securely anchored by at least two stakes or rebars driven through the bale. The first stake shall be driven toward the previously laid bale to force the bales together. Stakes shall be driven deep enough into the ground to securely anchor the bales.
5. The gaps between each bale shall be chinked (filled by wedging) with straw to prevent water from escaping between the bales.

C. Inlet Protection:

1. Install inlet protection for all catch basins, drop inlets, drop structures, inlets to drainage pipes, or other structures.

3.3 MAINTENANCE AND INSPECTIONS

A. Inspections:

1. Contractor shall make a visual inspection of all devices at least once every 14 days and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent erosion and/or movement of sediment to areas outside the limits of construction, Contractor shall promptly install additional devices as needed. Controls in need of maintenance shall be repaired promptly.
2. Contractor shall keep a log of all inspections indicating the following:

    a. Date and time of inspection
    b. Construction Project Inspector
    c. Amount of rainfall
    d. Erosion and sediment control devices inspected
    e. Condition of sediment and erosion control devices
    f. Repairs needed
    g. Date repair is completed

B. Minimum Device Maintenance:

1. Silt Fences:

    a. Remove accumulated sediment once it builds up to one-half of the height of the fabric.
    b. Replace damaged fabric, or patch with a 2-foot minimum overlap.

c. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.

2. Hay bale Barriers:

a. Remove accumulated sediment once it builds up to one-half of the height of the hay bales.
b. Replace damaged hay bales.
c. Make other repairs as necessary to ensure that the hay bales are filtering all runoff directed to the barrier.

3. Inlet Protection:

a. Remove accumulated sediment once it builds up to one-half of the height of the barrier.
b. Remove all sediment accumulated within the barriers.
c. Make repairs as necessary to ensure that the inlet protection device is operating properly.

3.4 TEMPORARY STABILIZATION

A. The duration of the exposure of uncompleted construction to the elements shall be as short as practicable. Completed areas shall be permanently stabilized with seeding and mulching in accordance with Section 02920: Reclamation within seven calendar days after completion.

B. Disturbed areas where work is temporarily halted shall be temporarily stabilized within seven days after the activity ceased unless work is to be resumed within 30 calendar days after the activity ceased. Temporary stabilization required by Contractor's negligence, or lack of proper scheduling, or for the convenience of the Contractor shall be at no cost to the Owner.

C. Temporary stabilization is defined as the covering of disturbed areas with seed, mulch, mulch with a tackifier, or a combination thereof. Temporary soil stabilization techniques shall be proposed by the Contractor and approved by the Engineer. Furnish temporary seed, if required, in accordance with Section 02920: Reclamation.

3.5 REMOVAL AND FINAL CLEANUP

A. Once the Site has been fully stabilized against erosion as approved by the Engineer, remove sediment control devices and all accumulated sediment. Dispose of sediment and waste materials in proper manner. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Drawings or specified herein.

END OF SECTION

SECTION 01575
DISPOSAL OF WASTE MATERIALS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Classification of Waste Materials.
2. Disposal of Waste Materials.

1.2 CLASSIFICATION OF WASTE MATERIALS

A. Waste materials to be disposed of are classified in three categories: 1) excavated waste materials, 2) cleared vegetation, and, 3) other waste materials

1. Excavated waste materials include only those materials which are excavated from the designated excavations at the site which are not suitable for use in construction as determined by the Engineer, or in excess of that needed for construction.
2. Cleared vegetation includes vegetation cleared from within the limits of site disturbance including excavation areas, borrow and disposal areas, staging and stockpile areas, and temporary construction roads.
3. Other waste materials include, but are not limited to demolished concrete and other demolished materials, sediment from sediment and erosion control devices reinforcing steel, pipe, miscellaneous metalwork etc., concrete truck wash water, oil and other petroleum products, solvents, paints and stains, refuse, garbage, debris, sanitary waste, crank case oil, grease, paint thinner, cleaning solvents or any other materials used in maintenance or operation of construction equipment.

1.3 DISPOSAL OF MATERIALS

A. The following materials shall be disposed of at an off-site disposal facility:

1. Cleared vegetation.
2. Other waste materials described in this Section.

B. The following materials may be disposed on site:

1. Excavated waste materials described in this Section.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 OFF-SITE DISPOSAL OF WASTE MATERIALS

A. Remove waste materials from the construction area prior to the completion of the work by the Contractor. Dispose of waste materials in an approved solid-waste facility or other approved facilities.

B. It is the responsibility of the Contractor to make any necessary arrangements with private parties and with County officials pertinent to locations and regulations of area landfills. Any fees or charges required to be paid for disposal of materials shall be paid by the Contractor.

C. In the event that certain materials cannot be disposed of in the local waste disposal facility, the Contractor shall identify a suitable alternative approved waste disposal facility and shall dispose of the material at such facility at no additional cost to the Owner.

3.2 ON-SITE DISPOSAL OF EXCAVATED WASTE MATERIALS

A. Clear, grub, and strip approved onsite spoils disposal area in accordance with Section 02230: Clearing and Grubbing, and Section 02235: Stripping and Stockpiling Topsoil.

B. Excavated waste materials may be disposed of in approved spoils disposal areas provided placement methods comply with the provisions specified herein.

C. Reduce excavated waste rock material with an average dimension greater than 3 feet in diameter to a maximum average dimension of 3 feet in diameter.

D. Spread excavated rock material evenly over the disposal area in approximately 3 foot lifts and in a manner that does not create nesting rocks or void areas that would cause post construction settlement as approved by the Engineer.

E. Place excavated waste material to fill voids between large excavated waste rock materials to the thickness required to fill areas between the larger material, moisture condition as directed by the Engineer and compact this layer with a minimum of 4 coverages of a D-6 or larger bulldozer or suitable roller as approved by the Engineer

F. Place remaining excavated waste material in maximum 12-inch loose lifts, moisture condition the material to near optimum as directed by the Engineer, and compact each lift with a minimum of 4 coverages of a D-6 or larger bulldozer or suitable roller as approved by the Engineer.

G. Grade and shape the placement area to match surrounding grade and such that existing drainage patterns are maintained and there are no areas that would pond water.

H. Place stockpiled topsoil over the spoils disposal area and revegetate in accordance with Section 02920: Reclamation.

END OF SECTION

SECTION 01720
LAYOUT OF WORK AND SURVEYING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section covers surveying requirements.

1.2 GENERAL

A. Existing site reference points and baselines as shown on the Drawings.

B. Provide all materials, items, operations or methods specified, listed or scheduled in specifications and drawings, including all materials, labor, equipment and incidentals necessary and required to conduct proper surveys required to stake and layout the Work.

C. Perform all surveys for the Work including checking existing survey control reference point locations and elevations; reestablishing construction control, resetting of stakes and monuments, measurement for payment of completed work, and performing surveys needed for restoration of public and private improvements that have been damaged, destroyed, or relocated by Contractor.

D. All surveys and staking shall be performed under the responsible charge of a Professional Land Surveyor licensed with the Board of Registration for Professional Engineers and Professional Land Surveyors (the Board) in the State of Colorado and in accordance with applicable CRS and Board rules.

E. The surveyor performing the on site construction staking shall have a minimum of 5 years of construction staking experience.

F. The cost to the Contractor of all work and delays occasioned by giving lines and grades, or making other necessary surveys and measurements, will be considered as having been included in the unit and lump sum prices for items of Work.

G. All field books, notes, and other data developed by Contractor in performing surveys required as part of the Work shall be available to Engineer for examination throughout the construction period. All such data shall be submitted to Engineer with the other documentation required for final acceptance of the Work.

H. Contractor shall keep neat and legible notes of measurements and calculations made in connection with the layout of the Work and measurement and payment. Copies of such data shall be furnished to the Engineer for use in checking Contractor's layout and measurement and payment.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Qualifications: Resume detailing the experience level of the licensed land surveyor shall be submitted to Engineer for review 10 days prior to the start of any staking activities. Include Telephone Number, Address, Qualifications, and License.

C. Survey Records: Contractor shall use the control points established and shown on the drawings. As the work progresses, all subsequent changes to the survey control plan shall be submitted.

D. A certificate signed by the PLS, stating that the elevations and locations of the Work are in conformance with Contract Documents shall be submitted at Contract closeout.

E. After a survey is conducted, submit survey data and field notes to the Engineer. Electronic data (drawings in AutoCAD-compatible .DWG format and data in ASCII format) also shall be submitted.

1.4 PROJECT PRIMARY SURVEY CONTROL

A. Horizontal and vertical primary survey control for the project consists of existing reference control points shown on the Drawings.

B. Contractor is responsible for checking the position of the reference points comprising the primary control prior to starting site work and to notify the Engineer of discrepancies found between actual and record measurements.

C. The existing reference points shall not be disturbed without prior written approval from the Engineer. If existing reference points are disturbed during construction, new reference points shall be installed by the Contractor to control the work. The locations of the new reference points will be approved by the Engineer prior to setting the new reference points.

D. Protection of monuments and stakes is the responsibility of Contractor. Replacement of damaged control and reference points shall be at Contractor's expense.

1.5 SECONDARY CONTROL

A. From the primary reference control provided by Engineer, establish secondary control points necessary for the construction of the Work. Secondary control shall consist of sufficient permanent points to establish the lines and grades for the various Work either directly or by offset. Layout lines for use in construction of the Work shall be established by the Contractor and taken directly from either the primary or secondary controls.

B. Secondary control shall be tied to and closed upon the primary control.

1.6 ACCURACY OF SURVEYS

A. Points for cross sections shall be located to the nearest 0.05 foot horizontally and vertically.

B. Vertical elevation surveys shall close within 0.05 foot times the square root of the length of the circuit in miles.

C. All grade stakes shall be set to 0.02 foot.

D. Alignment of tangents and curves shall be within 0.01 foot.

E. Points for structures shall be set to the nearest 0.02 foot, except where operational function of special features require closer tolerances.

F. Survey movement monuments shall be surveyed within an accuracy of 0.01 foot vertical and 0.01 foot horizontal.

G. Tolerances for all other Work shall be as shown or specified in the Contract Documents.

H. Survey instruments shall be accurate and shall be subject to inspection by Engineer for proper operation.

1. Electronic distance measuring (EDM) instruments used by Contractor on the Site shall be checked for calibration a minimum of once per month on an established base line approved by Engineer. Calibration results shall be kept in a log book, available Engineer's review, showing the date and distances measured on the base line. An EDM shall not be used if it does not meet the minimum advertised accuracy published by the manufacturer of the EDM.
2. Global Positioning System (GPS) equipment shall undergo a zero baseline test. A zero baseline test is a test on two or more receivers simultaneously gathering data from one antenna. The data is post processed to give a resulting vector between the receivers that is equal to zero.
3. Defective survey instruments shall be promptly replaced, repaired, or adjusted to operate within the tolerances of the instrument manufacturer.

I. All work not performed with the methods and equipment as submitted by Contractor and accepted by Engineer shall be removed and replaced by Contractor at its own expense.

1.7 PROTECTION OF MONUMENTS, STAKES, AND MARKS

A. Contractor shall preserve and protect all survey monuments and related marks. When removal is necessary, Contractor shall accurately reference the monuments or related marks, subject to the approval of Engineer.

1. All survey stakes, control points, monuments, benchmark, or reference stakes disturbed or destroyed during the work shall be replaced and reset to the satisfaction of Engineer at Contractor's expense.
2. Primary or secondary control monuments removed shall be reset by Contractor as soon as the Work requiring the removal is complete. Alternatively, other control points may be set so as to reestablish the control network.
3. The position of monuments, control points, or other marks that are subject to movement due to the passage of equipment or other forces shall be rechecked at regular intervals, but not less than monthly.

1.8 QUANTITY SURVEYS

A. Following the completion of all the clearing and grubbing operations in an area, and before commencing stripping, Contractor shall prepare a baseline survey consisting of, at a minimum, cross-sections at 50-foot intervals in all areas of disturbance as a basis for determining excavation, and placement of fill materials. Excavation and fill quantities shall be calculated by either the average end area method or by using digital terrain models.

B. Each month, determine the volume of excavation and earthwork accomplished. The quantities shall be determined using the same cross-sections established during the baseline survey.

C. At the point where the Work performed under each bid item is completed, perform a final survey using the same cross-sections established during the baseline survey. This survey shall be used by Contractor to calculate quantities (as described above).

D. The difference in calculated quantities between the initial and final cross-sections or digital terrain models for each item will be the basis for the total payment to Contractor for that item unless otherwise defined in the specifications. Submit a copy of cross-section survey data and quantity calculations to Engineer for each monthly payment.

E. The Engineer may perform check surveys in selected locations to verify measurements and quantities. Provide the Owner and Engineer access to the Work areas for survey measurements, as required.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 REQUIRED SURVEYS

A. Quantity surveys for payment including baseline surveys of existing ground and excavation surfaces.

B. Surveys for project boundaries, including easements, right of ways, and disturbance limits.

C. Surveys of existing structures, including structure and pipe inverts and elevations required to confirm, coordinate and attach existing work to new construction. Such surveys shall be completed as soon as features previously submerged or covered become accessible.

D. As-constructed surveys of new construction, including, but not limited to:

1. Spillway chute and stilling basin;
2. Spillway underdrain elevations and extents;
3. Toe drain elevations and extents;
4. All pipe inverts at minimum 50-foot spacing, ends, grade breaks, and changes in direction;
5. Regraded and disturbed areas;
6. Downstream embankment slope including drain blanket extents and elevations;
7. Relocated utilities, roads, or other site features;
8. New or relocated instrumentation.

E. All other surveys required for construction to plan elevation and locations and to provide as-constructed information for record documents.

END OF SECTION

SECTION 01770
CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SUMMARY

A. This section covers contract closeout items including closeout procedures, final cleaning, and project record documents.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's and Owner’s review.

B. Provide submittals to Engineer that are required by the Contract Documents, and governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Temporary road cut transition.

C. Clean debris from the site.

D. Sweep paved areas, rake clean landscaped surfaces.

E. Disconnect all temporary utilities to the site, and temporary site facilities and utilities.

F. Remove all Contractor constructed access roads and parking areas.

G. Clear, grade, and seed as required.

H. Remove waste and surplus construction materials, rubbish, wood, bituminous concrete, concrete debris, demolished materials, other foreign material, and construction facilities from the site.

1.4 PROJECT RECORD DOCUMENTS

A. Maintain on site, one set of the following record documents; record actual revisions to the Work:

1. Contract Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other Modifications to the Contract.
5. Reviewed submittals including shop drawings, product data, and samples.
6. Requests for information, field directives and project correspondence.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

E. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to completed construction and the project datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements or benchmarks.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract Drawings.

F. Submit closeout documents to Engineer with request for final Application for Payment.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 02090
PIPE CLEANING AND VIDEO INSPECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section covers requirements for conducting video inspections of pipes.

1.2 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Pipe cleaning procedures and equipment.

C. Qualifications of video inspection firm and video inspection equipment.

D. Three compact DVDs with the video of pipe inspection.

E. One copy of all field notes taken by the pipeline inspectors.

1.3 EXISTING CONDITIONS

A. The existing steel pipe is an outlet pipe.

1.4 COORDINATION

A. Coordinate video inspection of the pipe so the Engineer may be present. Notify the Engineer a minimum of 48 hours before the inspection is to be conducted.

B. Video inspection may be conducted in a flowing pipe.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 VIDEO INSPECTION

A. Clean existing pipes before video inspection.

B. Record single frames of video images and live video as well as inspection data onto a CD/DVD.

C. Video Pipe Inspection Equipment:

1. Video Camera: Conduct video inspection using a camera mounted on a remotely operated crawler or on push type cable. Provide the following:

a. Sufficient brightness to clearly illuminate the inside of the pipe.
b. Capability of viewing a minimum of 270 degrees around the pipe perimeter.
c. Capability to locate the vertical and horizontal camera position from the surface.

2. Video Recording Equipment.

   a. Video monitor for viewing real-time video footage, along with recording capabilities.
   b. Capability to record distance of camera location superimposed on the video image.
   c. Capability to record pipe inspection video on color video in DVD format. Provide the ability for any captured video to be played back from a CD/DVD by any user with a PC utilizing standard viewers.

D. Setup video monitor in a location for viewing by the Engineer. Provide shrouds or other light blocking so the video monitor is clearly visible.

E. Begin video recording as soon the crawler unit/camera unit is inserted into the pipe continuing to the end of the available pipe that can be videoed.

F. Record on video images the distance inside the existing host pipe and the time and date of the inspection.

G. Provide an audio voice with the video that includes a description of obstructions and anomalies or obstructions. Zoom and pause at anomalies when directed by the Engineer. Draw attention to all recognizable defects and imperfections on the video. Record on written notes locations of any defects.

H. Submit the video inspection within 1 day of inspection. The CD/DVD becomes the property of the Owner.

END OF SECTION

SECTION 02220
SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Selective demolition of existing features and items designated for removal, existing conditions, protection of existing work designated to remain, and sealing the existing corrugated metal pipe (CMP) toe drain penetration through the concrete outlet works headwall.

B. Demolition associated with modifications to extend existing piezometers is included in Section 13500: Instrumentation.

1.2 DEFINITIONS

A. Demolish, Demolition, or Remove: Remove and dispose of designated existing equipment, materials, and ancillary features and components.

B. Remove and Salvage: Remove and deliver existing equipment, materials, and ancillary features and components to Owner at location as directed.

C. Remove and Relocate: Remove and relocate equipment, materials, and ancillary features and components.

D. Reinstall: Make service connections, and provide functional equipment at designated new location.

E. Retain or Protect: Leave designated existing equipment, materials, and ancillary features and components in place and protect from damage.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Demolition Plan including:

1. Schedule of demolition, including removals, salvage and replacement in conjunction with Progress Schedule.
2. Proposed methods of demolition including removals, salvage and replacement and equipment to be used.

C. Permits: Copies of current valid permits required by state and local regulations all State and local licenses and permits necessary to carry out the work.

D. After demolition is complete, if requested by the Engineer, submit reports describing quantities and type of demolition materials, and the locations, quantity, and method of disposal.

1.4 EXISTING CONDITIONS

A. Information contained in Contract Documents indicating the general scope of demolition is based on available historic drawings. The Design Drawings show major features and not details for each item.

B. The Demolition Schedule included in this Section is a general summary solely for convenience of Contractor; inspect facilities and verify nature and location of work.

PART 2 PRODUCTS

2.1 GROUT

A. Unless otherwise approved by the Engineer, grout for sealing the existing corrugated metal pipe (CMP) toe drain penetration through the concrete outlet works headwall, shall be a pre-packaged standard ASTM C1107, non-metallic, non-shrink grout, amended with pea gravel in accordance with the manufacturers written instructions.

PART 3 EXECUTION

3.1 PREPARATION

A. The extent of demolition work shown on the Drawings is based on record Drawings and site observations. The specific extent of demolition for the various items will be determined by the Engineer in the field.

B. Notify Owner and Engineer minimum 7 days prior to beginning demolition work.

C. Protect existing vegetation, facilities, equipment, and fixtures to remain.

D. Provide temporary barricades and other protection as required.

E. Erect and maintain dustproof and weatherproof partitions and closures as required.

F. Provide required shoring, bracing, and supports.

G. Equipment and Materials Designated for Salvage:

1. Do not remove and salvage features and materials without approval of Engineer.
2. Store and maintain salvaged equipment and materials in same condition as when removed.

H. Contractor and Engineer will document and record the condition of features and materials prior to removal.

3.2 DEMOLITION

A. Conduct demolition operations and debris removal in a manner ensuring minimum interference with roads, structures, and other adjacent features and facilities.

B. Drawings define extent of demolition. Immediately notify the Engineer of damage to structures and features not identified for demolition or beyond the limits of demolition as shown or as determined by the Engineer.

C. Damage beyond the limits of demolition will be repaired or replaced using materials and methods appropriate for the particular location, as determined by the Engineer.

D. Remove materials to conform to new elevations, profiles, and sizes. Comply with specified tolerances and finishes.

E. Saw cut or otherwise isolate materials to be removed to minimize damage to adjacent surfaces.

F. Protect materials and equipment designated for reuse.

G. Remove items to be demolished to limits noted on Drawings.

H. Protect existing structures, gates, and surfaces from damage.

I. Use water sprinkling, temporary enclosures, and other methods to limit dust.

J. Comply with provisions of Section 01575: Disposal of Waste Materials for disposal of removed items, demolished materials, and debris.

K. Blasting is not allowed for demolition.

3.3 SALVAGE AND DISPOSAL

A. Transport the following items identified for salvage to a location acceptable to Owner:

1. No items are identified for Owner salvage.

3.4 DEMOLITION SCHEDULE

A. Existing Spillway Concrete: Demolish only the portion of the spillway indicated on the Drawings unless otherwise directed by the Engineer. Protect adjacent spillway concrete to remain.

B. Sealing Existing Toe Drain Penetration:

1. Carefully remove the CMP from the concrete wall.
2. Prepare the penetration surface as a construction joint in accordance with Section 03300: Cast-In-Place Concrete.
3. Using formwork and trough methods, place grout to seal the penetration.

END OF SECTION

SECTION 02230
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal of all surface debris, grass, trees, and shrubs within limits of disturbance indicated on the Drawings, and as required to perform the work.

B. The general work areas which require site clearing include, but are not limited to:

1. Contractor staging and stockpile areas.
2. Borrow areas.
3. Excavation areas.
4. Spoils disposal area.
5. Temporary and permanent access roads.

1.2 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Clearing and Grubbing Plan:

1. Describe method for vegetation removal and disposal.
2. Describe temporary barriers and methods to protect existing structures and property, existing plant life and features designated to remain, and areas beyond limits of disturbance as identified on the Drawings.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PROTECTION

A. Verify the area to be cleared and existing plant life and features designated to remain with the Engineer before initiating any clearing operations in that area. Unauthorized clearing will not be approved for payment, and the Contractor is responsible for replacement of damaged existing plant life and features designated to remain.

B. Flag barricade and clearly mark existing plant life and features designated to remain.

C. Protect any trees, plant growth, and site features not designated for removal or designated for protection. Remove only those trees and plant growth required for the Work.

D. Do not disturb trees or shrubbery in public right-of-way or on property outside of the limits of disturbance shown on the Drawings.

3.2 CLEARING AND GRUBBING

A. Remove all trees, shrubs, undergrowth, deadwood, and other surface debris as required to perform the Work, within the limits of disturbance shown on the Drawings, except for those trees and shrubs designated to be protected.

B. Remove all trees, stumps, branches, brush and other material from clearing and grubbing activities. Cut tree trunks and branches into 10-foot maximum lengths and stockpile in staging and stockpile areas designated on the Drawings.

C. Remove and stockpile topsoil in accordance with Section 02235: Stripping and Stockpiling Topsoil.

D. Do not leave logs, stumps, rocks, etc., lying in the public right-of-way or on adjacent property without written approval by the Engineer.

3.3 DAMAGED VEGETATION

A. Contractor is responsible for injuries to vegetation caused by Contractor operations, personnel, or equipment. Remove and replace damaged vegetation designated for protection with vegetation of same type and size at no additional cost to the Owner.

3.4 PLACEMENT AND DISPOSAL

A. Dispose of excess vegetative materials and debris materials in accordance with all applicable rules and laws and in accordance with the requirements of Section 01575: Disposal of Waste Materials.

3.5 MAINTENANCE OF CLEARED AREAS

A. Maintain cleared work areas in a condition free from additional vegetation growth for the duration of the project.

B. Compensation for clearing each area will occur only one time. If weeds and brush growth require additional clearing, it shall be performed solely at the Contractor's expense.

END OF SECTION

SECTION 02235
STRIPPING AND STOCKPILING TOPSOIL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removing grass, weeds, and topsoil within the limits of site disturbance as shown on the Drawings.

B. Stockpiling topsoil in the staging and stockpile areas shown on the Drawings.

1.2 DEFINITIONS

A. Topsoil – Topsoil stripped from the site shall be the top surface soil that is dark brown or black, fertile, and contains organic matter or the soil that is located within 6 inches of the surface, or as directed by the Engineer. Topsoil shall be free of subsoil, noxious weed seed or reproductive vegetation plants, heavy clay, hard clods, toxic substances or other material which would be detrimental to plant growth.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Excavate topsoil from areas requiring stripping, as indicated on the Drawings or as directed by the Engineer.

B. Remove roots larger than 1 inch, rocks larger than 3 inches, and debris prior to stockpiling of the topsoil, unless determined otherwise by the Engineer. Existing grass layers may be incorporated into topsoil provided the layers are mixed adequately into the topsoil stockpiles.

C. Stockpile topsoil in area(s) designated on the Drawings unless otherwise approved.

D. Install erosion protection around all stockpiles. Protect topsoil stockpiles from wind and water erosion.

3.2 DISPOSAL

A. Remove and dispose of excess vegetation in accordance with the requirements of Section 01575: Disposal of Waste Materials, and in accordance with all applicable local, state, or federal rules and regulations.

END OF SECTION

SECTION 02240
DEWATERING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Providing materials, equipment, and labor to install and maintain all pumps, piping, drains, well points, wells, and other facilities required to effectively control, collect, and dispose of groundwater or surface water to permit safe and proper completion of the Work. Use appropriate equipment and methods for dewatering based on existing site conditions.

B. Providing observation wells as necessary to verify satisfactory performance of the dewatering system.

C. Maintaining the foundations and other portions of the Work free from water as required for constructing each part of the Work.

D. Complying with all applicable environmental protection laws and requirements in operation of the dewatering system.

E. Removing all components of the dewatering system after it is no longer required.

1.2 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Dewatering Plan: Submit a Dewatering Plan prepared by a qualified dewatering specialist, with at least 10 years of experience in design, installation, and operation of dewatering installations. The Dewatering Plan shall be prepared by a Professional Engineer registered in the State of Colorado and shall include the following:

1. Details regarding the anticipated types and locations of various dewatering facilities, proposed number and locations of observation wells, and design calculations required to substantiate the Dewatering Plan.
2. Superintendence plan and schedule, indicating who will be responsible for observing the dewatering system and the proposed schedule describing when personnel will be on site to observe and maintain the system.
3. Proposed locations, depths, and construction details of observation wells. Data from these wells shall be used as appropriate, along with other available information, to modify dewatering requirements.
4. Coordination with other work including schedule, dewatering and diversion methods and operations, erosion and sediment control measures, equipment, and location and elevation of pumps, pipes, and any other features planned for use in the dewatering plan
5. Final recommendations for dewatering.
6. If the Contractor purchases, rents, installs, or mobilizes to the site any elements of the dewatering system before approval of the dewatering submittal, the Contractor does so at its own risk, and will not be due any additional compensation from the Owner if such elements are not subsequently used for the work.

7. Approval of the dewatering system proposed by the Contractor will only be with respect to the basic principles of the methods the Contractor intends to employ. Approval does not relieve the Contractor of full responsibility for adequacy of the dewatering system.

1.3 DEFINITIONS

A. Definitions

1. Dewatering: Removing water by single or multiple stage wellpoints, deep wells, ejector wells or sumps, as approved based on the Contractor's submittals.
2. Hydrostatic Groundwater Level: The groundwater level at any location during construction and before dewatering.
3. Observation Well: Temporary well to observe dewatering system performance during construction.
4. Sump: A depression excavated or constructed, from which water is pumped as part of dewatering.

1.4 AVAILABLE DATA

A. Logs of test borings and groundwater observations at the time of drilling are included on the Drawings.

B. The Contractor may refer to the boring and test pit logs on the Drawings, but shall draw their own conclusions as to the applicability of the information contained therein. The Contractor may choose to perform additional investigations to develop their dewatering plan.

C. The subsurface conditions and groundwater observations from the test pits and borings apply only to the locations of the test pits and borings and at the time of the explorations and measurements. The subsurface conditions at the site may be different at the time of construction as compared to when observations were made and recorded, and the groundwater level can be expected to fluctuate. These factors should be appropriately considered in developing the Contractor's Dewatering Plan.

1.5 QUALITY ASSURANCE AND QUALITY CONTROL

A. Dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 DEWATERING SYSTEM

A. The dewatering system shall be single- or multiple-stage wellpoints, deep wells, ejector wells, or sumps used for dewatering and which fulfill the dewatering requirements specified in this Section. The materials and construction of the dewatering wells will be selected by the Contractor and the Contractors' dewatering specialist.

B. Unless otherwise approved by the Owner, gasoline, diesel, or other gas-powered pumps are prohibited.

2.2 OBSERVATION WELLS

A. Observation wells shall be installed within the excavation limits at the locations and depths indicated in the approved Dewatering Plan. Observation wells shall be installed and functional before initiation of dewatering activities and excavation.

B. Observation wells shall be 2-inch-diameter, Schedule 40, PVC pipe installed in a drilled hole. Slot at least 5 feet of the pipe bottom, and provide slots to within 3 feet of the surface. Slots shall be a maximum of 0.02 inch in width and shall be spaced at 1/4 inch center-to-center along three separate rows for the entire length of the slotted section, and shall be installed by the manufacturer, and shall not be installed in the field. The bottom of the pipe shall be plugged with a PVC plug. The top shall have a removable cap. The entire slotted section of the pipe shall be surrounded with a minimum 1/2-inch-thick annular zone of 10-20 silica sand or equivalent. The bottom of the wells shall be at least 10 feet below the bottom of the required excavation. A bentonite and concrete seal shall be installed from the top of the well to a depth of 3 feet to prevent infiltration of surface water into the wells.

C. Observation wells shall be a type that will permit portions of the riser to be removed as excavation work progresses.

D. Observation wells shall be tested by adding or removing water from the well risers and subsequently monitoring the stabilization of the water levels in the wells to demonstrate that observation wells are functioning properly before taking water level readings.

PART 3 EXECUTION

3.1 GENERAL

A. Design, furnish, install, maintain, and operate a dewatering system that prevents loss of fines, boiling, quick conditions, or softening of foundation strata and maintain stability of bottom of excavations so that every phase of the work can be performed in the dry. The dewatering operations shall be operated such that excavation bottoms are firm, suitably dry, and free from standing water at all times.

B. Lowering of the groundwater level a minimum of 2 feet below the excavation bottom shall be verified by observation well readings before commencement of excavation below the hydrostatic groundwater level. The number of observations wells shall be as approved in the Dewatering Plan.

C. The location of every element of the dewatering system shall be such that interference with excavation and construction activity is minimized. Locations shall be subject to approval by the Engineer.

D. The Contractor shall review available subsurface data for the project site, available on the Drawings. It shall be the Contractor's responsibility to evaluate site subsurface conditions with respect to required dewatering facilities.

E. At all times during construction, provide ample means and devices to remove promptly, and dispose of properly, all water entering excavations and keep the bottoms of excavations firm and free of standing water until structures to be built thereon are completed and/or backfill to be placed therein is placed. Pumping and dewatering

operations shall be conducted such that no disturbance to foundation subgrade materials or to fill materials supporting any other work will result. Discharged water shall be piped to an approved area. Dewatering discharge shall not cause siltation or other negative environmental impact on natural waterways or other property; such discharge shall be in accordance with applicable federal, state, and local permit regulations. At dewatering discharge locations, silt barriers or other control measures as specified in Section 01570: Sediment and Erosion Control shall be installed to control and prevent siltation.

3.2 INSTALLATION AND OPERATION

A. The location of every element of the dewatering system shall be such that interference with excavation and construction activity is minimized. Locations shall be subject to approval by the Engineer.

B. Before any excavation below 2 feet above the hydrostatic groundwater level, the dewatering system shall be placed into operation to lower water levels as required and then shall be operated continuously 24 hours per day, 7 days per week until all facilities and structures affected by the dewatering have been satisfactorily constructed, including placement of fill materials to an elevation 2 feet minimum above the hydrostatic groundwater level. Maintain groundwater levels low enough to fulfill the requirements of this Section and do not allow the water level to rise until constructed facilities are complete, so that the water can be allowed to rise without damaging facilities, their foundations, or surrounding areas and structures. Provide superintendence in accordance with the approved plan during all periods of dewatering. Superintendence shall mean provision of qualified Contractor personnel knowledgeable in operation and maintenance of dewatering system(s). The Contractor is responsible for any damage resulting from failure to maintain the dewatering system.

C. Provide complete standby equipment and power sources available for immediate operation as may be required, to adequately maintain the dewatering on a continuous basis in the event that all or any part of the dewatering system becomes inadequate or fails. An automatic switchover system to the standby power source shall be provided to ensure uninterrupted power supply to pumps in an emergency. Spare pumps shall be automatically engaged if primary pumps fail for any reason.

D. When the dewatering system does not meet the specified requirements, and as a consequence, loosening or disturbance of the foundations strata, instability of the slopes, or damage to the foundations or structures occurs, the Contractor is responsible for supplying all materials and labor and performing all work for restoring foundation soils, slopes, foundations, and structures, to the satisfaction of the Engineer, at no additional expense to the Owner.

E. When failure to provide adequate dewatering and drainage causes disturbance of the soils below design foundation or excavation grade, provide adequate dewatering and excavate and re-fill the disturbed areas with approved, properly compacted fill material. Such work shall be at the Contractor's expense and at no additional cost to the Owner.

3.3 REMOVAL

A. Obtain written approval from the Engineer before discontinuing operation of any portion of the dewatering system(s).

B. Remove all elements of the dewatering system(s) and observation wells from the site at the completion of dewatering work.

C. Abandon observation wells by removing casing and backfilling holes with approved cement grout.

END OF SECTION

SECTION 02265
COFFERDAMS AND STREAM DIVERSION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for stream diversion during construction including:

1. Construction and removal of a temporary upstream cofferdam for spillway construction.
2. Construction and removal of a temporary downstream cofferdam for spillway construction.

1.2 RESPONSIBILITY FOR DESIGN

A. The Contractor shall have full responsibility for planning, design, installation, and monitoring of cofferdams.

B. Approval from the Owner and Engineer will only be with respect to the basic principles of the methods and procedures the Contractor intends to employ and shall not relieve the Contractor of full responsibility for the adequacy of the cofferdams and stream diversion including responsibility for repairing any damage to adjacent property, foundations, permanent structures, pipelines and utilities, or damage to any part of the Work caused by failure or inadequacy of any part of the system. Damage to the Work caused by flooding will be the responsibility of the Contractor, and shall be repaired at no cost to the Owner.

C. Basic flood hydrology and historical stream flow data applicable to the site are presented in the URS Design Report. The Owner has established the minimum level of protection for this project to be 100-year, or 1 percent chance of overtopping, as defined by the information presented in the URS Design Report. The data, facilities, and equipment discussed in these specifications are for information only and their use will not relieve the Contractor of full responsibility for the adequacy, safety, and maintenance of the diversion system and for the repair of any damage occurring to the Work as a result of flooding caused by any and all stream flows. Work specified in this Section shall be performed by an individual or firm of established reputation in the design of Cofferdams.

D. Assign a registered Professional Engineer responsible for stream diversion design including cofferdams (water dams) with at least five (5) years experience in the design of cofferdams for stream diversion.

1.3 DIVERSION REQUIREMENTS

A. General

1. Design diversion and sediment control facilities to divert water around the construction area, or convey through the area in a controlled manner, and to control the quality of water leaving the construction area from diversion, dewatering and Contractor operations.
2. The methods of diverting and controlling stream flows including designs and implementation, are fully the responsibility of the Contractor.

3. Design temporary cofferdams, diversion pipes, and temporary diversion channels to divert stream flows to minimize seepage and provide adequate slope stability.
4. Construct all diversion and erosion control facilities to protect facilities from erosion or damage.
5. Construct facilities as needed to maintain water quality from diversion, drainage, dewatering and all construction activities in compliance with the NPDES and other applicable permits.
6. Contractor is responsible for damages to the work that results from floods in that may occur during the construction period.
7. Approvals: The Contractor's design, including computations, schedule of operation, and drawings shall be submitted to the Engineer for approval. After the system is in operation, Engineer will monitor progress of the construction to confirm the timing when the system can be safely removed, and will provide written notice to the Contractor that it can be removed.

1.4 COFFERDAM DESIGN

A. Design cofferdams to meet the following criteria:

1. Maintain flow rate into the excavation not exceeding a flow rate that can be handled in accordance with Section 02240: Dewatering to conduct work in the dry.
2. Design the cofferdam to withstand all soil and hydrostatic loadings that might occur during the various stages of construction and for any surcharge loading. The diversion designer is responsible for determination of proper load distributions caused by such conditions, and the installer shall assure that those conditions are not exceeded in the field during construction. The designer shall make a determination of the lateral earth and water pressures and surcharge loads that could result from the installers methods and dewatering activities and shall design cofferdams for those pressures and loads. Design of the cofferdam shall also consider the installers sequence of excavation and placement of any lateral support elements.
3. The cofferdams shall generally include 1) free draining upstream (water side) face material, 2) impervious core material, 3) foundation and abutment treatment, and 4) riprap, with bedding, upstream (water side) face.
4. Meeting all applicable OSHA regulations, and all applicable federal, state, and local regulations.
5. Designed so crest elevation of the cofferdam does not interfere with adjacent and overlying construction.
6. Designed to prevent damage to other existing or proposed adjacent properties, buildings, structures, utilities, and other work.
7. Several borrow sources have been identified for the project. The Contractor can use these Owner identified sources or other sources for the cofferdams. If the Contractor selects another source it is the sole responsibility of the Contractor to justify the suitability of the material to be used for the project through materials testing. The material shall be approved by the Engineer for the project.

1.5 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Diversion plan for review and acceptance at least 20 calendar days prior to constructing stream diversion and cofferdams

C. The Diversion submittal shall contain, as a minimum, the following information:

1. Design of temporary cofferdams, showing embankment material description, embankment slopes, crest width, crest elevations, seepage control provisions, embankment fill gradations, and embankment placement procedure.
2. Design of stream diversion pipes, if used, including pipe material specifications, fittings, excavation plan and sections for the pipe, thrust blocks, and other necessary connections.
3. Design of temporary diversion channels, including location of channel, channel slope and length, channel width, side slopes, and backfill materials and backfilling procedures.
4. Proposed installation procedure and construction sequence.
5. Discharge erosion control measures

D. Name(s), qualifications, resumes, and references of proposed cofferdam designer.

E. Design calculations demonstrating that the cofferdam system meets the design criteria specified herein. All design calculations shall be stamped by a Professional Engineer registered in the State of Montana. The design calculations shall include, as a minimum:

1. An evaluation of the existing ground conditions to determine the basis for cofferdam foundations.
2. A list of all assumptions, criteria, and stress values used for all cofferdam materials.
3. A list of references substantiating all design assumptions, criteria, and stress values used.
4. A list of all calculation methods used, including references of all calculation methods.
5. An analysis of all design loads, including earth and hydrostatic pressures, and any anticipated live loads.
6. An analysis of seepage, stability, uplift, and bottom heave of the cofferdam.

1.6 MAINTENANCE

A. Maintain diversion channels, cofferdams, gates, pipes, sedimentation check dams, sedimentation dikes, drains, pumps, and/or other temporary diversions and protection works to prevent surface water from entering excavations, foundation areas, and other portions of the Work intended to be performed in the dry.

B. Repair any damage resulting from diversion operations at no cost to the Owner.

1.7 DAM SAFETY AND PUBLIC SAFETY

A. Work is planned to be performed with the reservoir draw down to the existing outlet invert. However, depending on inflows and outflows, reservoir water surfaces may rise or fall during construction. Precipitation events and floods may result in the reservoir pool exceeding the drawdown limit until it can be drawn back down. Proper diversion is essential to construction of the dam safety modifications, to the safety of the dam, and to public safety. Improper diversion by the Contractor may endanger the safety of the

workers, the Work, and the safety of the dam. Failure of the dam may result in both loss of life and property damage.

PART 2 PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that Work and property upstream, downstream, and adjacent to Work will not be damaged by water quality protection, erosion and sediment control, and diversion operations and facilities.

3.2 GENERAL CONCEPT

A. The general concept of a diversion scheme involves the following steps:

1. Maintain the diversion during the Work as necessary to complete the Work in the dry. Coordinate and sequence the work elements with diversion activities.
2. Remove the diversion system after all work is completed and accepted by Owner and Engineer.

B. Schedule and construct diversion features consistent with provisions outlined herein and the Contractor's needs.

3.3 DIVERSION FACILITIES

A. Temporary Cofferdams: Temporary cofferdams shall be constructed if included in the approved Diversion Plan. The typical cross-sections, minimum required crest elevation, detention storage capacity, location, and lines and grades shall be selected by the Contractor, and approved by the Engineer. The design and construction of the cofferdams shall be the responsibility of the Contractor. Contractor may use material from required excavations to construct cofferdams, or may import material at their option. Impervious and/or random fill and necessary seepage control measures shall be provided as required. Cofferdams shall be removed at the end of each construction season.

B. Pumps, Piping, and other miscellaneous facilities: Install the diversion system per the approved plan, and modify as needed to comply with the requirements stated herein.

3.4 INSTALLATION

A. Coordinate temporary diversion facilities with permanent construction facilities.

3.5 REMOVAL

A. After having served their purpose, remove all temporary diversion facilities and protective works as required by the Engineer so as not to interfere with the operation or usefulness of the reservoir, pipelines, channels and other facilities. Remove temporary diversion facilities and protective works only after approval of the Engineer.

B. Dispose of excess materials from diversion facilities in accordance with Section 01575: Disposal of Waste Materials.

3.6 FIELD QUALITY CONTROL

A. Provide testing and monitoring as required by the NPDES permit, and other permits required by the Specifications.

B. Construct diversion system per the approved design, installation procedures and quality control recommendations.

C. Repair at no expense to the Owner any damage to the foundations, structures, adjacent property, or any part of the diversion or protective works.

END OF SECTION

SECTION 02305
BLASTING

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the use of explosives in the drill-and-blast operations for work involving the excavation of rock.

B. The work covered in this section includes qualifications, pre-construction blasting survey, test blasts, blast design, monitoring systems, monitoring equipment, blast limitations, explosives and initiation system requirements, drilling and loading of blast holes, labor and supervision for the transportation and storage of explosives, protection of existing facilities, pre-blast and post-blast inspections and damage repairs.

1.2 WORKSITE CONDITIONS

A. This Statement of Concern is expressly written to alert the contractor (and prospective bidders) to the fact that ordinary practices that are customarily considered as standard for the blasting industry will not be acceptable on this project. Extra caution and skill will be required to accomplish this work in a satisfactory manner. Acceptance of blasting methods and the required monitoring will depend on the proximity to the dam, structures, and other critical facilities. Because of these concerns, the Engineer will exercise its prerogative to examine carefully the qualifications of any persons whose knowledge and skills may bear on the outcome of the work. In addition, the Owner will reject any persons who are deemed unqualified for any tasks that may be required.

1.3 REFERENCES

A. Code of Federal Regulations (CFR):

1. US Department of Labor, Occupational Safety and Health Administration (OSHA), Construction Standards and Interpretation, 29 CFR Part 1926.
2. Safe Explosive Act rules as found in CFR 27, U.S. Department of Justice, Alcohol, Tobacco, Firearms and Explosives Division (ATF). 27 CFR Part 555, Implementation of the Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296; Interim Final Rule.

B. Bureau of Alcohol Tobacco and Firearms (BATF):

1. Title XI, Regulation of Explosives (18 U.S.C. Chapter 40: 84 Statute 952), of the Organized Crime Control Act of 1970 (84 Statute 922) and 27 CFR 55.

C. U.S. Department of Transportation (USDOT):

1. Title 49 (49CFR) Parts 106, 107, 171-179, 383 and in 399

D. Office of Surface Mining (OSM)

1.4 DEFINITIONS

A. Air Blast: Air-Overpressure is the temporary changes in ambient air pressure generated in the air surrounding the blast. Air-overpressure is expressed in units of pounds per square inch (psi) or decibels (dB) (linear scale).

B. Attenuation Study: Small scale test blasts conducted to assess site specific vibration response to blasting. The test is conducted at a safe distance from sensitive structures to evaluate the site specific ground response to blast vibration. The results of an Attenuation Study is used to design a safe blast hole loading density and delays to control vibrations to a predetermined safe level for structures.

C. Blasting Consultant: A qualified third party entity whom the Contractor plans to retain to facilitate the development or review of all blasting designs and blast-effect control measures.

D. Blast Plan: A plan depicting the methods and details of the drilling, loading, monitoring and intended outcome of a future blast.

E. Blaster-in-Charge or Blasting Supervisor - The single designated and licensed person with complete responsibility and total authority over all decisions involving safe handling, use and on-site security of explosives.

F. Charge-per-Delay: The amount of explosives detonating within any 8-millisecond time period occurring from the beginning to the end of a blast.

G. Controlled Blasting: The use of special techniques at the perimeter of the excavation to control overbreak and produce sound and smooth rock surfaces.

H. Delays: Special devices manufactured specifically to delay the initiation of explosives in certain locations to provide for movement of rock during blasting.

I. Fly rock: Airborne rock fragments launched by a blast.

J. Line Drilling: A method or technique used where blast holes are closely spaced to act as stress concentrators or guides to cause cracks to form between them. The application of line drilling in conjunction with pre-splitting or trim blasting techniques should reduce blast damage beyond the limits of the line drilled alignment on the proposed excavation line.

K. Peak Particle Velocity (PPV): The maximum of the three ground vibration velocities measured in the vertical, longitudinal and transverse directions. Velocity units are expressed in inches per second (ips).

L. Powder Factor: Pounds of explosive per cubic yard of rock broken.

M. Pre-splitting: A method of blasting in which a planar crack is propagated by blasting to determine the final shape of a rock face before holes are drilled for the final blast pattern; firing with a minimum time scatter, can then be used. The crack helps to screen the surroundings from ground vibrations during the firing of the main round.

N. Primary Initiation: The method whereby the blaster-in-charge initiates the blast(s) from a remote and safe location. Primary initiation for non-electric systems use a pneumatic tubing or shock-tube to convey firing energy from the blaster-in-charge to the blast location.

O. Prohibited Persons - Persons prohibited from handling or possessing explosive materials as defined by the seven categories described in Section 555.11 of 27 CFR (ATF Rules).

P. Scaled Distance: The distance from a blast measured in feet, divided by the square root of the maximum charge-per-delay measured in pounds. These “square root” scaled distance values are used in calculations regarding ground vibration prediction and control. For air-overpressure calculations, cube-root scaling is used whereby distance is divided by the cube root of the maximum charge-per-delay.

Q. Shot: Firing of all explosives loaded at a given time.

R. Stemming - Crushed stone, tamped clay or other inert earth material placed in the unloaded collar area of blastholes for the purpose of confining explosive charges and limiting rock movement and air-overpressure (noise).

S. Sub-drilling: Drilling of blast holes below the specified foundation grade to prevent "tights" or high spots between holes.

1.5 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Qualifications:

1. A detailed description of the education, training and experience of all proposed persons that will be immediately in charge of drilling and blasting operations. Separate qualifications shall be submitted for each Supervisor and Blaster-in-Charge. The Contractor's submittal shall include names, addresses and telephone numbers of at least three persons who can verify such prior successful experience for each Supervisor and Blaster-in-Charge. Copies of valid Colorado blasting licenses shall also be submitted for each/all Blaster-in-Charge.
2. The name and qualifications of a recognized third party Blasting Consultant whom the Contractor plans to retain to facilitate the development or review of all blasting designs and blast-effect control measures. The qualifications of the blasting consultant shall meet or exceed the requirements given in these specifications. The blasting consultant shall be retained for the duration of the blasting. The blasting consultant shall review the contractor's blaster-in-charge's general blasting plans, oversee test blasts and participate in a minimum of one on-site meeting.

C. Pre-Blast and Post-Blast Surveys:

1. A pre-blast survey shall be jointly performed by the Contractor, the Contractor's blasting consultant, and the Engineer. Either the Contractor or the Contractor's blasting consultant shall be experienced in performing pre- and post-blast surveys. The pre-blast survey shall include written and photographic documentation of the dam embankment, upstream facing, spillway, and the condition of all other relevant facilities. The pre-blast survey shall be documented by the Contractor's blasting consultant and accepted by the Engineer prior to any blasting.
2. A post-blast survey shall be jointly performed by the same personnel that conducted the Pre-blast survey. The post-blasting survey is required to document any changes in the relevant facilities referenced in the pre-blast survey.
3. Contractor shall concur with and sign the existing condition report generated by the blasting consultant and/or provide evidence of additional existing conditions that need to be included.

D. Blasting Safety and Security Plan: Plan for public and worker protection for blasting activities including at a minimum the following:

1. Blast zone delineation for the work.
2. Control measures for securing the site from unauthorized entry.
3. Notifications and warning for blasting activities including locations and types of signage to be posted and schedule for notifying the public.
4. Planned road closures and schedule.

E. An Emergency Action Plan indicating storage locations, types and quantities of explosive materials, shall be submitted to and approved by the local emergency response agency. The approved emergency response plan will be submitted to the Engineer before explosives are allowed on-site.

F. Approval:

1. No blasting will be permitted until the Contractor's submittals have been accepted.
2. The SEO will need to review and approve the General Blast Plan.
3. No loading of individual blast holes will be permitted until the individual blast plan has been accepted.

G. General Blast Plan shall be submitted at least 30 days prior to any blasting operations and/or delivery of any blasting products to the project site. The submitted general blasting plan shall include as a minimum the following:

a. Information on test blasts planned by the Contractor or required by the Engineer.
b. Seismograph monitoring equipment details, instrument factory calibrations and methods for documenting the data, both electronically and hard copies.
c. Example of Seismograph recording: Real-time, permanent record of vibration measurements for each blast in terms of particle velocity and frequency.
d. Seismograph monitoring equipment characteristics, threshold levels, and proposed method for achieving the minimum Monitoring plan presented in the plans.
e. Maximum charge per delay anticipated to stay within the vibration limits at the Monitoring locations and vibration limits in accordance with the plans and specifications.
f. Complete summary of proposed transportation, handling, storage, and use of explosives.
g. Manufacturer’s product information sheets and Material Safety Data Sheets (MSDS) for all explosives, blasting agents, primers and initiator products, blasting devices, lightning detectors, blasting mats, and all other blasting equipment.
h. Names and qualifications of personnel who will supervise blasting operations
i. Data necessary to support adequacy of the Contractor's proposed efforts regarding safety of structures and slopes.

2. Detailed Scalable plan-view and cross-section drawings showing the proposed location of blasting and proposed final slope and grade configurations, proposed drill pattern, hole size, loading density, timing and smooth-wall blasting measures. The plans shall have enough detail to allow the Engineer to understand the locations, orientation, number, diameter and length of blast holes relative to assumed station, slopes and elevations. Also include blast timing and a prediction of seismic monitoring response for each seismograph location shown on the plans for each blast plan.

H. Individual Blast Plans:

1. An Individual Blasting Plan shall be provided for any blasting proposed on the project.

2. As a minimum the Individual Blast Plans shall include:

    a. Details of the Controlled Blasting Techniques to control overbreak damage to the excavation perimeter;
    b. Controlled blasting techniques to control noise, dust, fly rock, air-blast, and vibrations;
    c. Method of drilling, including equipment description (cut sheets);
    d. Scalable plan-view and cross-section drawings showing the locations, orientation, number, diameter and length of blast holes relative to specified stations, slopes and elevations, and include seismic monitoring locations.
    e. Drilling patterns and hole alignment techniques and measures that will be used to prevent excessive blast hole deviation;
    f. Table having the number, spacing, location, inclination, diameter, and depth of all blast holes drilled;
    g. Table or drawing having the amount, type, diameter, and distribution of explosive within the blast hole, showing the hole charging methods; primer make-up, placement of charges and inert stemming and method of securing detonators until tie-in;
    h. Pounds of explosives per lineal foot for controlled perimeter holes;
    i. Powder factor (#/cy in Production blast areas and #/sf in Perimeter blast patterns);
    j. Delay patterns, type of initiators, time of each delay, and pounds of explosive for each delay;
    k. Total pounds of explosives in the shot and in-place at any one time within areas to be excavated;
    l. Predicted PPV at each monitoring location;
    m. Methods of safe disposal of all explosive packaging materials; and
    n. Date & time of blast

3. Other data which the Engineer may deem pertinent to determine the Contractor's intent and purpose for of adjacent structures.
4. Individual Blast Plans shall be submitted to the Engineer at least 48 hours prior to the loading of any blast hole associated with the blast plan. No loading of blast holes will be permitted until the Engineer has reviewed and accepted the plan.
5. Submit results of the previous blast report prior to submittal of the subsequent blast plan. No loading of any subsequent blast will be allowed until the previous Blast Report has been submitted and accepted by the Engineer.

I. Individual Blast Report: The report transmitting the results of a blast that will have the associated blast plan attached to it. The report will include a summary of the blast results compared to the goals outlined in the blast plan.

1. As a minimum the Individual Blast Report shall include:

    a. Results of the Controlled Blasting Techniques to control overbreak damage to the excavation perimeter shall be included in the plan.
    b. Results of the controlled blasting techniques to control noise, dust, fly rock, air-blast, and vibrations;
    c. Issues associated with the method of drilling, including equipment description problems;
    d. Scalable plan-view and cross-section drawings showing the actual locations, orientation, number, diameter and length of blast holes relative to specified stations, slopes and elevations, and include seismic monitoring locations.

e. Actual drilling patterns and hole alignments and effectiveness of measures used to prevent excessive blast hole deviation;
f. Table having the actual number, spacing, location, inclination, diameter, and depth of drilled holes;
g. Table or drawing having the actual amount, type, diameter, and distribution of explosive per hole;
h. Actual hole charging methods; primer make-up, placement of charges and inert stemming and method of securing detonators until tie-in;
i. Actual pounds of explosives per lineal foot for controlled perimeter holes;
j. Actual pounds of explosives per cubic yard (powder factor) for production areas;
k. Actual delay patterns, type of initiators, time of each delay, and pounds of explosive for each delay;
l. Total pounds of explosives actually used in the shot and placed within areas to be excavated;
m. Actual –vs- Predicted PPV at each monitoring location;
n. Disposal location of all explosive packaging materials;
o. Electronic copies of the video recording(s) and location(s) identified; and
p. Actual date & time of blast

2. Other data which the Engineer may deem pertinent to determine: 1) the Contractor's success for blast and discussion of how the actual blast results compare to what was expected; 2) discuss the produced smooth and sound rock surfaces at lines of excavation; and 3) affect on and condition of adjacent structures.
3. Individual Blast Reports shall be submitted to the Engineer within 24 hours of the blast initiation time and prior to the loading of any blast hole associated with the a new blast plan. No loading of blast holes will be permitted until the Engineer has reviewed and accepted the previous blast report.

J. Forms: Submit proposed Individual Blast Plan and Individual Blast Report forms and drill log forms for acceptance 30 days prior to conducting the work.

1.6 QUALIFICATIONS

A. The blasting supervisor(s) blaster(s)-in-charge qualifications: At least five years recent on-the-job experience loading and firing of charges; possess all required licenses and permits. All blaster(s)-in-charge shall be able to document their experience directly related to controlled blasting work.

B. Supervising shift foremen: At least five years recent on-the-job experience supervising the crews loading and firing shots. The supervisor(s) shall be able to document they are properly qualified and licensed in accordance with applicable federal, state and local government regulations.

C. Blasting Consultant: The contractor shall retain the services of an experienced third party independent blasting consultant(s) with at least 10 years experience in preparing controlled blasting designs. The general blasting plan and revisions to any of the plans shall be reviewed by and covered with a signed review letter from the blasting consultant(s). The blasting consultant(s) shall not be required to sign the individual blast plans provided they are signed by the on-site licensed blaster-in-charge.

1.7 CONTRACTOR'S RESPONSIBILITY

A. The Contractor is responsible for blasting in a safe manner, for producing sound rock surfaces; for protecting existing and structures under construction from damage; and for controlling damage and vibration.

B. Acceptance of blasting plans, of blasting operations, and of blasting products by the Engineer, and compliance by the Contractor with provisions for protection of life and property shall not relieve the Contractor of the responsibility or liability for safety of persons and property.

C. Acceptance of the Contractor's submittals by the Engineer does not constitute nor shall it be construed to be a guarantee by the Engineer that desired results will be achieved.

D. Acceptance by the Engineer shall not relieve the Contractor from responsibility of complying with specification requirements.

1.8 SCHEDULING AND SEQUENCING

A. Schedule blasting operations 24 hours in advance to minimize disturbance to ongoing operations.

B. Notify the local Authorities, Response Agencies and Engineer prior to blasting. Notify occupants of structures that are located within 1,500 ft of the blast.

1.9 DELIVERY STORAGE AND HANDLING

A. Comply with all federal, state and local regulations, applying to the purchase, transportation, storage, handling, and use of explosives, blasting agents, primers, initiators and ancillary equipment and materials.

B. Explosives Security: The responsible Contractor holding the U.S. Department of Justice Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) license for this work shall ensure the security of explosive materials at all times when explosive materials are used or kept on the project site and the Contractor shall ensure that:

1. All persons that handle explosive materials, have control over them, or access to them, must not be prohibited persons, as defined in Section 555.11 of 27 CFR (ATF Rules).
2. The Contractor shall maintain copies of ATF Employee Possessor questionnaire forms (OMB No. 1140-0072) or documentation of ATF clearance on the Contractor’s BATF license for all employees who will possess, handle or have access or control over explosives for this work as defined in 27 CFR Part 555. This documentation must be available upon request by the appropriate authorities or the Engineer. Contractor and subcontractor employees, without submitted evidence of satisfactory ATF clearance, must not handle, control or have access to explosive materials.
3. All blasting work and explosive handling activities are done under the direct supervision of a properly licensed blaster-in-charge.
4. When explosives are delivered to the work sites, they must not be unloaded from delivery vehicles until a responsible blaster-in-charge has signed the delivery paperwork and assumes full authority and responsibility for the security of the explosive materials. Unused explosive materials must be similarly signed over to a properly licensed driver with a Commercial Drivers License with a Hazmat endorsement before explosive materials are loaded onto a fully-DOT-compliant vehicle for removal from the site.

C. Transportation:

1. Where explosives are transported on public roads, the carriage shall be in accordance with 49 CFR.
2. If explosives are to be transported in interstate or foreign commerce, a license or users permit shall be secured from the ATF (27 CFR 55)

D. On-Site Storage:

1. The locations, access and construction of explosive storage magazines and day-use magazines shall meet all requirements outlined in 27 CFR and all other applicable regulations.
2. No more than 2 weeks supply of explosives shall be stored on site at any time.
3. All day-use magazines shall be protected during the transport to the work area. Only employees designated by the Blaster-in-charge shall be within 50-ft of the day-use magazine area during the transport and handling of materials.
4. Maintain accurate and up-to-date inventory control of all blasting materials, equipment and supplies. Copies of inventory logs shall be kept as required by ATF rules and shall be made available for review at the request of the Engineer.
5. Contractor is responsible for the safeguarding of explosives and to ensure required regulations regarding storage are adhered to.

PART 2 PRODUCTS

2.1 BLASTING MATERIALS

A. Only fully non-electric blasting systems shall be used.

B. Use only products, blasting techniques, and monitoring equipment as recommended by the manufacturer, and which have been accepted by the Engineer.

C. Explosives, blasting agents, primers, initiators, and ancillary blasting materials shall be kept in original packaging with clearly marked date codes. All explosives and initiating devices used shall be less than three years old.

D. Do not use materials that are beyond the manufacturer's expiration date or are more than two years old, whichever is less.

E. Use only cap sensitive cartridge type explosives prepared and packaged by explosive manufacturing companies.

F. Do not use free flowing explosives.

G. Cap and fuse initiation devices are not allowed.

H. Electrical blasting caps are not allowed.

I. Pourable blasting agents, products etc., are not allowed.

J. If the Engineer determines that a blasting product appears to be in a damaged or deteriorated condition, the suspect product shall not be used until its condition can be determined. Products found to be damaged or in deteriorated condition shall be immediately returned to the supplier for safe disposal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Perform a pre-blast survey jointly with the Contractor, the Contractor's blasting consultant, and the Engineer to determine and document the condition of adjacent structures, utilities, wells, buried cables, and other features within 1,500 feet of the blast area prior to blasting. The pre-blast survey must be signed by all personnel who participated in the survey and submitted to the Engineer prior to any blasting activity.

B. Perform a post-blast examination jointly with the Engineer to determine if any damage to the facilities resulted from the blasting operations.

3.2 PROTECTION

A. Protect existing installations in accordance with the requirements of plans and this section.

B. Perform blasting carefully. Repair damage to the work, environment, and adjacent property that is directly a result of blasting, promptly at the expense of the Contractor.

C. Take necessary precautions to preserve material below and beyond approved lines of excavation in the soundest possible condition.

1. Take proper account of geology to prevent damage to foundation or perimeter rock, concrete, grout holes, or structures resulting from permanent blast-induced rock movements or blast-induced gas pressures.
2. Remove material beyond required lines which is shattered or loosened by the Contractor's blasting operations and backfill by and at the expense of the Contractor.
3. Adjust procedures as necessary to prevent overbreak.

D. Prevent fly rock damage to structures and individuals. Where necessary, as determined by the Engineer, use blasting mats to protect adjacent property and installations.

E. Blasting mats will be required to protect structures and systems during blasting if in the Engineer's opinion such protection is necessary.

F. At the completion of blasting, remove all loose rock from the blasted rock surface by scaling, wedging and barring, or other approved mechanical methods so that finished slopes are left in a stable condition.

3.3 BLASTING FOR OPEN CUT EXCAVATION

A. Perform blasting only in areas approved by the USFS permit conditions

B. The technique, perimeter hole spacing, and loading density for controlled blasts may vary depending on formation competency.

1. Actual techniques, loading densities, and spacing are subject to the approval of the Engineer.
2. The Engineer may require a change in controlled blasting technique, perimeter hole spacing, and/or loading density if unsatisfactory results are obtained.

C. Maximum blasthole diameter: 3 inches.

D. Drill perimeter blastholes following the lines of final excavation and do not deviate more than 6 inches from designed location in any direction along the length of the hole. Reduce depths of blastholes if necessary to conform to this requirement.

E. Use later delay for each row of blastholes than the delay used for the row immediately in front of it.

F. Delay the row of holes immediately in front of perimeter holes by two delay intervals from proceeding row.

G. To protect rock slopes, fire holes at ends of each row on a higher delay than adjacent holes in that row.

H. Drilling and blasting procedures will be evaluated for acceptability by the results achieved as blasting operations progress. If drilling and production blasting operations produce unacceptable results, such as overbreak or excessive vibrations, devise and employ methods which will produce acceptable results. The revision may include special methods such as but not limited to shorter holes, different delay patterns, reduction in size of individual blasts, smaller diameter blast holes, closer spacing of blast holes, reduction of explosives, or combination thereof, as necessary to achieve results acceptable to the Engineer.

3.4 MONITORING

A. Monitoring instrument calibration: Seismograph monitoring instruments shall have been factory calibrated no more than 12 months before blasting.

B. Seismograph equipment and use shall conform to all equipment standards and operating procedures developed by the Vibration Section of the International Society of Explosive Engineers (ISEE).

C. For every blast, monitor vibrations with calibrated self-triggering seismographs containing internal calibration and triaxial orthogonal transducers with flat frequency response from 2 to 250 hertz, a minimum sampling rate of 1,028 data points per second, sufficient memory to store the full blasting sequence. Select close-in instruments that have a minimum 10-in/s upper limit range. The data shall be downloaded after each shot so that a hard copy of the full spectrum will be provided to the Engineer within twenty four (24) hours.

1. A minimum of 4 Seismographs will be required for each blast.
2. Place transducers in designated locations or structures, as directed by the Engineer. Monitoring will be required at:

    a. Spillway structure.
    b. Outlet Works Headwall.
    c. Gate House.
    d. Dam Crest

3. Securely fasten transducers to the ground surface or structure being monitored as accepted by the Engineer.
4. Furnish computer software package, accepted by the seismograph manufacturer, which is capable of retrieving full waveform recordings from the field seismograph memory and storing the records for subsequent review, analysis, plotting and summary.

5. Provide high speed (min 24 frames/sec and 320x240 pixels resolution) video of each blast. Download the video and provide an electronic copy to the Engineer within 24 hrs of the blast initiation.

3.5 VIBRATION LIMITS

A. Peak particle velocity measured in any component on the ground surface adjacent to an existing structure shall not exceed the values given in Table 02305-1 - Maximum Peak Particle Velocity Permitted:

Table 02305-1
Maximum Peak Particle Velocity Permitted

Structure Type	Vibration frequencies (cycles/second)	Maximum allowable peak particle velocity (inches/second)
All Concrete and Steel Structures	--	4.0

B. If the Contractor intends to blast within 300-ft of concrete aged less than 28 days, a plan indicating details of the controlled blasting techniques that will be used to prevent damage to the concrete shall be submitted to the Engineer. The PPV at the green concrete shall be monitored by additional seismographs and the allowable PPV shall be as follows:

Table 02305-2
Peak Particle Velocity

Concrete Age after Batching	Maximum allowable peak particle velocity (inches/second)
Less than 3 days	No Blasting Allowed
3 to 7 days	6 x DF
7 to 10 days	7 x DF
10 to 28 days	8 x DF
Greater than 28 days	8

Table 02305-3
Definition of Distance Factor (DF)

Distance Factor	Distance from Blast (ft)
1.0	0 to 50
0.8	50 to 150
0.7	150 to 250
0.6	250 +

3.6 FIELD QUALITY ASSURANCE

A. The Engineer will observe drilling and loading of blast holes for any blasting to ensure that they are in accordance with accepted plans.

B. After each blast, the blast report, printed seismograph monitoring reports, video, and all pertinent information relative to the blast shall be submitted to the Engineer prior to loading any subsequent blast holes.

END OF SECTION

SECTION 02310
ROCK FOUNDATION PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparing the foundations for structures and fill founded on rock as shown on the Drawings.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum, as shown on the drawings.

3.2 GENERAL

A. The excavation lines shown on the drawings for the foundation excavations are approximate. The location of acceptable foundation material may be above or below the excavation lines shown on the drawings. Remove unacceptable materials as approved by the Engineer to meet the foundation objectives stated herein. The actual required depth of excavation and suitability of excavated surfaces to receive fill materials, concrete, will be determined by the Engineer based on actual conditions encountered.

B. Foundation treatment and cleanup shall occur only after foundation excavation has been completed in an area. The sequence of operations for foundation treatment and cleanup shall be as follows: (1) Perform initial cleaning for treatment; (2) treat foundation surface; (3) perform final foundation cleanup; (4) place first lift of fill or structural concrete materials.

C. Do not contaminate previously-placed fill materials while excavating, treating and preparing adjacent foundation excavation areas.

D. Take all necessary precautions to prevent the foundation rock to slake due to being exposed, and or re-prepare the foundation before placement of the first lift of fill or concrete material. Measures taken to re-prepare foundations shall be performed at no additional cost to the Owner.

3.3 FOUNDATION PREPARATION AND TREATMENT

A. Excavate to the lines and grades as shown on the drawings. Excavate in accordance with Section 02315: Excavation.

B. Shape the foundations so that a relatively uniformly varying profile is obtained free of sharp offsets, protruding points, edges, or breaks, and so that variations in elevation are gradual, as shown on the Drawings.

C. Take all necessary precautions to preserve the rock below and beyond the lines of excavation in undisturbed condition. Any damage to the foundations due to the Contractor's operations, including shattering of the material beyond the required excavation lines, shall be repaired at the expense of and by the Contractor. Repair of the damaged rock foundation shall include excavating the loosened or shattered rock and backfilling with dental concrete, as approved by the Engineer.

3.4 CLEANING FOUNDATIONS

A. When the excavation has been completed to firm bedrock or to the elevations directed by the Engineer; all cracks, crevices, fractures, voids, shear zones, and joints in the exposed foundation rock shall be thoroughly cleaned of all loose materials as determined by the Engineer, to a depth at least three times their width and shall be wetted immediately prior to concrete placement. The rock surface shall be cleaned with water jets, air jets, vacuums or other hand methods to completely remove soil or loose rock.

B. Final cleanup of the rock surface shall be subject to approval by the Engineer.

C. Clean foundation proceeding from the top to the bottom of the exposed foundation.

3.5 PROTECTION OF TREATED FOUNDATIONS

A. Take all necessary measures to prevent contamination of the treated foundation surfaces by loose rock, soil, debris, or other unsuitable conditions before placement of materials. Such measures include, but are not limited to, constructing concrete mats, directing water away from the surface, minimizing construction traffic on the treated surface, and treating access roads to minimize tracking of debris onto the foundation. Should the cleaned and treated foundation rock surfaces be contaminated by loose rock, soil, debris, or otherwise damaged, clean and repair the surface as specified herein prior to placing materials, and at no additional cost to the Owner.

B. Once foundation treatment and cleanup have been completed in a portion of the foundation, immediately cover the area with the first lifts of fill or concrete materials to protect the prepared foundation surface.

END OF SECTION

SECTION 02315
EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Required site excavations as shown on the Drawings.

1.2 WORK NOT INCLUDED IN THIS SECTION

A. Work associated with clearing and grubbing or stripping and stockpiling topsoil and are not considered as excavation and shall be performed in accordance with Section 02230: Clearing and Grubbing or Section 02235: Stripping and Stockpiling Topsoil.

B. Excavation by blasting is covered in Section 02305: Blasting.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Proposed excavation plan at least 14 calendar days prior to performing any excavations. Include: Proposed excavation method(s) to be used; proposed excavation slopes, trench shields, bracing or other methods of construction to complete the construction safely; proposed excavation equipment; and proposed excavation sequence. Combine the excavation plan submittal in the Earthwork Plan required in Section 02330: Earthwork.

1.4 EXCAVATED MATERIALS CLASSIFICATION

A. Make provisions and plan for potential winter operations. This shall be documented in Contractor's method submissions and accommodated in their schedule.

B. Excavated materials are classified as follows:

1. Rock Excavation – For purposes of classification of excavation, rock excavation is defined as a sound and solid mass, layer, or ledge of mineral matter in place and of such hardness and texture that it cannot be effectively loosened or broken down by ripping in a single pass with a late model tractor-mounted hydraulic ripper equipped with one digging point of standard manufacturer's design adequately sized for use with and propelled by a crawler-type tractor rated between 385- and 410-net flywheel horsepower, operating in low gear. In areas where the use of the ripper described above is impracticable, rock is defined as sound material of such hardness and texture that it cannot be loosened or broken down by a 6-pound drifting pick. The drifting pick shall be Class D, Federal Specification GGG-K-506D, with handle not less than 34-inches in length. All boulders or detached pieces of solid rock more than 1 cubic yard in volume will be classified as rock excavation.
2. Unclassified Excavation – Unclassified excavation includes all earth materials which do not meet the requirements of rock excavation as defined above. All boulders or detached pieces of solid rock less than one cubic yard in volume shall be classified as unclassified excavation.

1.5 PROTECTION

A. Comply with all safety requirements of OSHA.

B. Protect existing structures and facilities to remain. Damage to existing structures and facilities by the Contractor shall be repaired by the Contractor at no cost to the Owner and to the satisfaction of the Engineer

1.6 EXISTING SITE CONDITIONS

A. Use equipment and methods appropriate for site conditions.

B. Exploratory investigations cannot be relied on to accurately characterize all conditions that may exist in the foundations and that may be encountered during construction. Therefore, final excavated lines and grades will be determined in the field by the Engineer.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 GENERAL EXCAVATION REQUIREMENTS

A. Identify required excavation lines, levels, contours, and datum, as shown on the Drawings.

B. Verify locations of buried underground utilities and pipes and overhead utilities prior to excavations. Immediately notify the Engineer if underground utilities or other unexpected underground structures are encountered. Repair any utilities or pipes damaged during construction at no cost to the Owner.

C. Excavate to the lines and grades as shown on the Drawings.

D. Repair damage to the work caused by the Contractor's operations including disturbance of the material beyond the required excavation at no additional cost to the Owner. Make repairs in accordance with this section as directed by the Engineer, and at no additional cost to the Owner.

E. Assume all responsibility for determinations as to the nature of the materials to be excavated and the difficulties of making and maintaining the required excavations.

F. The Engineer reserves the right, during the progress of the Work, to vary the slopes, grades, or the dimensions of the excavations from those specified herein. Where the Engineer determines that foundation material is unsuitable through no fault of the Contractor, additional excavation will be ordered in writing and payment will be made in accordance with Section 01200: Price and Payment Procedures.

G. Take all necessary precautions to preserve the material below and beyond the established lines of all excavation. Repair any damage to the Work or the foundations as a result of the Contractor's operations as directed by the Engineer at the expense of and by the Contractor.

H. Unless authorized in writing by the Engineer, all excavations shall be in the dry and in accordance with Section 02240: Dewatering.

I. Do not excavate in frozen materials, except with written approval of the Engineer.

J. Side slopes of all earth excavations shall be no steeper than that shown on the drawings. In all cases, excavations shall conform with all safety requirements of OSHA

K. Notify the Engineer as soon as possible of any unusual soil conditions, soil conditions that vary from test borings, or soils of questionable stability or bearing capacity.

L. Dispose of excavated materials which are excess or deemed unsuitable. Dispose of unsuitable/excess excavated materials in accordance with Section 01575: Disposal of Waste Materials.

M. Do not waste any excavated material without the approval of the Engineer.

N. Excavated material will not be judged “unsuitable” due to moisture content alone.

O. If slumping, heaving, or any other evidence of instability is observed during excavation, immediately report evidence of instability to the Engineer, whether it is observed during working or non-working hours.

P. Be prepared to temporarily backfill any unstable excavation to stabilize the area, if directed to do so by the Engineer.

3.2 EXCAVATED MATERIAL SUITABLE FOR FILL

A. Stockpile excavated materials that are acceptable for use as fill materials. Suitability of excavated material shall be based on specified material requirements in Section 02330: Earthwork.

B. Transport excavated materials suitable for use as fill to designated (or mutually agreeable) stockpile areas.

C. Condition and re-use suitable materials from required excavations in the permanent construction as directed by Engineer.

D. Perform operations so that the excavations will yield as much suitable material for construction purposes as practicable.

E. Separate suitable materials for construction purposes from materials to be wasted; and minimize handling by placing suitable materials directly in the designated final locations, if possible and so directed by the Engineer.

F. Excavated materials that are acceptable for use as fill but are too wet for immediate compaction shall be aerated, by discing and mixing until the moisture content is reduced sufficiently to permit them to be placed in the embankment.

3.3 FOUNDATION PREPARATION

A. Should the excavation be carried below the lines and grades specified on the Drawings or should the bottom of the rock excavation be disturbed because of the Contractor's operations, refill to the proper elevation with backfill concrete in accordance with Section 03300: Cast-In-Place Concrete at no cost to the Owner.

B. For areas identified by the Engineer as unsuitable foundation, remove this material to the depths established by the Engineer.

C. Structure foundations. - The bottom and side slopes of soil excavations upon or against which concrete will be placed shall be excavated to the required dimensions as shown on the drawings or as required by OSHA. No material will be permitted to extend within the neatlines of the structure.

D. Excavate foundations to final grade using procedures that do not disturb the subgrade.

3.4 FIELD QUALITY CONTROL

A. Prepare surfaces to receive concrete in accordance with Section 02310: Rock Foundation Preparation. The Engineer will conduct visual inspections of excavation bottoms and foundation subgrades. The Engineer will accept suitable subgrades in writing. Soft or yielding areas, shall be excavated and backfilled with suitable material as specified and as approved by the Engineer.

B. When the excavation on rock cut faces and benches has been completed, clean loose rock to a safe condition for the purposes of inspection, geologic mapping and rock bolt location selection.

END OF SECTION

SECTION 02330
EARTHWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing, placing, and compacting fill materials.

1.2 REFERENCES AND DEFINITIONS

A. All references are the most recent version.

B. American Society for Testing and Materials International (ASTM)

1.	ASTM C 117	Standard Test Method for Materials finer than 7-μ (No. 200) Sieve in Mineral Aggregates by Washing
2.	ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3.	ASTM D 422	Standard Test Method for Particle Size Analysis of Soils
4.	ASTM D 698	Standard Specification for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
5.	ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
6.	ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
7.	ASTM D 2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
8.	ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
9.	ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
10.	ASTM D 4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
11.	ASTM D 4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
12.	ASTM D 4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
13.	ASTM D 4643	Standard Test Method for Determination of Water Content of Soil by the Microwave Oven Method
14.	ASTM D 4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
15.	ASTM D 5080	Standard Test Method for Rapid Determination of Percent Compaction
16.	ASTM D 6913	Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
17.	ASTM D 6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil- Aggregate by Nuclear Methods (Shallow Depth).

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

1. AASHTO T272 Standard Method of Test for Family of Curves—One Point Method

C. Colorado Department of Transportation (CDOT), Standard Specifications for Road and Bridge Construction, 2005.

D. Definitions

1. Fines: Material passing the No. 200 sieve.
2. Borrow: Material excavated on the site, or taken from designated areas approved by the Owner and Engineer.
3. Well-graded: A mixture of particle sizes that has no specific concentration, or lack thereof, of one or more sizes. A material type that, when compacted, produces a strong and relatively incompressible soil mass with a minimum of voids.
4. Coverage: One coverage is defined as the result of successive passes by a piece of compaction equipment, which by means of sufficient overlap, will ensure that all areas of the layer or lift being compacted have been subjected to one pass of the compaction equipment.
5. Optimum Moisture Content: That moisture content which will result in a maximum dry unit weight of the soil resulting from the ASTM D 698 laboratory compaction test.
6. Percent Compaction: The percent compaction in place shall be calculated as the ratio (in percent) of the in place dry density to the estimated maximum dry density, in accordance with ASTM D 698, of the representative fill material at the location of the in-place density test. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as accepted by Engineer.
7. Prepared Subgrade: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.
8. Proof Rolling: Rolling a soil surface with a minimum of 4 passes with approved compaction equipment for the purpose of detecting and compacting soft or loose areas that will not support future loading without excessive settlement.
9. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of sod, or stripping of topsoil and excavation to grade prior to placement of fill or concrete.
10. Unsuitable Materials: Materials that contain waste, debris, roots, organic matter, frozen matter, or any other materials determined by the Engineer to not meet the specifications for required fills. Unsuitable materials does not include wet or dry materials requiring moisture conditioning for placement, or materials requiring processing to remove oversize particles in order to meet the specifications for a particular fill.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Complete Earthwork Plan. The Earthwork Plan may be combined with the Excavation Plan in Section 02315: Excavation. The earthwork plan shall be submitted at least 30 days in advance of the start of earthwork. The earthwork construction plan shall be approved by the Engineer prior to any earthwork activities. Include all the following in the earthwork construction plan:

1. Proposed schedule.
2. Proposed borrow source(s) for offsite materials and proposed method(s) of sampling on-site and offsite source(s) for acceptance.
3. Proposed soil excavation, transport, processing, placement, compaction, and moisture control equipment, including equipment catalog with weight, dimensions, and operating data.
4. Proposed equipment and methods for removing embankment material from required excavations.
5. Proposed plan and sequencing for excavation including the extent and quantity of excavation, and an excavation schedule.
6. Proposed excavation, stockpiling, and staging plan describing handling and transport of on-site and off-site materials including proposed haul routes.
7. Proposed plan to obtain, convey, and store construction water, including proposed water source.
8. Proposed methods for processing including means and methods of moisture conditioning in advance of excavation and after placement.
9. Proposed method of protecting Work, to include temporary dewatering, drainage, moisture conditioning, and frost protection measures.
10. Proposed placement plan for drain materials that limits waste of these materials. Include proposed equipment, and methods proposed for temporary stockpiling, hauling, spreading, placing, and compacting the granular drain materials.

C. Samples: Submit samples of on-site excavated materials and off-site materials for Engineer's approval. For imported material, submit samples and laboratory test results prior to shipment of the material to site.

D. Submit gradation and moisture density compaction curve test reports for all imported earthwork materials, material from designated borrow areas, and on-site excavated materials suitable for use as fill. Any time the Contractor changes the source and/or stockpile from which materials are obtained, or should proposed material not meet requirements, additional gradation and moisture density compaction curve test reports for these new sources shall be required. Include costs for all testing in the bid price. No additional compensation will be allowed for testing.

E. Certified truckload weight bills: Provide the original certified truckload weight bills at the time of delivery for all materials delivered to the site.

PART 2 PRODUCTS

2.1 COMMON FILL

A. Suitable well-graded materials from required excavations and reservoir bottom, having a maximum particle size of 3 inches, and a maximum of 12% fines.

B. Excavated on site materials that meet or are processed to meet the requirements of the respective materials above are acceptable as fill.

C. Common Fill shall be tested by the Contractor and approved by the Engineer before use.

D. A list of required material QC testing for Common fill is presented in Table 02330-1. The tests shall be conducted by the Contractor's independent testing firm at the frequencies designated in these specifications unless otherwise directed by the Engineer.

TABLE 02330-1
COMMON FILL TESTING

Test	Test Method (Current Version)	Test Frequency
Classification	ASTM D 2487	Minimum 4 tests per source(1)
Grain size with – #200 Wash	ASTM D 422, D-1140	
Moisture content	ASTM D 2216	
Atterberg limits	ASTM D 4318	
Laboratory Moisture-Density (Standard Proctor) (3)	ASTM D 698	Minimum 2 tests per material classification

Notes:

(1) Material classification tests, including grain size and Atterberg limits for fill from on site or imported sources shall be conducted on samples from stockpiled material.

(2) Samples for Standard Proctor testing shall be obtained from material mixed and stockpiled on site and tested after material classification testing to represent the variation in material types.

(3) If compacted fill consists of free draining granular materials where a moisture density relationship cannot be established in accordance with D698 as approved by the Engineer, test material in accordance with ASTM D 4253 and D 4254.

2.2 FILTER SAND

A. Filter sand shall be a well-graded sand material obtained from an approved off-site source, conform with ASTM C 33, and be graded within the following limits:

TABLE 02330-2
FILTER SAND GRADATION

U.S. Standard Sieve	Percent Passing by Weight
3/8 inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	0-10
No. 200	0-3

B. The above specified gradation limits for the No. 200 sieve are different from ASTM C 33, and have been adjusted specifically for this project.

C. The fraction of filter sand material finer than the No. 40 sieve shall be classified as non-plastic based on Atterberg Limit testing.

D. The range specified for the No. 200 sieve is for material delivered and stockpiled at the site. Material sampled in place after compaction shall have a range of 0 to 5 % passing the No. 200 sieve.

E. A list of required material testing for filter sand is presented in Table 02330-3.

TABLE 02330-3
FILTER SAND TESTING

Test	Test Method (Current Version)	Test Frequency
Grain size	ASTM C 117 and C 136	2 tests on samples of material stockpiled at the site before placement. 2 test on in-place material after compaction

2.3 DRAIN GRAVEL

A. Drain gravel shall conform to ASTM C 33, #8 Coarse Aggregate, with angular to sub-angular shape. Rounded gravel will not be accepted. Drain gravel shall be graded within the following limits:

TABLE 02330-4
DRAIN GRAVEL GRADATION

U.S. Standard Sieve	Percent Passing by Weight
1/2 inch	100
3/8 inch	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5
No. 50	0-3

B. The above specified gradation requirements were modified from the ASTM C 33 gradation size No. 8 for coarse aggregate. The requirement for the No. 50 sieve differs from that stated in the ASTM standard, and has been changed specifically for this project.

C. The range specified for the No. 50 sieve is for material sampled in place after compaction.'

D. A list of required material testing for drain gravel is presented in Table 02330-5.

TABLE 02330-5
DRAIN GRAVEL TESTING

Test	Test Method (Current Version)	Test Frequency
Grain size	ASTM C 117 and C 136	2 tests on samples of material stockpiled at the site before placement. 2 test on in-place material after compaction

2.4 AGGREGATE BASE COURSE

A. Aggregate base course shall meet the Colorado Department of Transportation 2005 Standard Specifications for Road and Bridge Construction – Section 703, Table 703-3, Class 5 Aggregate Base Course, and be graded within the following limits:

TABLE 02330-6
AGGREGATE BASE COURSE TESTING

U.S. Standard Sieve	Percent Passing by Weight
1 1/2 inch	100
1 inch	95-100
No. 4	30-70
No. 200	3-15

B. A list of required material testing for aggregate base course is presented in Table 02330-7. The tests shall be conducted at the frequencies specified unless otherwise approved by the Engineer. If material tests from the source for the conducted by the Contractor at the frequencies designated specified properties conducted within the last year may be provided, some source testing may be waived at the Engineer's discretion.

TABLE 02330-7
AGGREGATE BASE COURSE TESTING

Test	Test Method (Current Version)	Test Frequency
Grain size with – #200 Wash	ASTM D422, D-1140	Minimum 1 per source
Atterberg limits	ASTM D4318	
Laboratory Moisture-Density (Standard Proctor)	ASTM D698	Minimum 1 test per source

C. Grain size and Atterberg limits for aggregate base course shall be conducted on samples from material stockpiled on site.

D. Samples for Standard Proctor testing shall be obtained from material mixed and stockpiled on site and selected after material classification testing to represent the variation in material types.

2.5 COMPACTION EQUIPMENT

A. Compaction equipment shall conform to the manufacturer's specifications and shall be maintained in good working condition at all times.

B. Compaction Equipment: Self propelled, padfoot, vibratory compactors with a minimum static operating weight of 25,000 pounds, and capable of producing a centrifugal force of 25,000 to 50,000 pounds. Smooth drum rollers meeting the static and centrifugal forces specified above may be approved at the discretion of the Engineer for compaction of free draining granular materials except where special compaction is required. Operate vibrating compactors at a constant frequency of vibration, as recommended by the equipment manufacturer for the material type being compacted, and as approved by the Engineer.

C. Special Compaction: Use hand operated power tampers, vibratory plate compactors having a minimum static weight of 300 pounds and a minimum dynamic force of 1,000 pounds, or other special compaction equipment acceptable to the Engineer to obtain the compaction specified. Use special compaction equipment in locations where other compactors specified in this Section cannot operate effectively, and as specified for areas requiring special compaction as specified herein.

D. All equipment and tools used in the performance of the Work are subject to review by the Engineer before work is started.

E. Provide compaction equipment appropriate for the material types as approved by the Engineer, and sufficiently sized to obtain the specified densities.

F. Provide hand-operated compaction equipment in areas closer than 3 feet from structures or 2 feet from pipes (for special compaction).

G. Operate and maintain compaction equipment in accordance with the manufacturer's instructions and recommendations.

H. Provide equipment for applying water of a type and quality adequate for the work, free of leaks and equipped with a distributor bar or other approved device to ensure uniform application.

I. Provide equipment for mixing, aerating and moisture conditioning fill materials, such as blades, discs, or other approved equipment.

PART 3 EXECUTION

3.1 GENERAL FILL PLACEMENT

A. Before placing fill material, verify that the subgrade has been prepared and inspected by the Engineer. Do not place fill without written approval from the Engineer.

B. Do not place fill material until the subgrade has been dewatered in accordance with Section 02240: Dewatering, and the prepared subgrade has been inspected and approved by the Engineer.

C. Moisten earth-excavated surfaces upon or against which concrete is to be placed with water, and tamp or roll to form a firm foundation upon which to place concrete.

D. The compacted surface of any layer of fill or subgrade which is too wet or too dry for bonding to the next layer of material shall be dried or moistened, scarified, and compacted before the next layer is placed.

E. Place fill to the lines, grades and cross-sections shown on the Drawings and written field clarifications by the Engineer.

F. Take special care to ensure bonding of new embankment to previously placed or existing embankment material by benching in approximately one foot horizontally into the previously placed and compacted embankment, as each new fill layer is placed and compacted, unless otherwise directed by the Engineer. If the surface of the fill or the adjacent embankment dries and cracks after exposure, or if loose material is present, bench into existing embankments sufficiently to remove loose material, rework the dry material into new moisture conditioned fill, and still extend into compacted fill. For filter or drain materials, place directly against compacted fill, do not bench or mix edges of filter or drain materials into compacted fill.

G. The distribution and gradation of materials throughout the fill shall be such that the material will be free from lenses, pockets, streaks or layers of material differing substantially in texture, gradation and moisture from the surrounding material. The combined excavation and placing operations shall be such that the fill shall be mixed and blended sufficiently to provide the most homogeneous section and best practical degree of compaction and stability.

H. Control and conduct all operations including but not limited to transporting, stockpiling, excavating, producing, and placing the materials to minimize contamination, segregation, and particle breakdown.

I. Do not place frozen fill material, and do not place fill below water or on frozen ground. Stop fill placement temporarily during unsuitable weather conditions, as directed by the Engineer.

J. Fill materials shall be thoroughly moisture treated as necessary to achieve compaction, and shall be maintained at the appropriate moisture content during compaction.

K. Re-work materials which have not been placed in accordance with these specifications. Re-working may include removal, rehandling, reprocessing, recompacting, or combinations of these procedures, as required by the Engineer.

L. Do not place fill adjacent to structures before the concrete has attained sufficient strength to withstand the applied construction loads. Unless otherwise approved by the Engineer, do not place fill against structure walls until the concrete has attained at least 100% of the 28-day design compressive strength per Division 3 of these specifications.

M. Where applicable, place fill against structures in uniform lifts on both sides of the structure such that no unbalanced loading will occur against the structure.

3.2 SUBGRADE PREPARATION

A. Excavate to final grade in accordance with Section 02315: Excavation so that the subgrade is not disturbed.

B. The foundation for all structures shall be placed on prepared natural soils, bedrock or, in the case of fill conditions, foundations shall be placed on fill approved by the Engineer. Compacted, approved fill will be required where excavation is required to remove unsuitable existing materials below structures.

C. Notify the Engineer as soon as possible of any unusual soil conditions, soil conditions that vary from test borings, or soils of questionable strength or bearing capacity.

D. Soil subgrade preparation shall consist of scarifying the material a minimum of 6 inches in depth, moisture conditioning the scarified material to the Optimum Moisture Content, and compacting the area with a minimum of 4 passes with approved compaction equipment prior to fill placement.

E. Proof roll prepared subgrades in the presence of the Engineer. The proof roll shall consist of four overlapping rolls using approved compaction equipment. Proof rolling of small areas may be performed using hydraulic backhoe-mounted vibratory compactors or hand-operated jumping jacks subject to Engineer's approval.

F. Excavate soft/yielding subgrade as determined by the Engineer and replace with the appropriate compacted new fill material for the location in the foundation and new embankment zone.

G. For areas identified by the Engineer as unsuitable, remove the material to the depths and limits established by the Engineer. Replace removed material with suitable compacted fill material placed per these specifications and to the required elevations.

3.3 FILTER SAND AND DRAIN GRAVEL PLACEMENT

A. Place filter sand and drain gravel to the locations, lines, grades, and thicknesses shown on the drawings.

B. To the degree practical, maintain filter sand materials one foot above the adjacent embankment materials to prevent contamination.

C. Control and conduct all operations including but not limited to transporting, stockpiling, excavating, producing, and placing the materials to minimize contamination, segregation, and particle breakdown.

D. Place filter sand in maximum 9-inch loose lifts; thoroughly wet the sand immediately before compaction using moisture application procedures as approved by the Engineer,

and compact with 4 coverages of approved compaction equipment. Do not over compact sand or allow breakdown of sand grains to create fines in the sand mass.

E. Prevent soils from adjacent zones from being tracked onto the filter/drain sand. Remove and replace all filter/drain sand material containing unsuitable material.

F. Place drain gravel in maximum 9-inch loose lifts and compact with 4 coverages of approved compaction equipment. Do not over compact gravel or allow breakdown of individual grains.

G. Rework materials, which have not been placed in accordance with these specifications. Reworking may include removal, recompacting, reconditioning, or combinations of these procedures, as required by the Engineer.

3.4 PLACING COMMON FILL AND AGGREGATE BASE COURSE

A. Place fill materials in uniform horizontal layers not exceeding 9-inches.

B. Add water to the fill prior to compaction. Use moisture addition procedures, as approved by the Engineer.

C. The placement moisture content for Common fill and aggregate base course shall be 2 percentage points below to 2 percentage points above the optimum moisture content (ASTM D 698).

D. Compact Common fill and aggregate base course to not less than 95% of the laboratory maximum dry density (ASTM D 698).

E. If compacted fill consists of free draining granular materials where a moisture density relationship cannot be established in accordance with D698 as approved by the Engineer, compact material by thoroughly wetting and compacting with vibratory compactors to obtain a minimum of 75% relative density as determined by ASTM D 4253 and D 4254.

3.5 SPECIAL COMPACTION

A. Special compaction shall be required within 3 feet laterally of all structures, and in tight, restricted, or steep areas not accessible by larger rollers, and within 2 feet of pipes. The intent of the zones of special compaction is to prevent damage to structures or pipes from compaction equipment loads.

B. Place specially compacted fill in accordance with paragraph 3.5 above, except for the following:

1. Compact in maximum 6-inch thick loose lifts.
2. Compaction equipment used in special compaction areas shall be small rollers, walk-behind sheeps-foot rollers, vibratory plates, or other small compactors appropriate for the material and as approved by the Engineer. No equipment may be used which by its weight or movement will damage, move or tilt out of alignment any part of the pipe or structure above, adjacent, or below the ground surface.

3.6 TOLERANCES

A. Finished earthen surfaces shall be within an allowable tolerance of plus or minus 0.1 foot from the grades shown on the Drawings.

3.7 FIELD QUALITY CONTROL

A. Give advance notice of at least 48 hours to Engineer for the following:

1. Before commencement of foundations proof-rolling.
2. Before commencement of placement and compaction of fill.
3. Before sampling or testing fill materials.

B. Specified QC testing is the responsibility of the Contractor and shall be performed by qualified, approved personnel and by a qualified, approved commercial testing laboratory/firm, subject to approval by the Engineer.

C. The final acceptance or rejection of the fill will be based on the Engineer's judgment considering test results and the general disposition of the fill.

D. If the fill is rejected, remove and replace rejected material at no cost to Owner.

E. Contractor's qualified independent testing firm shall conduct testing at the minimum frequencies for materials under Part 2 in this Section.

F. All testing and sampling locations are subject to approval by the Engineer

G. Contractor's qualified independent testing firm shall conduct field testing for Common fill and aggregate base course at the minimum frequencies specified in Table 02330-8 below.

H. The Engineer will select the location of testing. When observations indicate proper moisture conditioning and compaction are not being followed, or if there is a pattern of failing tests, the Engineer reserves the right to increase the specified testing frequency. Such additional testing shall be at no cost to the Owner.

TABLE 02330-8
FIELD QUALITY CONTROL TESTING

Test	Test Method (Current Version)	Test Frequency
Common Fill		
Field density and moisture (nuclear method)	ASTM D 6938	Minimum one per 500 CY Placed [(1)]
Aggregate Base Course		
Field density and moisture (nuclear method)	ASTM D 6938	Minimum one per 50 CY Placed [(1)]
Correlation Testing		
Sand Cone	ASTM D 1556	1 per 20 nuclear density tests[(2)]
Moisture correlation (oven dried)	ASTM D 2216	1 per 20 nuclear density tests[(2)]

Notes:

[1]Minimum one per day (on days of placement) or one per area of placement, whichever results in the greatest number of tests.
[2]Specified correlation testing frequency shall be following an initial calibration check and moisture calibration adjustment, if necessary, in accordance with ASTM D 6938 and a minimum of 4 density and moisture correlation tests using ASTM D 1556 on each material type at the start of testing.
CY = Cubic yards

I. If any of the analyses or visual inspection by the Engineer indicates the material may not meet specifications or has changed significantly from material represented by material testing, additional testing shall be performed by the Contractor to treat the changed material as a new material type. No fill material will be permitted in the work that has not, in the Engineer's opinion, been represented by material QC testing. For subsequent tests to prove conformance with the Technical Specifications, additional soil samples shall be collected from the borrow area, on-site stockpiles, or from in-place areas as directed and as deemed appropriate by the Engineer. Such additional testing shall be carried out in accordance with the requirements and the standard test methods for pre-construction testing set forth in the specifications.

J. The percent compaction requirements for materials where a moisture density relationship can be established will be evaluated as follows: The in-place density as compacted by the Contractor will be determined by the field density test using the nuclear method (ASTM D 6938) or sand-cone method (ASTM D 1556). The maximum dry density of the fill at the location of the in-place density test will be estimated using a one-point moisture density test and full-curve moisture density tests (family of curves) of representative fill materials. Both the one-point and the full-curve laboratory moisture-density tests will be performed according to ASTM D 698. The one-point test results will be compared to the representative moisture density curves to estimate the maximum dry density of the compacted fill at the location of the in-place density test. Comparison of the one-point laboratory moisture density test to the family of curves will be in accordance with AASHTO T 272, except that ASTM D 698 will be used as the laboratory moisture density test. The percent compaction in-place will be calculated as the ratio (in percent) of the in-place dry density to the estimated maximum dry density of the compacted fill at the location of the in-place density test.

K. The Contractor shall be responsible for scheduling work activity in accordance with material QC testing and Engineer's review period.

L. The Engineer may retain its own quality assurance laboratory for material testing services. The Contractor shall provide equipment and labor to assist the Engineer in any quality assurance testing and in obtaining soil samples. The Contractor shall cooperate in every way with this effort.

END OF SECTION

SECTION 02375
RIPRAP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and placing riprap and riprap bedding at the locations shown on the Drawings.

B. Screening, sorting, and processing existing riprap excavated from the downstream slope of the dam and adjacent areas to meet the specified gradation.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM)

1.	ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
2.	ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate.
3.	ASTM C 131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

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

1.	AASHTO T103	Standard Method of Test for Soundness of Aggregates by Freezing and Thawing

C. Colorado Department of Transportation (CDOT), Standard Specifications for Road and Bridge Construction, 2005.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. List of equipment proposed for use in hauling and placing riprap and riprap bedding.

C. Proposed source(s) of riprap bedding.

D. Certified copies of test certificates from a qualified testing laboratory stating that the riprap and riprap bedding conforms to the requirements of this Section.

E. Samples of riprap bedding if requested by the Engineer. Minimum sample size: 1 ton for riprap, and 50 pounds for riprap bedding.

F. Proposed plan and list of equipment for screening, sorting, stockpiling, and processing existing on-site riprap..

PART 2 PRODUCTS

2.1 RIPRAP

A. Riprap shall be dense, angular, reasonably well-graded, and with sound fragments resistant to abrasion. Material shall be free of cracks, seams, clay, organic material and other defects that would hasten degradation by water and/or frost action. Rounded boulders or cobbles shall not be accepted as riprap.

B. Existing riprap material excavated from the downstream dam face and accepted by the Engineer may be used as riprap without testing.

C. Imported riprap material shall meet the following properties:

1. Bulk specific gravity (saturated surface dry) shall be equal or greater than 2.6 as determined in accordance with ASTM C 127.
2. The weight loss of the material as tested under ASTM C 88 for 5 cycle sodium sulfate soundness shall be 10% or less.
3. The weight loss of the material when tested for resistance to abrasion in accordance with ASTM C 131 shall be 10% or less after 100 revolutions and not more than 40% after 500 revolutions.
4. The weight loss of the material when tested for resistance to disintegration by freezing and thawing in accordance with AASHTO T 103 shall be 5% or less.
5. Neither the breadth or thickness of any piece of riprap shall be less than one-third of its length.
6. Material used for riprap may be approved by the Engineer if, by visual inspection, the rock is determined to be sound and durable. The Engineer may require the Contractor to furnish laboratory results if, in the Engineer's opinion, the material is marginal or unacceptable.

D. Riprap shall be well-graded, from the smallest to the largest size, and shall be graded within the limits in Table 02375-1.

Table 02375-1
Riprap Gradation

D_{50} Size[1] (Inches)	% Of Total Wt Smaller Than Given Size[2]	Typical Stone Dimensions[3] (Inches)
18	100	30
	50-70	24
	35-50	18
	2-10	6
12	100	21
	50-70	18
	35-50	12
	2-10	4

[1] D_{50} = nominal stone size
[2] based on typical rock mass
[3] equivalent spherical diameter

2.2 RIPRAP BEDDING

A. Riprap bedding shall be a free draining, well-graded sand and crushed gravel mixture. Riprap bedding shall be imported from off-site sources.

B. Riprap Bedding shall meet the Colorado Department of Transportation 2005 Standard Specifications for Road and Bridge Construction – Section 703, Table 703-3, Class 1 Aggregate Base Course, and be graded within the following limits:

Table 02375-2
Riprap Bedding Gradation

U.S. Standard Sieve	Percent Passing by Weight
2 1/2 inch	100
2 inch	95-100
No. 4	30-65
No. 200	3-15

PART 3 EXECUTION

3.1 PLACING RIPRAP BEDDING

A. Place riprap bedding at the locations, thicknesses, lines, and grades shown on the Drawings.

B. General: Surfaces to receive bedding materials shall be smooth and firm, free from deleterious materials, and shall be brought to the lines and grades shown on the Drawings. Prepare the surfaces that are to receive bedding materials, by rolling and

trimming as necessary to enable a uniform lift of bedding of the specified thickness to be placed thereon. Surface preparation will include, but not be limited to, bringing all low spots up to the lines and grades shown on the Drawings with compacted fill and removing all material projecting above lines and grades shown on the Drawings.

C. Placement: Place the bedding materials in a manner that minimizes segregation and results in uniform lifts of bedding materials of the thicknesses shown on the Drawings. Place riprap bedding materials from the bottom of the slope working up the slope.

D. Moisture condition the materials as necessary to control dust and to minimize segregation.

E. Compaction is not required for the bedding materials; however, bedding materials shall be spread in such a manner as to form a smooth, uniform layer under underlying bedding and riprap.

3.2 SCREENING, SORTING AND PROCESSING EXISTING RIPRAP

A. Excavate existing riprap on the downstream slope of the dam in the areas designated on the Drawings and stockpile for measurement and payment.

B. Screen, sort, and process riprap obtained from site excavations to create mixtures of material that are graded to meet the specified riprap grading. Placed graded material in separate stockpiles and obtain Engineer approval before placing.

3.3 PLACING RIPRAP OVER BEDDING

A. Place riprap at the locations, thicknesses, lines, and grades shown on the Drawings.

B. Place riprap by dumping and working with a hydraulic excavator, and smoothing by moving rocks in such a manner as to produce a well-graded mass of rock with a minimum practical percentage of voids and that the material, when in place, is stable. Place riprap from the bottom of the slope working up the slope. The finished riprap shall be free from objectionable pockets of unacceptable soil fines, small stones and clusters of nested large rocks, as determined by the Engineer.

C. Place riprap materials to full layer thickness in one operation in such a manner as to minimize segregation and avoid displacement of underlying bedding materials.

D. Chinking: Provide laborers during placement for rearrangement of loose rock fragments, “chinking” of void spaces, and hand placement as needed to comply with the requirement of a well-keyed and stable layer of rock riprap.

3.4 TESTING

A. Riprap obtained on-site does not need to be tested for physical properties before use.

B. Conduct specified testing for physical properties of imported riprap using the services of an independent testing laboratory acceptable to the Engineer. Physical properties include specific gravity, sodium sulfate soundness, LA Abrasion, and freeze/thaw durability.

C. If acceptable certificates of compliance are provided by the imported riprap supplier physical properties testing may be waived at the Engineer’s discretion.

D. Test placements of riprap and riprap bedding (with a minimum volume of 50 cubic yards each) shall be prepared by the Contractor, and observed by the Engineer to develop a procedure for placement of riprap and riprap bedding, and to confirm the placement methods result in suitably placed riprap and riprap bedding.

E. Control of gradation will primarily be by visual inspection. The Engineer will be the sole judge of riprap gradation acceptability by visual inspection. If the Engineer elects to perform a gradation test(s) of the riprap, provide equipment and labor to assist the Engineer in performing the tests.

END OF SECTION

SECTION 02490
DRILLED ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installing drilled deformed reinforcement bar anchors, grouted in place under spillway chute slabs and stilling basin slabs as shown on the Drawings.

1.2 REFERENCES

A. American Society of Testing and Materials International (ASTM)

1.	ASTM A 615	Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
2.	ASTM C 150	Standard Specifications for Portland Cement.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Drilling Plan: Equipment and procedures for drilling and casing anchor holes.

C. Shop Drawings and Product Data

1. Submit shop drawings, product data and manufacturer's test data, including cement grout mix design, reinforcing bars (if other than standard deformed bars), couplers and the Contractor's proposed procedures for installing anchors and for conducting pull-tests of the spillway grouted anchors.

D. Final Anchor Locations and Pull Test Records

1. Submit records of final locations and depths of spillway anchors and pull-test records.

PART 2 PRODUCTS

2.1 MATERIALS

A. Anchors and Dowels: Steel reinforcing bars, ASTM A 615, Grade 60, standard deformed bars or bars provided with rolled threads; Uncoated finish; size and length as indicated; cut and bent, where necessary, before installation.

B. Couplers: Capable of developing 125 percent of the yield strength of the bars in both tension and compression.

C. Centralizers: Reinforcing bar centralizers for cement-grouted bars shall be in accordance with the manufacturer's requirement for the bar and drill hole diameters. Provide centralizers located at 1/3 and 2/3 points on the embedded portion of each bar.

D. Cement grout:

1. Cement: Type II, low alkali or Type III, high early strength portland cement conforming to requirements of ASTM C 150.
2. Grout: One part cement and maximum three parts sand, mixed with the minimum quantity of water to obtain a suitable consistency. Design grout mix to obtain a 7-day compressive strength of 4,000 psi.

PART 3 EXECUTION

3.1 HOLES FOR GROUTED ANCHORS

A. Lengths as indicated on the Drawings are the embedment depths required for the foundation anchors. In overbreak areas, extend hole depth and bar length to maintain the required depth of embedment. No extra payment will be made for longer bars required due to overbreak or over-excavation. Use minimum hole diameters as shown on the Drawings for grouted anchors.

B. After drilling, thoroughly clean each hole by first cleaning with a water jet and then blowing out with an air jet until no water, dirt, or dust remains. If cleaned holes are left open, and become contaminated with dirt and/or water, repeat the cleaning process until anchor holes are clean. If bars are not to be grouted in place immediately, plug the hole and clean again immediately before placing and grouting the bars.

3.2 GROUTED ANCHOR INSTALLATION

A. Before installation, clean bars of rust, scale, grease, mud, and other foreign material.

B. Grouting: Grouting shall be done by either of the following procedures:

1. Grouting with bar and centralizers in place:

    a. Attach centralizers to the bar and place the bar in the hole to its full depth.
    b. Insert grout tremie pipe to the bottom of the drill hole.
    c. Pump the grout through the tremie pipe until grout exits the collar of the hole. Raise the tremie pipe while injecting grout until the tremie pipe is entirely out of the hole and the grout fills the hole to the surface. Maintain tremie pipe in grout at all times while grouting.

2. Installing bar and centralizers after grouting:

    a. Insert grout tremie pipe to the bottom of the drill hole.
    b. Pump the grout through the tremie pipe. Raise the tremie pipe while injecting grout. Maintain tremie pipe in grout at all times while grouting.
    c. Attach centralizers to the bar and place the bar in the hole to its full depth.
    d. Pump the quantity of grout required so grout exits the hole when the bar is installed.
    e. If grout is not observed to exit the hole after bar installation, immediately remove the bar, clean out hole as specified in Paragraph 3.1.B to completely remove grout, clean all grout from the bar, and repeat the grouting and bar installation process until grout is observed exiting the hole during bar installation.

3. After grouting with one of the above methods, observe grout level. If grout level falls before initial set, top off add additional grout using tremie methods.

C. For foundation anchor bars spliced with a mechanical coupler, install the lower, straight section as specified. Bend the upper section before installation, and install by coupling not sooner than 24 hours after grouting the lower portion. Do not bend bars after grouting.

3.3 FIELD TESTING

A. Field Pull-Test Requirements: Conduct field pull-testing of anchors for the spillway, in the presence of the Engineer, in accordance with the following requirements:

1. Apply a test load equal to 50% of the specified minimum yield strength of the bar; and
2. Maintain the specified test load for a continuous period of not less than five minutes.

B. Pull-Test Procedures: Develop detailed test procedures based on the following:

1. Perform pull-test using a hydraulic jack equipped with calibrated gages for measuring the jacking load. Design and fabricate a test stand for the jack which has adequate bearing area and rigidity to distribute the test load to the foundation with minimal deformation and creep.
2. Conduct each test not less than 48 hours and not more than 72 hours after grouting bar.
3. Apply the test load to each anchor gradually in order to "seat" the test stand to the foundation. If foundation deformation or creep occurs when the test load is initially reached, continue to increase the jacking pressure until the load stabilizes.
4. When the load on the anchor stabilizes, hold the test load on the anchor for the specified period of time.

C. Acceptance criteria: Any anchor which does not hold the test load for the specified time period will be considered to have failed the test requirements. If a bar fails to meet the test requirements due to improper or inadequate installation, redrill and install a new anchor and retest. In the event that an anchor fails, the anchor bars immediately adjacent to or placed on the same day as the failed anchor shall also be tested.

D. Amount of testing required: Conduct one pull test each pull-test on the first anchor installed in rock and on the first anchor installed soil. Additionally, perform one pull-test as specified above for every ten foundation anchors placed in rock, and every five anchors installed in soil. The Engineer will select the anchors to be tested. Additional anchor bars will need to be tested in the event of a failed anchor bar test as specified above.

E. If, due to the nature of the foundation material, it is not possible to obtain the required load, advise the Engineer immediately so that a modified procedure can be determined. The Engineer may:

1. Increase the length of the anchors; or
2. Increase the quantity of bars and reduce the loading requirements of each bar.

END OF SECTION

SECTION 02495
TEMPORARY WALL ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for drilling, installing, grouting, and testing self drilling hollow bar injection anchors and attachments to secure the existing concrete spillway wall at the locations shown on the Drawings.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM)

1. ASTM A 36 Standard Specification for Carbon Structural Steel.
2. ASTM A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A 519 Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing.
4. ASTM A 563 Carbon and Alloy Steel Nuts.
5. ASTM A 615 Standard Specification for Bars, Deformed and Plain, for Concrete Reinforcement.
6. ASTM C 109 Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or {50 mm} Cube Specimens)
7. ASTM C 150 Standard Specification for Portland Cement.
8. ASTM C 845 Standard Specification for Expansive Hydraulic Cement.
9. ASTM F 436 Standard Specification for Hardened Steel Washers

1.3 DEFINITIONS

A. Bearing Plate: Steel bearing plate, equipped with a hole for the threaded hollow anchor bar. The bearing plate acts to secure the spillway wall to the drilled anchor.

B. Hollow Bar Injection Anchors: Untensioned anchors fully encapsulated with cement grout installed with a threaded bar equipped with a sacrificial cutting head in a single drilling/grouting operation.

1.4 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Qualifications: Anchor installer experience demonstrating compliance with the specified requirements.

C. Anchor Installation and Testing Plan: Plan describing proposed equipment, tools, and procedures to, install, and test the anchors. Include the following:

1. Drilling equipment including catalog cut sheets, grout mixing and pumping equipment, test equipment, and test procedures.
2. Hollow bar injection anchor components, including bar, cutting head, centralizers, nuts, bearing plates, washers, couplers, protective steel casing and cement grout.

3. Manufacturer’s literature for anchors, end hardware, and installation instructions.
4. Methods and equipment for storage, handling, drilling holes, installing anchors, grouting holes, and verifying load capacity.
5. Name, experience, and qualifications of proposed independent testing firm.
6. Once reviewed and approved, no changes or deviations to the Anchor Installation and Testing Plan will be permitted without further review by the Engineer.

D. Manufacturers Product Data: Copies of mill test reports and certificate of compliance from the manufacturer stating chemical properties, ultimate strengths, yield strengths, modulus of elasticity, and other physical properties for the anchors furnished.

E. Grout Mix: Mix design for drilling and installation cement grout.

F. Test Results: Pull-test records.

G. As-Built Information: Records of final locations and depths of anchors.

1.5 QUALITY ASSURANCE AND QUALIFICATIONS

A. Manufacturer: Obtain anchor elements and accessories from an established manufacturer who has regularly engaged in the production of these products for a minimum of 3 years. All system components shall be provided by the same manufacturer. Do not mix components from multiple manufacturers.

B. Installer Requirements: Firm regularly engaged in the installation of hollow bar anchors and has at least 5 years experience in the installation of similar anchorage systems as that proposed for use on this project. The Superintendent shall have installed hollow bar anchors on at least 5 projects in the last three years of similar scope and size in materials and conditions similar to the site. The supervisor shall be on site at all times during anchor installation.

C. Provide the services of an independent testing firm experienced in anchor installation observations and testing. Independent testing firm responsibilities:

1. Inspect and approve materials delivered to the jobsite before the materials are used in the work.
2. Inspect and approve Contractor's equipment to be used for installation and testing operations before the equipment is used in the work.
3. Instruct the Contractor's personnel on the proper anchor installation methods required for the jobsite conditions at the beginning of the work.
4. Inspect anchor installation and testing for conformance with Drawings and Specifications.
5. Collect and test grout cube samples.
6. Report inspection and test results to the Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Metal materials:

1. Protect materials from damage and corrosion during shipping, handling, and storage.
2. Store anchors on dunnage.

3. Wrap ends of hollow bars to prevent dirt entry.
4. Replace damaged or corroded components as directed by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Anchors shall be furnished complete with all accessories for installation as shown on the drawings. This specification includes product information for DYWIDAG Systems International-Lang (DSI-Lang) anchors. Other acceptable manufactures of self drilling hollow core injection anchors are Con-Tech Systems, Ltd, and Willams Form Engineering Corporation (Williams).

B. Bars: High-strength heavy wall steel tubing with continuous threaded surface for mechanical coupling conforming to ASTM A519 and ASTM A615 grade 75 or better. Minimum OD 1 1/4 inch, Minimum yield strength of 47 kips. DSI-Lang R32N or equal as approved by the Engineer.

C. Cutting Heads: Bars shall be equipped with cutting heads sized to produce the hole diameter shown on the Drawings. The Contractor is responsible for selecting a suitable cutting head to achieve the specified hole depth and diameter, and sufficiently grouted bond length in the subsurface conditions at the site, which includes bedrock (volcanic tuff), hard rock cobbles, large boulders, sand, gravel, and other such subsurface conditions. The cutting head shall be equipped with venturi holes that allow for proper grout flow during drilling and final grouting for the entire length of the anchor.

D. Centralizers: Hollow injection bar anchor star centralizers in accordance with the anchor manufacturer's recommendations.

E. Bearing Plate: Fabricated from steel conforming to ASTM A36 Grade 36, with oversized round or slotted center hole sized for the injection anchor bar. Bearing plate dimensions as shown on the Drawings.

F. Hex Nuts: Heavy duty, steel, hexagonal type meeting ASTM A108. Overtapped as required to facilitate threading onto bar. Capable of developing 100% of the guaranteed ultimate tensile strength of the bars. DSI-Lang R32N or equal as approved by the Engineer.

G. Couplers: Sized for bar, capable of developing 100% of the guaranteed ultimate tensile strength of the bars, and fitted to prevent loss of grout pressure during drilling.

H. Washers: Heavy duty, steel, meeting ASTM F436.

I. Anchor Grout:

1. Cement: ASTM C 150, type III, with low alkali requirements and false-set limitations.
2. Water: Clear, potable water, free of oil, acid, alkali, organic matter, or injurious quantities of chlorides, fluorides, sulfates and nitrates.
3. Admixtures:

a. Admixtures which control bleed, improve flowability, reduce water content and retard or accelerate set may be used in the grout subject to approval by the Engineer.
b. Any admixture used shall be compatible with the anchor and reinforcement dowel.
c. Mix in accordance with manufacturer's recommendations.

4. Mix:

a. Mixture proportions for anchor drilling and grouting shall be the responsibility of the Contractor.
b. Grout shall consist of a homogeneous, pumpable, stable mixture of Portland cement and water mixed with a colloidal high shear mixer producing complete dispersion of particles.
c. Water-cement ratio: As approved in the mix design.
d. Final proportions of cement grout materials shall be based on results of test made on sample mixtures of grout. The minimum 28-day compressive strength of 2-inch cubes, molded, cured, and tested in accordance with ASTM C 109 shall be 5,000 psi.

2.2 EQUIPMENT

A. Drilling Equipment:

1. Selected and sized to safely access all locations of the spillway for anchor installation without damage to the spillway, or other site features.
2. Sufficient horsepower to drill in the subsurface conditions at the site that include bedrock, hard rock cobbles, large boulders, and gravels.

B. Testing Equipment:

1. Dial gauge, a dial gauge support, jack and pressure gauge, and reaction frame.
2. Dial gauges capable of measuring to 0.001 inch, minimum stroke equal to the theoretical elastic elongation of the total anchor length plus 1 inch, aligned within 5 degrees from the axis of the anchor.
3. A hydraulic jack and pump shall be used to apply the test load.
4. The jack and pressure gauge shall be calibrated by an independent testing laboratory as a unit. The pressure gauge shall be graduated in 100 psi increments or less and shall have a range not exceeding twice the anticipated maximum pressure during testing unless otherwise approved by Engineer. Use a pressure gauge to measure the applied load. The minimum ram travel of the jack shall not be less than the theoretical elastic elongation of the total anchor length at the maximum test load plus 1 inch. The jack shall be capable of applying each load in less than 1 minute.
5. The jack shall be independently supported and centered over the anchor so that the anchor does not carry the weight of the jack. Monitor loads on the anchors during the tests with a pressure gauge. Provide recent (within 60 days) calibration curves for gauges. Place stressing equipment over the anchor in such a manner that the jack, bearing plates, load cell, and stressing anchorage are in alignment. Position jack at the beginning of the test such that unloading and repositioning of the jack during the test will not be required.
6. Design a reaction frame that is sufficiently rigid and of adequate dimension such that excessive deformation and creep of the test apparatus requiring

repositioning of any components is avoided. Where the reaction frame bears directly on the concrete spillway wall, the reaction frame shall be designed to avoid damage to the concrete spillway wall.

PART 3 EXECUTION

3.1 VERIFICATION ANCHOR INSTALLATION AND TESTING

A. Install two pre-production (verification) anchors at the locations selected by the Contractor and approved by the Engineer. Use identical procedures, hole diameter, equipment, and methods approved for production anchor installation.

B. Verification testing shall be performed prior to installation of production anchors to verify the contractor's installation methods, anchor pullout capacity, and design assumptions. The anchors used for the verification tests shall be sacrificial and shall not be incorporated as production anchors.

C. The bond length of test anchors shall be determined by the Engineer such that the allowable bar load is not exceeded. The bar load during testing shall not exceed 90% of the steel yield strength for Grade 60 and Grade 75 bars.

D. The design test load (DTL) during testing shall be determined by multiplying the bond length of the anchor times the design pullout resistance of 0.4 kips/ft. Verification test anchors shall be incrementally loaded and unloaded in accordance with the following schedule:

Load	Hold Time	Load	Hold Time
AL	1 minute	1.75DTL	Until stable
0.25DTL	10 minutes	1.50DTL	Until stable
0.50DTL	10 minutes	1.25DTL	Until stable
0.75DTL	10 minutes	1.00DTL	Until stable
1.00DTL	10 minutes	0.75DTL	Until stable
1.25DTL	10 minutes	0.50DTL	Until stable
1.50DTL	60 minutes	0.25DTL	Until stable
1.75DTL	10 minutes	AL	Until stable
2.00DTL	10 minutes		

E. The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed 0.05DTL. Dial gauges should be zeroed after the alignment load is applied.

F. Each load increment shall be held for at least 10 minutes. The verification test shall be monitored for creep for 60 minutes at the 1.50DTL load increment. Anchor movements during the creep portion of the test shall be measured and recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes.

3.2 GENERAL ANCHOR INSTALLATION

A. Before drilling holes, mark the planned installation locations for production anchors. Obtain Engineer approval before installing anchors. Engineer may adjust anchor locations based on field conditions.

B. Install centralizers on the anchor bars to insure that the anchor will be centered in the hole and that minimum grout cover encapsulates the bar completely around the circumference of the anchor bar for its entire length. Centralizers may be waived if it can be demonstrated to the Engineer that the anchor will remain centered during grout placement.

C. Install anchors in accordance with the methods and procedures in the manufacturers written guidance instructions and the approved installation plan. Drill anchors to the depth and diameter shown on the Drawings.

D. Grouting shall be done continuously during the anchor drilling operation through a rotary injection adapter or grout swivel system attached to the end of the anchor. Pressure shall be sufficient to maintain circulation at all times with a small amount of drilling grout return visible at the mouth of the borehole.

E. At the completion of drilling installation inject full strength grout through the bar. Grout shall exit the mouth of the borehole. If grout is not observed to exit the opening after bar installation, remove the bar while filling the borehole with injected grout. Observe grout level in mouth of borehole over a period of several hours to determine if formation is taking grout. Top off grout if needed to maintain borehole full of grout. If grout loss is substantial, consult with Engineer to evaluate and alter operations. If grout loss is not excessive, redrill hole after grout sets, but not less than 12 hours (if type III cement is used) after last filling, and install anchor as specified.

3.3 ANCHORAGE INSTALLATION

A. Bearing Plate and Hardware Attachments: After grout for the wall anchors has set a minimum of 72 hours and testing (if required on that anchor) is completed, install the bearing plate. Install and tighten nut against washer and bearing plate to 5,000 pounds using a pneumatic torque wrench and appropriate torque-tension relationship. Do not over tighten nuts that would result in damage to the spillway wall to remain.

B. After the nut is installed, trim the top of the anchor bar as shown on the Drawings. The tops may be cut with torch methods provided the nut is installed and tightened first.

3.4 PROOF TESTING PRODUCTION ANCHORS

A. Proof testing shall be performed on the first production anchor installed, and on approximately 10 percent of the production anchors as determined by the Engineer. If anchor installation methods are substandard on any particular anchor or series of anchors, additional tests may be required.

B. The bar load during testing shall not exceed 90% of the steel yield strength for Grade 60 and Grade 75 bars.

C. Proof test anchors shall be incrementally loaded in 0.25DTL increments to a maximum load of 1.50DTL in accordance with the following schedule:

AL	1.00DTL
0.25DTL	1.25DTL
0.50DTL	1.50DTL
0.75DTL	

D. The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed 0.05DTL. Dial gauges should be zeroed after the alignment load is applied.

E. Depending on performance, either a 10 minute or 60 minute creep test shall be performed at 1.50DTL. Anchor movement shall be measured and recorded at 1, 2, 3, 5, 6, and 10 minutes. Where the anchor movement between 1 minute and 10 minutes exceeds 0.04 inches, the maximum test load shall be maintained an additional 50 minutes and movements shall be recorded at 20, 30, 50, and 60 minutes.

F. Proof Test Procedures: Develop and submit detailed test procedures based on the following:

1. Conduct a proof test on the first anchor installed and 10% of remaining anchors using a hydraulic jack equipped with calibrated gages for measuring the jacking load. The test anchors shall not be preselected. The Engineer will select the anchors to be tested after installation.
2. Conduct each test at least 72 hours after grouting bar unless otherwise approved by the Engineer. If cement other than type III is used, testing period will be at the Engineer's discretion.
3. Conduct testing using equipment and procedures that distribute loads and do not damage the concrete spillway wall.
4. Apply the jacking load to each anchor gradually in order to "seat" the load frame onto the foundation. If foundation deformation or creep occurs when the test load is initially reached, continue to increase the jacking pressure until the load stabilizes.
5. When the load on the anchor stabilizes, hold the test load on the anchor for the specified period of time.

G. Acceptance Criteria:

1. A test anchor shall be considered acceptable when:

    a. For verification tests, a creep rate less than 0.08 inches per log cycle of time between the 6 and 60 minute readings is observed during creep testing, and the rate is linear or decreasing throughout the creep test load hold period.
    b. For proof tests, a creep rate less than 0.04 inches per log cycle of time between the 1 and 10 minute readings is observed or a creep rate less than 0.08 inches per log cycle of time between the 6 and 60 minute readings, and the creep rate is linear or decreasing throughout the creep test load hold period.
    c. The total movement at the maximum test load exceeds 80% of the theoretical elastic elongation of the unbonded length.
    d. A pullout failure does not occur during testing. Pullout failure is defined as the load at which attempts to increase the test load simply result n continued pullout movement of the test anchor.

2. Any anchor which does not hold the test load for the specified time period will be considered to have failed the test requirements. Relocate and replace any anchor which will not withstand the required testing at Contractor's expense and as directed by the Engineer.

3. Engineer may require that the Contractor replace some or all of the installed anchors between a failed test and the last passing test. Alternatively, Engineer may require that additional proof testing be conducted based on the results of the tests.
4. If the Engineer determines that due to the nature of the foundation material it is not possible to obtain the required load, a modified procedure may be specified. The Engineer may increase the length of the bars, increase the drill hole diameter, or increase the quantity of bars, and/or reduce the loading of each bar.
5. Relocate and replace any anchor that is damaged or made ineffective by excavation or Contractor operations, at Contractor's expense.

3.5 FIELD QUALITY CONTROL

A. Anchor Installation Records: Keep accurate driller logs and records of all work accomplished and deliver these logs and records to the Engineer upon completion of the work or as directed by the Engineer.

B. Contractor's independent testing firm shall:

1. Monitor the anchor installation for compliance with the manufactures direction and this specification. Provide quality control reports to the Engineer daily and immediately report any deficiencies to the Engineer.
2. Test grout densities at least once each day grout is placed. Grout density shall match approved mix design.
3. Randomly collect and test three 2-inch grout cubes of cement grout in accordance with ASTM C 109 each day grout is placed. Engineer may direct when and where samples will be collected. Test grout samples for compressive strength at the approved independent laboratory at 5, 7, and 28 days. Report results to Engineer within 2 days of test completion.

END OF SECTION

SECTION 02496
MICROPILES

PART 1 GENERAL

1.1 WORK INCLUDES

A. Providing project control, qualified supervision, labor, equipment and materials, and performing operations in connection with the installation of micropiles by a pre-qualified specialty contractor.

1.2 REFERENCES

A. ASTM International (ASTM)

1.	ASTM A 252	Standard Specification for Welded and Seamless Steel Pipe Piles
2.	ASTM A 615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
3.	ASTM A 722	Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
4.	ASTM C 33	Standard Specifications for Concrete Aggregates
5.	ASTM C 109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
6.	ASTM C 150	Standard Specification for Portland Cement
7.	ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
8.	ASTM A 572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
9.	ASTM A 529	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality

B. American Welding Society (AWS)

1.	AWS D1.1-06	Standard Specification for Structural Welding Code-Steel

1.3 DEFINITIONS

A. Micropile: A small-diameter, drilled and grouted replacement pile reinforced with steel casing and central reinforcement bar. The pile capacity is achieved by the steel elements and the grout-to-ground bond strength. The grout-to-ground bond strength is influenced by ground type, drilling method, and grouting method and shall be field verified.

1.4 SUBMITTALS

A. Submit the following in accordance with Section 01330: Submittals.

B. .Installer Qualifications: At least 40 calendar days before the planned start of micropile construction, the micropile contractor shall submit 5 copies of the completed project reference list and a personnel list for acceptance by the Engineer. The project reference list shall include a brief project description with the owner's name and current phone number and load test reports. The personnel list shall identify the micropile system design reviewer, supervising project engineer, drill rig operators, and on-site foremen to be assigned to the project. The personnel list shall contain a summary of each

individual's experience and be complete enough for the Engineer to determine whether each individual satisfies the required qualifications.

C. If welding of casing is proposed, submit the proposed welding procedure, proposed filler material, and welder certifications.

D. Information on space requirements for installation equipment that verify the proposed equipment can perform at the site.

E. Plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed.

F. Details regarding load-test setup including drawings showing proposed configuration. Provide verification of bearing plate strength for tensile proof test loads and verification test loads based on the connection configuration of the proposed test jack. If required, provide details for proposed base plate support modifications such as the addition of stiffener plates.

G. Calibration reports and data for each test jack, pressure gauge and electronic load cell to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within 90 calendar days of the date submitted. Testing shall not commence until the Engineer has reviewed and accepted the jack, pressure gauge, master pressure gauge, electronic load cell, and associated calibration data for each device to be used.

H. Submit full-length installation records for each micropile installed. The records shall be submitted within one work shift after that pile installation is completed. A separate log shall be provided for each micropile.

1.5 QUALITY CONTROL

A. Micropile contractor shall have a minimum of 5 years experience in the construction and load testing of micropiles and have successfully constructed at least 5 micropile projects in the last 5 years of similar capacity to those required on the drawings and in these specifications.

B. The micropile contractor shall assign a licensed professional engineer to supervise the work. The micropile engineer shall have demonstrated successful past performance of supervision of similar projects.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Grout Admixtures: Conform to the requirements of ASTM C 494. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout, subject to the review and acceptance of the Engineer. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations and anchorage covers. Accelerators are not permitted. Admixtures containing chlorides are not permitted.

B. Centralizers and Spacers: Centralizers and spacers shall be fabricated from schedule 40 PVC pipe or tube steel, or material non-detrimental to the reinforcing steel. Wood shall not be used. Centralizers and spacers shall be securely attached to the reinforcement; sized to position the reinforcement within 3/8 inch of plan location from center of pile; sized to allow grout tremie pipe insertion to the bottom of the drillhole; and sized to allow grout to freely flow up the drillhole and casing and between adjacent reinforcing bar.

C. Grout: All grout cement shall be Portland cement conforming to ASTM C 150/AASHTO M85, Types II, III or V. If sand-cement mixture is used, sand shall conform to ASTM C 144/AASHTO M45. Neat cement or sand-cement grout mixture shall have a minimum 3-day compressive strength of 2,000 psi and a 28-day compressive strength of 4,000 psi.

D. Water: Water used in the grout mix shall be potable, clean, and free from substances that may be injurious to cement and steel.

E. Permanent Casing Pipe: Permanent steel casing/pipe shall have the diameter and at least minimum wall thickness shown on the drawings. The permanent steel casing/pipe:

1. Shall meet the tensile requirements of ASTM A 252, Grade 3, except the yield strength shall be a minimum of 80,000 psi.
2. May be new "Structural Grade" (a.k.a. "Mill Secondary") steel pipe meeting the above requirements but without mill certification, with two coupon tests per truckload delivered to the fabricator.
3. The pipe shall be free from defects (dents, cracks, tears), deleterious substances such as soil, mud, grease, or oil that might contaminate the grout or coat the pipe and impair bond.
4. For permanent casing/pipe that will be welded, the following material conditions apply:

    a. The carbon equivalency (CE) as defined in AWS D1.1, Section X15.1, shall not exceed 0.45, as demonstrated by mill certifications.
    b. The sulfur content shall not exceed 0.05%, as demonstrated by mill certifications.
    c. For permanent casing/pipe that will be shop or field welded, the following fabrication or construction conditions apply:
    d. The steel pipe shall not be joined by welded lap splicing.
    e. Welded seams and splices shall be complete penetration welds.
    f. Partial penetration welds may be restored in conformance with AWS D1.1.
    g. The proposed welding procedure certified by a welding specialist shall be submitted for approval.

5. Threaded casing joints shall develop at least the required nominal resistance used in the design of the micropile.

F. Reinforcing Bars: Reinforcing steel shall be all-thread-bar in accordance with ASTM A 722 Grade 75. A bearing plate and nut are required to be threaded onto the top end of reinforcing bars for the pile top to footing anchorage as shown on the Drawings. Bearing plate shall be ASTM 529 or ASTM 572 Grade 50 plate or bar. The bearing plate to casing weld connection shall be completed using 80 ksi electrodes.

G. Bar Tendon couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate existing utilities and structures within 25 feet of micropile installation, including alignment and depth, prior to micropile installation.

B. Protect located utilities and structures at all times during micropile installation.

C. Repair any damage to existing utilities and structures as a result of micropile installation at no cost to the Owner.

3.2 GENERAL INSTALLATION

A. Micropiles

1. The micropile contractor is responsible for selecting the drilling method, the grouting procedure, and the grouting pressure used for the installation of the micropiles. The micropile contractor shall also determine the micropile casing size and final drill hole diameter necessary to develop the specified load capacities and load testing requirements. The micropile contractor is also responsible for estimating the grout take. There will be no extra payment for grout overruns.

B. Drilling

1. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to any overlying or adjacent structures, services or utilities. The drillhole must be open along its full length to at least the design minimum drillhole diameter prior to placing grout and reinforcement.
2. Temporary casing or other approved method of pile drillhole support will be required in caving or unstable ground to permit the pile shaft to be formed to the minimum design drillhole diameter. The micropile contractor's proposed method(s) to provide drillhole support and to prevent detrimental ground movements shall be reviewed by the Engineer. Detrimental ground movement is defined as movement that requires remedial repair measures. Use of drilling fluid containing bentonite is not allowed.

C. Ground heave or subsidence

1. During construction, observe the conditions in the vicinity of the micropile construction site on a daily basis for signs of ground heave or subsidence. Immediately notify the Engineer if signs of movements are observed. Micropile contractor shall immediately suspend or modify drilling or grouting operations if ground heave or subsidence is observed, if the micropile structure is adversely affected, or if adjacent structures are damaged from the drilling or grouting. If the Engineer determines that the movements require corrective action, the

micropile contractor shall take corrective actions necessary to stop the movement or perform repairs.

D. Pipe Casing and Reinforcing Bars, Placement and Splicing

1. Reinforcement may be placed either prior to grouting or placed into the grout-filled drillhole before temporary casing (if used) is withdrawn. Reinforcement surface shall be free of deleterious substances such as soil, mud, grease, or oil that might contaminate the grout or coat the reinforcement and impair bond.
2. Check pile top elevations and adjust all installed micropiles to the planned elevations shown on the drawings.
3. Provide centralizers and spacers (if used) at 10 foot centers maximum spacing. The upper and lower most centralizer shall be located a maximum of 5 feet from the top and bottom of the micropile. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bar and permanent casing. The central reinforcement bar with centralizers shall be lowered into the stabilized drill hole and set. The reinforcing steel shall be inserted into the drill hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. Contractor shall redrill and reinsert reinforcing steel when necessary to facilitate insertion.
4. Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity or angle between the axes of the two lengths to be spliced. Threaded pipe casing joints shall be located at least two casing diameters (OD) from a splice in any reinforcing bar.

E. Grouting

1. Micropiles shall be primary grouted the same day the load transfer bond length is drilledusing a stable neat cement grout or a sand cement grout in accordance with this Section. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The grouting equipment used shall produce a grout free of lumps and undispersed cement. The micropile contractor shall have means and methods of measuring the grout quantity and pumping pressure during the grouting operations. The grout pump shall be equipped with a pressure gauge to monitor grout pressures. A second pressure gauge shall be placed at the point of injection into the pile top. The pressure gauges shall be capable of measuring pressures of at least 100 psi or twice the actual grout pressures used, whichever is greater. The grout shall be kept in agitation prior to mixing. Grout shall be placed within one hour of mixing. The grouting equipment shall be sized to enable each pile to be grouted in one continuous operation. The grout shall be injected from the lowest point of the drill hole and injection shall continue until uncontaminated grout flows from the top of the pile. The grout may be pumped through grout tubes, casing, hollow-stem augers, or drill rods. Temporary casing, if used, shall be extracted in stages ensuring that, after each length of casing is removed the grout level is brought back up to the ground level before the next length is removed. The tremie pipe or casing shall always extend below the level of the existing grout in the drillhole. The grout pressures and grout takes shall be controlled to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole, but must be filled with grout.

3.3 FIELD QUALITY CONTROL

A. Perform verification and proof testing of piles at the locations specified herein or designated by the Engineer. Perform tension load testing in accord with ASTM D3689, except as modified herein.

B. Verification Load Tests: Perform one pre-production verification pile load test to verify the design of the pile system and the construction methods proposed prior to installing any production piles. One sacrificial verification test pile shall be constructed at the location selected by the Engineer.

1. The verification load test shall be performed to verify that the installed micropiles will meet the required load capacities and load test acceptance criteria and to verify that the length of the micropile load transfer bond zone is adequate by verifying the grout-to-ground bond strength assumed in design. The micropile verification load test results must verify the micropile contractor's design and installation methods, and be reviewed and accepted by the Engineer prior to beginning installation of production micropiles.
2. The drilling and grouting method, casing length and outside diameter, reinforcing bar lengths, and depth of embedment for the verification test pile shall be identical to those specified for the production piles. The verification test micropile structural steel sections shall be sized to safely resist the maximum test load.
3. The maximum verification and proof test loads applied to the micropile shall not exceed 80 percent of the structural capacity of the micropile structural elements. Any required increase in strength of the verification test pile elements above the strength required for the production piles shall be provided.
4. The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required. Use a minimum of two dial gauges to measure pile top movement when the test required reaction against the ground or single reaction piles on each side of the test pile.
5. Verification Test Loading Schedule. Test verification pile in tension designated for load testing to a maximum test load of 2.5 times the micropile Design Load shown on the Drawings. The verification pile load tests shall be made by incrementally loading the micropile in accordance with the following cyclic load schedule for tension loading:

AL = Alignment Load, DL = Design Load		
	LOAD	**HOLD TIME**
1	AL (0.05 DL)	1 minute
2	0.25 DL	1 minute
3	0.50 DL	1 minute
4	AL	1 minute
5	0.25 DL	1 minute
6	0.50 DL	1 minute
7	0.75 DL	1 minute
8	AL	1 minute
9	0.25 DL	1 minute
10	0.50 DL	1 minute
11	0.75 DL	1 minute
12	1.00 DL	1 minute
13	AL	1 minute
14	0.25 DL	1 minute
15	0.50 DL	1 minute
16	0.75 DL	1 minute
17	1.00 DL	1 minute
18	1.33 DL	60 minutes (Creep Test Load Hold)
19	1.75 DL	1 minute
20	2.00 DL	1 minute
21	2.25 DL	1 minute
22	2.5 DL (Maximum Test Load)	10 minute
23	AL	1 minute

6. The test load shall be applied in increments of 25 percent of the DL load. Each load increment shall be held for a minimum of 1 minute. Pile top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be monitored for creep at the 1.33 Design Load (DL). Pile movement during the creep test shall be measured and recorded at 1, 2, 3, 4, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of the DL load. Dual gauges shall be reset to zero after the initial AL is applied.
7. The acceptance criteria for micropile verification load tests are:

    a. At the end of the 1.33 DL creep test load increment, test piles shall have a creep rate not exceeding 0.04 inches/log cycle time (1 to 10 minutes) or 0.08 inches/log cycle time (6 to 60 minutes or the last log cycle if held longer). The creep rate shall be linear or decreasing throughout the creep load hold period.
    b. Failure does not occur at the 2.5 DL maximum test load. Failure is defined as load at which attempts to further increase the test load simply result in continued pile movement.

8. Verification Test Pile Rejection. If a verification-tested micropile fails to meet the acceptance criteria, the micropile contractor shall modify the design, the construction procedure, or both. These modifications may include modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification that necessitates changes to the structure shall require the Engineer prior review and acceptance. Any modifications of design or construction procedures or cost of additional verification test piles and load testing shall be at the micropile contractor's expense. At the completion of verification testing, test piles shall be removed down to the elevation specified by the Engineer.

C. Proof Load Tests. Perform tension proof load tests on the micropiles indicated on the Drawings. Test piles designated for tension proof load testing to a maximum test load of 1.67 times the micropile Design Load shown on the drawings.

1. Proof tests shall be made by incrementally loading the micropile in accordance with the following schedule:

AL = Alignment Load, DL = Design Load		
	LOAD	**HOLD TIME**
1	AL	1 minute
2	0.25 DL	1 minute
3	0.50 DL	1 minute
4	0.75 DL	1 minute
5	1.00 DL	1 minute
6	1.33 DL	10 or 60 minute Creep Test
7	1.67 DL (Maximum Test Load)	1 minute
8	AL	1 minute

2. Depending on performance, either a 10-minute or 60-minute creep test shall be performed at the 1.33 DL Test Load. Where the pile top movement between 1 and 10 minutes exceeds 1 mm, the Maximum Test Load shall be maintained an additional 50 minutes. Movements shall be recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of DL. Dial gauges shall be reset to zero after the initial AL is applied.
3. The acceptance criteria for micropile proof load tests are:

   a. The pile shall sustain the tension DL test load with no more than 0.5-inch total vertical movement at the top of the pile, relative to the position of the top of the pile prior to testing.
   b. At the end of the 1.33 DL creep test load increment, test piles shall have a creep rate not exceeding 0.04 inches/log cycle time (1 to 10 minutes) or 0.08 inches/log cycle time (6 to 60 minutes). The creep rate shall be linear or decreasing throughout the creep load hold period.
   c. Failure does not occur at the 1.67 DL maximum test load. Failure is defined as the load at which attempts to further increase the test load simply result in continued pile movement.

4. Proof Test Pile Rejection: If a proof-tested micropile fails to meet the acceptance criteria, the micropile contractor shall immediately proof test another micropile within that footing. For failed piles and further construction of other piles, the micropile contractor shall modify the design, the construction procedure, or both. These modifications may include installing replacement micropiles, incorporating piles at not more than 50% of the maximum load attained, postgrouting, modifying installation methods, increasing the bond length, or changing the micropile type.

D. During production, micropile grout shall be tested for compressive strength in accordance with ASTM C 109 at a frequency of three 2-inch grout cubes for each day of operation. The compressive strength shall be the average of the 3 cubes tested.

3.4 ALLOWABLE CONSTRUCTION TOLERANCES

A. Centerline of piling shall not be more than 3 inches from indicated plan location on the drawings.

B. Pile shall be plumb within 2 percent of total-length plan alignment.

C. Top elevation of pile shall be plus 1 inch or minus 2 inches maximum from vertical elevation indicated.

D. Centerline of reinforcing steel shall not be more than ½ inch from indicated location.

3.5 MICROPILE INSTALLATION RECORDS

A. Prepare and submit to the Engineer a separate log for each micropile installed within one work shift after that pile installation is completed.

END OF SECTION

SECTION 02620
HDPE DRAIN PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installing slotted and solid High Density Poly Ethylene (HDPE) drain pipes in locations indicated on the Drawings, and cleaning and performing video inspection of drain pipes after installation.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM)

1.	ASTM D 2321	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
2.	ASTM D 3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
3.	ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
4.	ASTM F 2306	Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile- Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications

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

1.	AASHTO M 252	Corrugated Polyethylene Drainage Pipe.
2.	AASHTO M 294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter.
3.	AASHTO SSHB	Standard Specifications for Highway Bridges

C. National Transportation Product Evaluation Program (NTPEP)

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Material Certifications

1. Manufacturer’s certification that raw materials and pipe to be furnished meet the requirements of this Section. The certification shall state that pipe complies with these specifications based on complete tests which the manufacturer has conducted on the lot.
2. Product data for piping materials, fittings, and jointing methods; and recommended method of installation of pipe and construction of branches in pipe.
3. National Transportation Product Evaluation Program audit report indicating approval of specified pipe.

C. Installation Plan

1. Installation plan outlining the proposed plan for constructing drains shall be submitted to the Engineer for approval at least 14 days prior to the anticipated commencement of the Work. Plan shall include a proposed schedule, proposed products to be used during installation, and measures that will be put in place to protect the Work during construction. Contractor shall include in the plan, measures to keep drain materials from becoming contaminated with soil, or other materials during stockpiling and construction activities.

D. Inspection Video

1. Submit 3 copies of inspection video(s) in DVD format with audio recording documenting video inspection of all drain pipes.

1.4 QUALITY ASSURANCE

A. Pipe manufacturer shall be a participating member of the National Transportation Product Evaluation Program. Only products from suppliers whose manufacturing plant and Poly Ethylene (PE) pipe products comply with this specification will be approved.

1.5 STORAGE AND HANDLING

A. Handle materials to ensure delivery to installation locations in sound undamaged condition.

B. Thermoplastic pipe shall be unloaded and handled with reasonable care. Do not drop pipe, for pipes smaller than 18" in diameter manual handling is acceptable. For pipes larger than 36" in diameter, lift with a sling at two points spaced 10 feet apart. Do not use a loading boom or forklift to directly on or inside the pipe.

C. Non-palletized pipe may be temporarily stockpiled on a flat, clear area. Stack pipe no higher than 6 feet.

D. Do not drag or strike pipe ends against anything.

E. Store and block pipe in a manner that prevents warping or distortion.

PART 2 PRODUCTS

2.1 DRAIN PIPE

A. HDPE Resin

1. HDPE pipe and fittings shall be manufactured from virgin resin. HDPE pipe and fittings manufactured from reclaimed or recycled resin will be rejected.
2. Virgin material for pipe and fitting production shall be high density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch diameters, or 435400C for 12- through 60-inch diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content shall not exceed 4%.

B. HDPE Pipe

1. Furnish pipe in the nominal sizes shown on the Drawings.

2. Slotted pipe

a. AASHTO M252 or M294, Type SP pipe with corrugated exterior and smooth interior.
b. Perforations

1) AASHTO Class 2 slotted holes with a width of 0.1 inches.
2) Clean and completely free of burrs, cuttings, frayed edges, tears and cracks, and other defects.
3) Pipe not meeting these requirements will be rejected. Pipe is not allowed to be slotted in the field.

3. Solid pipe

a. AASHTO M252 or M294, Type S pipe with corrugated exterior and smooth interior.

4. Pipe Joints

a. Join pipes using a bell and spigot joint meeting AASHTO M252, AASHTO M294 or ASTM F2306.
b. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

5. Pipe and Connection Type by Area:

a. Toe drain outfall: Solid, water-tight.
b. Spillway foundation drains and toe drains: Perforated and solid, soil-tight.

C. HDPE Fittings

1. Suitable for use in perforated and solid corrugated drain pipe
2. Manufactured for the diameter of pipe being connected.
3. Water–tight or soil-tight connections as specified herein.

D. Manufacturer and product:

1. Manufacturer: Advanced Drainage Systems (ADS)/Hancor.
2. Product: N-12 WT1B or ST1B, or equal as approved by the Engineer.

2.1 LOCKING CLEANOUT CAP

A. In accordance with Section 05500: Metal Fabrications.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install drain pipes in accordance with this Section, ASTM D 2321 and the manufacturer's written installation instructions. In case of a conflict, this specification shall govern.

B. Excavate for drains in accordance with Section 02315: Excavation.

C. Furnish and place filter sand and drain gravel in accordance with Section 02330: Earthwork and this Section.

D. Place fill materials carefully around the drainage pipe so as not to disturb the drainage pipe and to hold it securely in position while the overlying material is being placed.

E. Due to the polyethylene corrugated drainage pipe's light weight and buoyancy, special care shall be exercised in laying the drainage pipe and placing materials adjacent to the pipe to ensure that the pipe is laid in a manner to remain on grade and in alignment.

F. Method of laying the drainage pipe shall prevent stretching of the pipe during laying operations.

G. Install couplings with a close fit and in accordance with the manufacturer's deflection tolerances. Install in a manner that maintains alignment of the pipe, prevents separation of the joints, and maintains gasket integrity.

H. Any drainage pipe which is broken, cracked, or otherwise unsuitable for use, as determined by the Engineer, shall be removed and replaced by the Contractor.

I. Check interior of pipes before making connections. Keep the drainage pipe free from deposits of snow, ice, mud, sand, gravel, or other foreign matter and in good working condition for the duration of the Work.

J. Remove and replace damaged sections of pipe.

K. Use straight pipe sections and elbows not exceeding 22.5°. Provide sufficient length between angled connections to allow for camera inspection equipment access.

L. Do not drop drain materials directly on pipe.

M. Support drain pipe circumferentially with drain material prior to backfilling above pipe.

N. Do not compact drain material directly over the drain pipe.

O. Prevent introduction of contaminants in drain materials.

3.2 FIELD INSPECTION AND TESTS

A. Do not bury, cover, or conceal piping until it has been inspected, tested and approved by the Engineer.

B. Deflection Test

1. The pipe shall evaluated to determine whether the internal diameter of the barrel has been reduced more than 5% of nominal internal diameter when measured not less than 30 days after installation. Deflection testing may be waived at the discretion of the Engineer if video inspection can demonstrate that deflection has not occurred.
2. Pipes shall be checked for deflection using a mandrel or any other device approved by the Engineer. The mandrel shall be a nine arm mandrel and shall be sized and inspected by the Engineer prior to testing. The mandrel shall be pulled through the pipe with a force not exceeding 1000 pounds.
3. For locations where the pipe exceeds 5% of nominal internal diameter an evaluation of the deflection shall be conducted by the Contractor and submitted to the Engineer for review. Pipe remediation or replacement is required for locations where the Engineer determines that the deflection may compromise the drain integrity. For pipe deflections greater than 7.5% of the nominal metric inside diameter, remediation or replacement of the pipe is required.

C. Video Inspection

1. Conduct video inspection in accordance with Section 02090: Pipe Cleaning and Video Inspection.
2. Conduct video inspection after a maximum of 3 to 5 feet of fill or concrete has been placed over the pipe, and again after all fill or concrete materials have been placed.

3.3 PROTECTION AND CLEANING

A. Do not allow traffic loads on pipe and structures until the pipe has been covered to a depth sufficient to prevent damage or breakage.

B. All drain pipes shall be clear and free from debris at the time of final acceptance.

END OF SECTION

SECTION 02820
FENCES AND GATES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Furnishing and installing chain link fence and gates for the spillway.

1.2 REFERENCES

A. American Society of Testing and Materials International (ASTM).

1.	ASTM A 121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
2.	ASTM A 123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3.	ASTM A 153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4.	ASTM A 392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
5.	ASTM A 824	Metallic Coated Steel Marcelled Tension Wire for Use with Chain Link Fence
6.	ASTM C 94	Standard Specification for Ready-Mixed Concrete
7.	ASTM F 567	Standard Practice for Installation of Chain Link Fence
8.	ASTM F 626	Standard Specification for Fence Fittings
9.	ASTM F 900	Standard Specification for Industrial and Commercial Swing Gates
10.	ASTM F 1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
11.	ASTM F 1083	Standard Specification for Pipe, Steel, Hot Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
12.	ASTM F 1553	Standard Guide for Specifying Chain Link Fence

B. Chain Link Fence Manufactures Institute (CLFMI)

1.	CLFMI CFR 2445	Product Manual

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Material Certification: Written certification that materials conform to the standards specified in Part 2 of this Specification Section.

C. Shop Drawings: Installation plan and drawings that illustrate the installation of the fence and gate shall be submitted to the Engineer at least 14 days prior to the anticipated commencement of the Work and shall include, but is not limited to the following:

1. Material and methods for constructing fencing.
2. Material, methods, and location for constructing gates.

3. Material and methods for installing posts, gate hardware, and fabric; attaching gate; installing tension wire and bracing.
4. Method for installing the fence posts.

1.4 QUALITY ASSURANCE AND QUALITY CONTROL

A. Standards of Manufacture: Standards of Manufacture for chain link fence and swing gates shall comply with the standards of the Chain Link Fence Manufacturer's Institute Product Manual and applicable referenced ASTM standards.

B. Provide chain link fabric, chain link fence, and chain link swing gates as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings, and fastenings.

C. Delivery, Storage, and Handling.

1. Handle and store chain link fence materials in accordance with manufacturing recommendations.
2. Remove immediately from the site any chain link fence material damaged during delivery, storage and handling.

PART 2 PRODUCTS

2.1 CHAIN LINK FENCE

A. Fabric

1. 9-gauge (diameter of coated wire = 0.148 inch) galvanized wire woven in 2-inch mesh; height, eight (8) feet. Metallic (Zinc) coating: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. applied after weaving.

B. Industrial Fence Framing

1. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:

a. Group: IA, round steel pipe, Schedule 40.
b. Fence Height: 8 feet.
c. Strength Requirement: Heavy industrial according to ASTM F 1043.
d. Post Diameter and Thickness: According to ASTM F 1043.

1) Line Post: 1.875 by 1.63 inches.
2) End, Corner and Pull Post: 2.875 inches
3) Swing Gate Post: According to ASTM F 900 2.375-inch diameter, 3.11-lb/ft. weight.

2. Metallic Coating: Type A, consisting of not less than minimum 2.0-oz./sq. ft. zinc coating per ASTM A 123 or 4.0-oz./sq. ft. zinc coating per ASTM A 653.

C. Tension Wire

1. Metallic-Coated Steel Wire: ASTM A 824, Type II, Marcelled No. 7 gage, 0.177 inch diameter.

2. Metallic Coating: Type II, zinc coated (galvanized) by hot-dip process. Minimum coating weight: Class 1, Not less than 0.8 oz./sq. ft. of uncoated wire surface.

D. Fittings

1. Post and Line Caps, Rail and Brace Ends, Braces and Bands: ASTM F 626, galvanized coated to match fabric.
2. Top Rail Sleeves, Tension Bars, and Truss Rods: ASTM F 626, galvanized coated to match fabric.
3. Ties or clips: ASTM F 626, 9-gage steel. Attach fabric to all line posts, top rail and tension wire per CLFMI 2445.
4. Barbed Wire Supporting Arms: Angled at 45 degrees with height sufficient to accommodate three strands of barbwire with clips or equal. Capable of with standing 250 lb load applied at the outer strand of barbwire.

E. Concrete

1. Furnish and place concrete with a minimum compressive strength of 4,000 psi @ 28 days in accordance with Section 03300: Cast in Place Concrete.

F. Non-shrink Grout

1. Furnish and place in accordance with section 03300: Cast-In-Place Concrete.

G. Chain Link Swing Gate

1. Gate frames: Fabricate chain link swing gates in accordance with ASTM F 900 using galvanized steel tubular members, 2-inch square, weighing 2.60 lb/ft. Fusion or stainless steel welded connections forming rigid one-piece unit.
2. Chain link fence fabric: Color, mesh, and gauge to match existing fence. Install fabric with hook bolts and tension bars at all 4 sides (no substitution). Attach to gate frame at not more than 15 inches on center.
3. Hardware materials: Hot dipped galvanized steel or malleable iron shapes to suit gate size. Field coat moveable parts (e.g. hinges, latch, keeper, and drop bar) to match adjacent finishes.
4. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 90° inward toward the reservoir.
5. Latch: Forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.
6. Keeper: Provide keeper for each gate leaf. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.
7. Double gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.
8. Gate posts: Steel pipe ASTM F 1083 standard weight schedule 40; minimum yield strength of 25,000 psi, 2.875-inch round, weighing 5.79 lb/ft. Hot-dipped galvanized with minimum 1.8 oz/ft^2 of zinc or respective material finished in accordance with ASTM F 1043.

H. Padlocks

1. Padlocks: For access gate. Heavy duty, industrial use equipment with 3 sets of keys. Match new locks and keys to existing site locks and keys, if required by Owner.

PART 3 EXECUTION

3.1 CHAIN LINK FENCE INSTALLATION

A. Install chain link fence and gates in accordance with ASTM F 567, this Section and drawing details.

B. Set posts plumb and in alignment.

C. For installation in soil or rock, thoroughly consolidate concrete around each post so as to be free of voids. Extend concrete 2 inches above grade and finish top to allow water to drain freely away from embedded posts. Allow concrete to cure for 72 hours prior to attachment of any item to the post.

D. For installation on concrete, core a hole to the diameter shown on the Drawings, place and consolidate non-shrink grout. Shape grout to allow water to drain freely away from embedded posts. Allow grout to cure for 48 hours prior to attachment of any item to the post.

E. Install horizontal (compression) braces and diagonal truss (tension) rods. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal.

F. Tension wires shall be installed along the bottom of the fence line and attached to the terminal posts of each stretch of the fence. Bottom tension wires shall be installed within the bottom six (6) inches of the installed fabric. Tension wire shall be pulled taut and shall be free of slack.

G. Chain link fabric shall be installed on the outside of the poles and top rails.

H. Fabric shall be pulled taut to provide a smooth uniform appearance free from slack.

I. Install chain link swing gate at the locations shown on the Drawings unless otherwise directed by the Owner. Install in accordance with manufacturer’s instructions. Mount hinges to swing gates as indicated.

J. Install all hardware including latches, stops, drop bars, and keepers in accordance with manufacturer’s instructions. Attach padlocks to gates or gate posts with welded chains or other approved method to prevent padlock removal.

END OF SECTION

SECTION 02850
FABRICATED STEEL BRIDGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Designing, furnishing, and installing one shop assembled modular weathering steel bridge for access across the spillway as shown on the Drawings.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A325 Specification for High Strength Bolts for Structural Steel Joints.
2. ASTM A 588 Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance A-588.
3. ASTM A 709 Standard Specification for Structural Steel for Bridges.

B. American Institute of Steel Construction

1. Handbook of Steel Drainage and Highway Construction Products.

C. AASHTO American Association of State Highway and Transportation Officials.

1. Standard Specifications for Highway Bridges, 17th Edition with current Interims..

D. American Welding Society (AWS):

1. AWS D1.5 Bridge Welding Code-Steel.

E. Steel Structures Painting Council

1. SP-6 Commercial Blast Cleaning.

1.3 BRIDGE DESIGN

A. Design modular bridge with a full bolt-together design that eliminates the need or requirement for field-welding on the bridge or its anchoring system. Field splices shall be fully bolted with ASTM A-325 Type 3 high strength bolts in accordance with the AISC Manual of Steel Construction. Each bridge module shall incorporate more than one main support beam to maximize safety and eliminate a “fracture critical” designation. No field welded structural connections will be permitted.

B. Verify span length, substructure clearance, and elevation of bearing supports required by the Bridge Manufacturer, and clearance between the ends of the bridge and the abutments.

C. Design bridge members in accordance with the AISC Manual of Steel Construction; Allowable Stress Design.

D. Welded Tubular Connection Design: In accordance with ANSI/AWS D1.1.

E. Load Ratings:

1. Dead load: Weight of bridge structure and grating deck.
2. Uniform Design Live Load: 65 pounds per square foot placed on the design span and over the full deck width for main structural members. 85 pounds per square foot placed on the tributary area for secondary structural members.
3. Concentrated Design Live Load: 1,000 pound load distributed over 2.5 feet by 2.5 feet at any point on the bridge deck.
4. Bridge Deck: Design for concentrated loads as specified herein and to carry the imposed deck loads at the stringer or floor beam spacing as determined by the bridge manufacturer. Consider reduced load capacity due to serrations in deck in design.
5. Deflection, Wind Load, And Wind Uplift: In accordance with AASHTO's Guide Specifications for Pedestrian Bridges.

F. Dimensions:

1. Approximate Average Length**:** 17-feet. The approximate length of the bridge does not include the clearance between the end of bridge and the structures at each end, as determined by the Bridge Manufacturer. Provide allowance for temperature expansion between the ends of the bridge and the supporting structures.
2. Width: 6-feet - 0-inches clear between side rails.

G. Expansion Joints: Provided by the bridge manufacturer and compatible with the superstructure.

1.4 SUBMITTALS

A. Submit in accordance with section 01330: Submittals

B. Shop Drawings:

1. Provide unique drawings, prepared to illustrate the specific portion of the work to be done.
2. Clearly specify all relative design information such as materials, member sizes, bridge reactions, and general notes on the drawings. Service load reactions exceeding the loads in the Drawings require approval by the Engineer.
3. Prepare accurate shop drawings by skilled draftsmen that are complete in every respect. Drawings shall have cross-referenced details and sheet numbers. All drawings shall be signed and sealed by a Professional Engineer responsible for the design of the bridge superstructure.
4. Provide calculations to demonstrate the bridge can support the design load. All calculations must be signed and sealed by a Professional Engineer responsible for the design of the bridge superstructure.
5. Provide details for the location and bolt-hole configuration for the bearing pads and guardrails supported on concrete.
6. The bridge manufacturer is responsible for bridge design and conformance with applicable standards for bridge design and fabrication
7. Shop Drawings will be reviewed by the Owner and Engineer to confirm dimensional conformance and site-specific application suitability.
8. Adjustments to the bridge dimensions/elevations shown on the Drawings specified herein may be necessary based on the proposed superstructure dimensions. Changes shall be submitted to the Engineer for approval.

C. Certifications:

1. AISC Certification.
2. Welder qualifications.
3. Certified Mill test results for all structural and bridge deck steel. Charpy V-notch impact test results for main steel members .

D. Installation and Rigging Plan:

1. Accompany delivered units with a installation and rigging plan that provides manufacturer's installation sequence, recommended handling, placement, fit-up, bolting, and securing to the abutment system.
2. The plan shall include a description of the installation of the bridge. The number and types of equipment to be used for the bridge installation shall be included in this plan.
3. The installation and rigging plan shall be laminated and suitable for review in a field environment.

E. Warranty

1. Manufacturer's Written Warranty.

1.5 QUALITY ASSURANCE

A. The materials and workmanship shall be in accordance with the best standard practices of modern bridge construction. All materials used in fabrication of the superstructure shall conform to the applicable specifications. Bridge fabrication must be conducted in an AISC (American Institute of Steel Construction) shop approved for Major Bridge fabrication.

B. The Bridge Manufacturer shall be a qualified fabricator who participates in the AISC Certification Program and is designated an AISC Certified Plant, Category Major Steel Bridge (CBR) at time of bid.

C. The Bridge Manufacturer shall provide a professional engineer with a minimum of five years of bridge design experience to perform all engineering related design. Calculations and details shall be checked by a qualified engineer.

D. The Bridge Manufacturer shall have at least five years of experience fabricating these types of structures and have at least five successful bridge projects, each of which has been in service for at least three years. The Bridge Manufacturer shall provide a list of the location, bridge size, Owner, and a contact for reference for each of the five projects.

E. All materials used in the fabrication of the superstructure, frame, deck, and guardrails shall be new and conform to the standards and quality for this type of fabrication and best engineering practices.

F. Acceptance of the structure will occur after it has been fabricated and delivered in accordance with the specifications contained herein, and after all required certifications have been furnished.

G. Welding - All welding shall be completed to D1.5 specifications by certified welders meeting requirements and qualifications tests of the American Welding Society. Welding

operators shall be certified for the 6G position in accordance with ANSI/AWS. D1.1. All welds shall conform to specifications of the American Welding Society.

1.6 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. The bridge manufacturer shall provide notice of delivery 14 days prior to the anticipated delivery date. The manufacturer shall provide 7 days notice to the firm delivery date. The bridge shall not be delivered on a weekend or holiday.

B. Design and supply each bridge module with a minimum of 4 or more integral lifting lugs to facilitate safe handling and placement of the bridge module.

C. The Contractor is responsible for unloading the bridge and gate from the truck at the time of arrival. The bridge supplier/manufacturer shall be a representative at the site during placing of the bridge on the abutments to assure that damage to the bridge does not occur during handling.

D. Lift and support units only at designated lifting and supporting points.

1.7 WARRANTY

A. The Manufacturer shall warrant its structure and appurtenances to be free of design, material and workmanship defects for a period of ten years from the date of delivery. The warranty shall not apply to wood attachments or to defects in the bridge caused by abuse, misuse, overloading, accident, improper maintenance, alteration or any other cause not the result of defective materials or workmanship. Repair or replacement is the exclusive remedy for defects under this warranty. The Manufacturer shall not be liable for any consequential or incidental damages for breach of any express or implied warranty on its structure.

PART 2 PRODUCTS

A. General:

1. Domestic (USA) manufacture with full material traceability provided upon customer request.
2. Unpainted self-weathering bridges fabricated from high-strength, self-weathering, low alloy, atmospheric corrosion resistant ASTM A847 cold-formed welded square and rectangular tubing and ASTM A588 or ASTM A242 plate and structural steel shapes (Fy minimum yield stress = 50,000 psi).
3. Field splices shall be fully bolted with ASTM A-325 Type 3 high strength bolts in accordance with the AISC Manual of Steel Construction. No field welded structural connections will be permitted.
4. All exposed surfaces of self-weathering steel shall be cleaned in accordance with Steel Structures Painting Council Surface Preparation Specifications No. 6, Commercial Blast Cleaning, SSPC-SP 7 – Latest Edition prior to shipment to assure uniform weathering.

B. Deck and Rails

1. Bridge Deck: Serrated Weathering Steel Grating. Grated decking with serrated bearing bars, comprised of ASTM A588 weathering steel. Designed for concentrated loads as specified herein and designed to carry the imposed deck

loads at the stringer or floor beam spacing as determined by the bridge manufacturer. Reduced load capacity due to serrations in deck shall be considered in design.

2. Horizontal Safety Rails: Life safety rails 54 inches high with maximum clear openings of 4-inches. Steel rolled sections, ASTM A588, welded to structure.
3. Rub Rail: Ipe or equal.

C. System Hardware:

1. Manufacturer's recommended bearing plates, electrometric bearing pads, and all assembly and anchor bolts.

PART 3 EXECUTION

3.1 ERECTION

A. Follow manufacturers written instructions for the proper lifting procedure for unloading and erecting the bridges. Care must be taken to prevent damage to the finish of the bridge.

B. The unloading of the bridges is the responsibility of the Contractor. The bridge supplier/manufacturer shall have a licensed representative at the site to supervise placement of the bridges on the abutments.

C. No bolting, drilling or welding of final structure will be permitted without prior approval of the Manufacturer.

D. Erection of bridge structures shall not proceed until substructure concrete has reached 100% of the design strength in accordance with Section 03300: Cast-in-Place Concrete.

END OF SECTION

SECTION 02920
RECLAMATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reclaiming and restoring areas disturbed by construction within the limits of disturbance as shown on Drawings. Reclamation work includes preparing subsoil, placing topsoil, applying soil amendments, seeding, mulching, and maintaining vegetation establishment through the warranty period.

B. Areas to be seeded and reclaimed:

1. Areas disturbed during construction unless otherwise specified to not require seeding.

C. Areas that do not require seeding and reclamation:

1. Access roads.
2. Concrete structures.
3. Riprap areas.
4. Exposed rock areas as approved by the Engineer.

1.2 REFERENCES AND DEFINITIONS

A. Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction, 2005 (CDOT Specifications).

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Seeding and planting plan containing:

1. Qualifying experience for person(s) responsible for supervision of seeding, hydraulic mulching, and seedling planting, for approval. Qualifying experience shall include names, addresses, and telephone numbers of references for proposed individual(s).
2. Proposed seeding and hydraulic mulch installation procedures.
3. Name and address of seed suppliers.

C. Seed Mixture Certification:

1. Origin of seed.
2. Percent purity and germination.
3. Prohibited and restricted weed seed content.
4. Species of cover crop.

D. Hydro mulch product data.

1.4 QUALITY ASSURANCE AND QUALITY CONTROL

A. Seed which has become wet, moldy or damaged in transit or in storage will not be accepted. No seed will be accepted with a test date of more than 9 months before delivery date to the site.

B. Soil amendments which become caked or damaged will not be accepted.

C. Seeded areas shall be reviewed by the Engineer for bare soils caused by surface or wind erosion. Bare areas caused by surface or gully erosion, blown away mulch, etc. shall be regraded, seeded, and have hydro mulch tackifier applied as necessary.

D. The seeding and planting contractor shall have experience seeding and planting in the Colorado high country on at least 5 projects of similar size and scope.

1.5 DELIVERY STORAGE AND HANDLING

A. Seed containers.

1. Sealed: Each type of seed shall be delivered in separate sealed containers and fully tagged unless exception is granted in writing by the Engineer.
2. Labeled: Seed shall be labeled in accordance with the state laws and the U.S. Department of Agriculture rules and regulations under the Federal Seed Act in effect on the date of invitations for bids. Bag tag figures are evidence of purity and germination.
3. Interstate Shipping: In accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act.

PART 2 PRODUCTS

2.1 TOPSOIL

A. Topsoil shall conform to the product described in Section 02235: Stripping and Stockpiling Topsoil and this Section.

B. Native soil materials removed and stockpiled shall consist of soil material free of subsoil, refuse, stumps, large roots, large rocks (greater than 6 inches), brush, noxious weed seeds or reproductive vegetative parts, heavy clay, hard clods, toxic substances, or other material which would be detrimental to plant growth.

2.2 SEED

A. Provide the following live seed mixture to be used in disturbed areas as indicated in the Drawings:

Scientific Name	Common Name	Variety	Lbs. PLS per acre
Bromus marginatus	Mountain brome	Garnet	9.0
Festuca saximontana	Rocky Mountain fescue	VNS	7.3
Poa ampla	Big bluegrass	VNS	3.9
Poa alpina	Alpine bluegrass	Sherman	2.1
Festuca brachyphylla	Alpine fescue	VNS	1.5
Elymus trachycaulus	Slender wheatgrass	San Luis	6.0
Penstemon strictus	Rocky Mountain penstemon	VNS	0.8
Achillea lanulosa	Common yarrow	VNS	0.8
Helianthella quinquenervis	Aspen sunflower	VNS	3.0
Eriogonum sp.	Sulfur flower	E. *subalpinum* or high altitude variety of *E. umbellatum*	4.5
Bouteloua gracilis	Blue grama	VNS	6.0
		Total	44.9

Lbs. = pounds
PLS = Pure Live Seed
VNS = Variety Not Specified

B. Rates provided are for broadcast seeding. Minimum germination percentage is 85 percent. Substitutions will be allowed only when the designated material is not available and as authorized by the Engineer. Except for named varieties, all seed shall be from sources native to Colorado and adapted to the site.

C. All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net mass (weight), origin, the percent of weed seed content, the guaranteed percentage of purity and germination, pounds of pure live seed (PLS) of each seed species, and total pounds of PLS in the container. All seed shall be free from noxious weeds, including but not limited to Canadian thistle, musk thistle, dalmation toadflax, knapweed, leafy spurge, and other species listed by the Colorado Department of Agriculture and Conejos County. The Contractor shall furnish to the Engineer a signed stated certifying that the seed is from a lot that has been tested by a recognized laboratory for seed testing within six months prior to the date of seeding. Seed which has become wet, moldy, or damaged in transit or in storage will not be accepted.

D. Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis. If seed

available on the market does not meet the minimum purity and germination percentages specified, the Contractor must compensate for a lesser percentage of purity or germination by furnishing sufficient additional seed to equal the specified product. Product comparison shall be made on the basis of PLS in pounds.

2.3 AMMENDMENTS

A. The soil amendment used shall be Biosol® 6-1-1 or other compost type amendment as approved by the Engineer. Soil amendments shall meet the standard for grade and quality specified by Colorado State law. Where soil amendments are furnished from bulk storage, the contractor shall furnish a supplier's certification of analysis and weight. If required by the Engineer, a representative sample of the soil amendments shall be furnished to the Engineer for chemical analysis.

2.4 EXTENDED TERM-FLEXIBLE GROWTH MEDIUM

A. Hydraulically applied mulch product with incorporated adhesive binder (tackifier), that does not contain any mineral filler, recycled cellulose fibers, clays, or other substances which may inhibit germination or growth of plants, and be non-toxic and non-injurious to plants, wildlife, or personnel.

B. Product: Flexterra Extended Term-Flexible Growth Medium (ET-FGM) with Cocoflex addition, fully bio-degradable with a functional longevity of up to 24 months.

C. ET-FGM shall consist of wood and coconut fibers and manufacturer’s proprietary biodegradable fibers bound together by adhesive and premixed at the factory. The wood fibers shall be manufactured expressly from clean whole wood chips and contain a range of fiber lengths. The adhesive binder shall be formulated to form a water resistant bond. The fibers shall be colored yellow or green with a water-soluble, non-toxic dye to help the operator apply the material uniformly. The mixture shall also contain a copolymer gel. A sample of the ET-FGM shall be submitted for approval at least two weeks in advance of its use on the project.

D. Mix Water: Clean, fresh and free of substances which could inhibit vigorous growth of plant material.

PART 3 EXECUTION

3.1 GENERAL

A. Reclaim and restore areas disturbed by construction activities within the limits of disturbance as shown on Drawings or determined by the Engineer.

3.2 EXAMINATION

A. Verify that prepared soil base is ready to receive the Work of this Section.

3.3 TOPSOIL PLACEMENT

A. In preparation for seeding, spread stripped and stockpiled topsoil evenly over areas to be reclaimed.

B. Final grade disturbed areas with a smooth blade grader, bull dozer, or other approved equipment, to the lines and grades shown on the Drawings or specified, or as directed by the Engineer.

C. In areas where equipment cannot be operated, the seedbed shall be prepared by hand.

D. If the topsoil is compacted, a spring tooth harrow equipped with utility or seedbed teeth, or similar equipment, will be used to loosen and smooth the soil surface either after or in conjunction with incorporation of soil amendments.

E. If topsoil is loose, it shall be compacted with a cultipacker or similar implement to provide a firm seedbed.

F. Before seeding slopes flatter than 2H:1V, the top 4 inches of the surface shall be tilled into an even and loose seedbed 4 inches deep. Before seeding slopes steeper than 2H:1V, the top 1 inch of surface shall be raked or tilled. Slopes shall be free of clods greater than 4 inches in diameter.

3.4 SEEDBED PREPARATION

A. Complete prior to seeding.

B. Scarify topsoil to minimum depth of 3-inches. Where equipment can operate on slopes safely, the seedbed shall be adequately loosened (4 to 6 inches deep) and smoothed.

C. Remove stiff clods, lumps, roots, litter, stones, and other foreign material greater than 6 inches in size from the surface. Dispose of removed materials in accordance with Section 01575: Disposal of Waste Materials.

D. Fill or smooth topsoil surface to remove rills, gullies and depressions.

E. Unless otherwise approved, apply soil amendment (Biosol or other soil amendment as specified by the Engineer) at a rate of 1,800 pounds per acres.

F. Protect prepared topsoil surfaces from erosion and washouts. Repair damaged surfaces as required.

3.5 SEEDING

A. Seed only from September 15 until consistent ground freeze or snow accumulation to avoid seed germination and breaking of dormancy and to prevent seedling frost damage. Seed shall not be sown when the surface soil or topsoil is in a frozen or crusted state. Do not seed outside this time period unless approved by the Engineer or when the Contractor's request is approved in writing.

B. If seeding cannot be conducted by the time it is no longer feasible due to freezing, erosion control shall be maintained until seeding and mulching is completed.

C. Seed will be hand broadcast only. Hydroseeding is not allowed. A spike-toothed harrow or similar equipment will be used to cover the broadcast seed. Seeded areas shall be raked or covered with soil to a depth of ¼ to ½ inch.

D. Seeded areas shall be raked or covered with soil to a depth of ¼ to ½ inch.

3.6 EXTENDED TERM-FLEXIBLE GROWTH MEDIUM

A. Apply ET-FGM over all seeded areas after broadcast seeding is completed. Do not mix seed into ET-FGM.

B. A technical representative of the manufacturer or authorized distributor shall be present for the initial mixing and application of the ET-FGM. Handle, mix and place ET-FGM in accordance with the manufacturer's written instructions and technical representative's sit-specific recommendations.

C. Do not apply when rain is imminent and manufacturer's minimum cure time cannot be met. Replace damaged ET-FGM.

D. Apply ET-FGM mixture at the manufacturer's recommended rate of application for site-specific conditions and slopes, but at a rate no less than 2,600 lbs/acre

E. Apply mixture in even layers, working back and forth between top and bottom of the slope, to uniformly cover soil with the mixture. Spray the product through a fan or slit-type nozzle (22 to 50 degree tip). The nozzle shall create a fine, uniformly dispersed spray that "rains down" on the soil. Unless otherwise approved, apply tackified mulch in opposing directions to ensure complete coverage with no "shadowing" in accordance with the manufacturers written instructions.

F. Do not apply tackified mulch in ditches or other areas of concentrated flow.

3.7 MAINTENANCE

A. Maintain the reclaimed areas for a period of 2 years after completion of seeding and planting.

B. Maintenance shall consist of repairing areas where damage is due to the Contractor's operations, failure to establish a satisfactory stand of permanent grass seed as specified herein, or failure of ET-FGM mulch to prevent gullying or other seed and seedbed loss. Areas to be repaired shall be re-amended, reseeded, and remulched.

C. After Final Completion, access to the site will be allowed each year for inspections and maintenance. Coordinate all access for maintenance activities with Owner.

D. Reseed areas that show bare spots by the end of October of the year following the seeding.

E. Any seeded areas which are not producing a satisfactory stand of permanent grass seed within 2 years of the seeding operations shall be reseeded and remulched at no expense to the Owner.

F. Satisfactory Stand of Seed: A satisfactory stand of permanent grass seed is defined as a uniform coverage of the area to be seeded that prevents the formation of rills or other erosion damage, has a coverage rate equal to or greater than adjacent native grassed areas, and is acceptable to the Owner.

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in place concrete with shoring, bracing, and anchorage, openings for other work, form accessories, and form stripping.

1.2 REFERENCES AND DEFINITIONS

A. American Concrete Institute (ACI)

1.	ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials.
2.	ACI 301	Specifications for Structural Concrete for Buildings
3.	ACI 318	Building Code Requirements for Structural Concrete
4.	ACI 347	Guide to Formwork for Concrete.
5.	ACI SP-4	Formwork for Concrete

B. American Plywood Association

1.	APA PS-1	Construction and Industrial Plywood.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01330: Submittals.

B. Shop Drawings:

1. Drawings and design computations for all formwork shall be submitted to the Engineer for approval at least 30 days prior to the commencement of the Work.
2. Include type, size, quantity, and strength of all form materials, plan for jointing of facing panels, details affecting the appearance, and assumed design values and loading conditions.

C. Product Data:

1. Manufacturer's literature for form materials, form accessories, prefabricated forms, and form coating materials shall be submitted to the Engineer for approval at least 30 days prior to the commencement of the work.

1.4 QUALITY ASSURANCE AND QUALITY CONTROL

A. Include Work required in Contractor Quality Control plan submitted under Section 01450: Quality Control.

B. Perform Work in accordance with ACI 301, ACI 318 and ACI 347. Tolerance shall be as necessary to provide completed concrete structure within the tolerance specified in ACI 117.

C. Supply all labor, tools, equipment and materials to set forms so that resultant concrete conforms to required shapes, lines, and dimensions of the design, as well as the necessary code requirements. It is the Contractor's responsibility to design and build adequate forms and to leave them in-place until the forms can be safely removed. The Contractor is responsible for damage and injury caused by removing forms carelessly or before the concrete has gained sufficient strength.

D. Inspect erected formwork, shoring, and bracing to ensure that Work is in accordance with formwork design and that supports, fastenings, wedges, ties, and items are secure.

E. Monitor forms during concrete placement and correct deficiencies.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Plywood: Concrete form plywood, exterior grade, mill-oiled and edge-sealed as specified herein and in accordance with APA PS-1. High-density overlaid, or provided with an equivalent smooth form liner as the minimum form material for surfaces indicated to receive smooth form finish or any rubbed finish.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surface.

C. Lumber: Fir species; No. 2 grade or better; with grade stamp clearly visible.

D. Steel: Minimum 16 gauge sheet, well matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished surfaces.

2.2 FORMWORK ACCESSORIES

A. Form Ties: Removable snap-off type, galvanized metal, ¾-inch break back dimension, fixed length, cone type, neoprene rubber washer for water seal, free of defects that could leave holes larger than 1-1/4 inch in concrete surface.

B. Form Release Agent: Standard manufactured product specifically formulated for form release. Colorless material that will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete. Provide NSF 61 certified product where in contact with potable water.

C. Corners: Chamfered, rigid plastic or wood strip, 3/4 x 3/4 inch size, maximum practical lengths.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Joint Filler: A dense, closed-cell, foam rubber approved by the Engineer.

PART 3 EXECUTION

3.1 GENERAL

A. Construct formwork for cast-in place concrete with shoring, bracing, and anchorage. The formwork shall include the openings for other work, form accessories, and form stripping.

3.2 INSPECTION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with the Drawings.

3.3 EARTH FORMS

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

B. Do not use rock cuts for forms except where specifically indicated on the Drawings or approved by the Engineer in writing.

C. When rock form is indicated or allowed, the rock face shall be sound.

3.4 DESIGN

A. Design, engineering, and construction of formwork shall be the responsibility of the Contractor.

B. Design, support, brace, and maintain formwork to safely support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Vertical and lateral loads shall be carried to the ground by the formwork system until the in-place concrete has attained adequate strength.

C. Designs and drawings are required to be stamped by a registered Professional Engineer.

D. Design formwork for anticipated live and dead loads.

E. Comply with tolerances specified in Section 03300: Cast-In-Place Concrete

F. Design as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others.

G. Monitor adequacy of formwork design and construction prior to and during concrete placement.

3.5 ERECTION - FORMWORK

A. Erect formwork, shoring, and bracing to achieve design requirements in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shoring.

D. Align joints and make watertight to prevent leakage of mortar. Keep form joints to a minimum.

E. Provide chamfer strips on all external corners, unless indicated otherwise.

3.6 APPLICATION - FORM RELEASE AGENT

A. Clean form surfaces of encrustations of mortar, grout, or other foreign material.

B. Apply form release agent on formwork in accordance with manufacturer's recommendations.

C. Apply prior to placement of reinforcing steel, anchoring devices and embedded items.

D. After form release agent is applied to form, the concrete shall be placed within 14 calendar days. If concrete is not placed within 14 calendar days, the forms shall be removed and form release agent reapplied.

E. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes which may be affected by the agent such as crystal forming waterproofing. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.7 INSERTS, EMBEDDED PARTS AND OPENINGS

A. Provide formed openings where required for items to be embedded in or pass through concrete work.

B. Locate and set in place items which will be cast directly into concrete.

C. Coordinate Work of other Sections in forming and placing openings, sleeves, bolts, anchors and other inserts.

D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Secure all embedded items before placing concrete. Ensure that items are not disturbed during concrete placement. Fill voids with readily removable material to prevent entry of concrete.

E. Provide blockouts for mechanical and electrical Work wherever necessary, and as shown on the Drawings.

F. Install waterstops continuously without displacing reinforcement. Heat seal joints watertight per manufacturer’s instructions.

G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

H. Close temporary openings with tight fitting panels, flush with inside face of forms and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.8 FORM CLEANING

A. Clean and remove foreign matter within forms as erection proceeds.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heat enclosure. Use compressed air or other means to remove foreign matter.

3.9 FORM REMOVAL

A. Notify the Engineer prior to removal of forms.

B. Remove forms in a manner, which will not damage concrete.

C. Do not wedge pry bars, hammers or tools against finish concrete surfaces scheduled for exposure to view.

D. Forms for walls, columns, and sides of beams and girders may be removed no less than the following number of days after concrete placement provided that the forms do not support formwork for slab or beam soffits:

1. Lifts under 15 feet: 1 day
2. Lifts over 15 feet: 2 days

E. It shall be the Contractor's responsibility to limit construction loads at all times to those which can be carried safely by the developed strength of the structure at time of loading, and by formwork and shoring in-place at time of loading.

F. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION

SECTION 03150
CONCRETE JOINTS AND WATERSTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Forming construction, expansion, contraction, and control joints in concrete structures, the tooling or chamfering exposed edges of concrete, and furnishing and installing PVC waterstop materials in joints.

1.2 REFERENCES

A. American Society of Testing and Materials International (ASTM)

1.	ASTM D 638	Standard Test Method for Tensile Properties of Plastic
2.	ASTM D 746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
3.	ASTM D 747	Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
4.	ASTM D 1203	Standard Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods
5.	ASTM D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
6.	ASTM D 1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. U.S. Army Corps of Engineers (USACOE)

1.	EM 1110-2-2102	Water Stops and Other Preformed Joint Materials for Civil Works Structures
2.	COE CRD-C-572	Polyvinylchloride Waterstop

C. American Concrete Institute (ACI)

1.	ACI 224.3R	Joints in Concrete Construction.
2.	ACI 318-05	Building Code Requirements for Structural Concrete

D. International Concrete Repair Institute (ICRI)

1.	ICRI 0372	Selecting and Specifying Concreter Surface Preparation for Sealing, Coatings, and Polymer Overlays

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.
B. Approval Samples of Waterstops:

1. 2-foot long sample of each size and type of waterstop to be used in work.

C. Certifications of Waterstops:

1. Manufacturer's certification for PVC compound used to fabricate PVC waterstop. Include physical property test data on compound from tests performed by manufacturer or other laboratory within 18 months before submittal.
2. Sampling certification that samples are representative of waterstop to be used in work.

D. Instructions for Waterstops:

1. Manufacturer's recommendations for installing and splicing waterstop.

E. Material Approval Data for Joint Filler:

1. Name and manufacturer of joint filler. The Engineer reserves the right to require submission of manufacturer's test data and certification of compliance with specifications.

1.4 CONTRACTOR QUALITY CONTROL

A. Perform concrete work in accordance with ACI 318 and ACI 224.

1.5 DEFINITIONS (Note: The following language regarding concrete joints takes precedence over the language in the referenced American Concrete Institute Document entitled "Joints in Concrete Construction.")

A. Construction Joints (CJ):

1. Construction joints are joints which are purposely placed in concrete to facilitate construction; to reduce initial shrinkage stresses and cracks; to allow time for the installation of embedded metalwork; or to allow for subsequent placing of other concrete.
2. Bond is required at construction joints regardless of whether or not reinforcement is continuous across the joint.

B. Contraction Joints (CRJ):

1. Contraction joints are joints placed in concrete to provide for volumetric shrinkage of a monolithic unit or movement between monolithic units.
2. Contraction joints are constructed so no bond exists between concrete surfaces forming the joint
3. Except as provided for dowels, reinforcement is never continuous across a contraction joint.

C. Control Joints (CTJ):

1. Control joints are joints placed in concrete to provide for control of initial shrinkage stresses and cracks of monolithic units.
2. Control joints are constructed the same as contraction joints, with the exception that reinforcement is continuous across control joints.

D. Expansion Joints (EJ):

1. Expansion joints are joints provided to allow for expansion and contraction between two adjacent concrete members.
2. Joints are filled with sponge rubber joint filler.

E. Tooled Edges: Tool permanently exposed edges of slabs to a radius of ¼ inch.

PART 2 PRODUCTS

2.1 SPONGE RUBBER JOINT FILLER

A. ASTM D1752, Type I, except as specified.

B. Test Specimen Compression Load: 50 to 1500 lb/in^2.

C. Joint filler adhesive: Non-bituminous adhesive recommended by filler manufacturer.

D. Premolded sponge rubber fully compressible with recovery rate of minimum 95 percent.

2.2 PVC WATERSTOPS

A. Polyvinyl Chloride (PVC) Waterstop:

1. Provide flexible PVC (polyvinyl chloride) waterstop as shown on the Drawings, as manufactured by Greenstreak, Va. 3400 Tree Court Industrial Boulevard, St. Louis, MO 63122, telephone (800) 352-9504, or equal in the following styles.

a. Style 705 (6-inch ribbed with centerbulb).

B. PVC Compound:

1. Domestic virgin PVC with additional resins, plasticizers, stabilizers, or other materials required to meet specified requirements.
2. Do not use reclaimed PVC or manufacturer's scrap.

C. Meet physical characteristic requirements specified in Table 03150-1, PVC Waterstop Physical Characteristics.

Table 03150-1
PVC Waterstop Physical Characteristics

Property	Test Method	Requirement
Tensile test, minimum	ASTM D 638, speed D, specimen type IV	2,000 lbs/in^2
Ultimate elongation, minimum	ASTM D 638, speed D, specimen type IV	300 percent
Stiffness in flexure, minimum	ASTM D 747	600 lbs/in^2
Low temperature brittleness at –35 degrees F	ASTM D 746	No cracking or chipping
Volatile loss, change in weight, maximum	ASTM D 1203, method A, 0.08-inch thick specimen	0.50 percent
Tensile strength after accelerated extraction test, percent of tensile strength before extraction test, minimum	COE CRD-C-572	80 percent
Ultimate elongation after accelerated extraction test, percent of ultimate elongation before extraction test, minimum	COE CRD-C-572	80 percent
Change in weight after effect of alkalies test	COE CRD-C-572	+0.25 percent -0.10 percent
Change in Shore durometer hardness after effect of alkalies test	COE CRD-C-572	+/- 5

D. Prepare test specimens in accordance with COE CRD-C-572.

E. Ties for PVC Waterstop: “Hog Rings” or grommets for each edge at 12-inches maximum spacing.

PART 3 EXECUTION

3.1 INSTALLING PVC WATERSTOPS

A. Before starting installation of waterstops, furnish the Engineer with the manufacturer’s recommendations for installing and making splices in the waterstops.

B. Install waterstops at locations shown on the Drawings.

C. Install waterstops in accordance with these Specifications and manufacturer’s recommendations.

D. Install waterstops so as to form a continuous watertight diaphragm in the joint unless otherwise shown on the Drawings. Vertical waterstops shall extend to 6-inches below the top of walls or floors, unless otherwise shown.

E. Concrete surrounding waterstops shall be given additional vibration, over and above that used for adjacent concrete placement, to ensure complete embedment of waterstops in the concrete.

F. All waterstops shall be installed with approximately one-half of the width of the waterstop embedded in the concrete on each side of the joint.

G. To eliminate faulty installation that may result in joint leakage, particular care shall be taken so that waterstops are correctly positioned and secured during installation.

H. Adequate provision shall be made to completely protect waterstops during progress of the Work.

I. Provide pre-molded waterstop of maximum practicable length to minimize the number of joints.

J. Use only factory made waterstop fabrications for intersections, changes of direction, and transitions.

K. Fabricate splices of waterstops with workers who have demonstrated to the satisfaction of the Engineer that they are sufficiently skilled to fabricate the required splices.

L. Remove curing compound and other foreign material from waterstops in all joints before placing concrete.

3.2 SPLICING PVC WATERSTOP

A. Splice waterstops at joints in waterstop sections and at intersections of waterstops.

B. Fabricate splices of waterstops with workers who have demonstrated to the satisfaction of the Engineer that they are sufficiently skilled to fabricate the required splices.

C. Only straight butt splices using heat welding are permitted for field splicing of waterstops unless specifically detailed otherwise. Lapping of waterstop, use of adhesives, or solvents is not allowed.

D. Reform waterstops at splices with a remolding iron with ribs to match the pattern of the waterstop.

E. Allow minimum of 10 minutes before new splice is pulled or strained in any way.

F. After allowing joint to cool, bend completed joints at a sharp angle to test. Cut out and reweld joints that separate under this test.

G. Finished splices: Provide cross-section dense and free of porosity with tensile strength of not less than 80% of unspliced materials.

3.3 CONCRETE JOINTS

A. Construction Joints:

1. Locate construction joints where shown on Drawings or approved by the Engineer in writing. Show proposed locations of construction joints on the placement Drawings submitted under Section 03300: Cast-In-Place Concrete.

Relocation, addition, or elimination of construction joints is subject to approval by the Engineer.

2. Locate horizontal joints in walls at the tops of footings or grade slabs. Place haunches at the same time as slabs.
3. Prepare construction joint surfaces for bonding by sandblasting, steel shot blasting, or high-pressure water jetting (6,000 psi minimum), or other method approved by the Engineer to thoroughly clean the surface. Remove all laitance, loose or defective concrete, coatings, sand, curing compound, and other foreign material to expose coarse aggregate uniformly, free of laitance, loose aggregate, or damaged concrete. Roughen concrete to produce minimum roughness profile of 1/4 inch. Surface preparation shall be conducted in a manner sufficient to keep from undercutting the edges of the larger particles of aggregate
4. Thoroughly moisten surfaces of construction joints to be covered with fresh concrete to surface saturated dry condition and remove standing water leaving the surface damp just before concrete placement.
5. Existing Spillway Surface Preparation Test Section:

    a. Construct a test section for existing spillway construction joint surface preparation at least one week before production surface preparation using the same equipment and procedures proposed for production surface preparation. Prepare a minimum test section of 200 square feet. The Engineer will inspect the surface and inform the Contractor if the results are acceptable, or require procedures to be modified to achieve the desired surface preparation. Be prepared to modify equipment and procedures and prepare additional test sections until the Engineer accepts the surface.

B. Contraction Joints:

1. Construct contraction joints so that there shall be no bond between the concrete surfaces forming the joint.
2. Waterstop shall be installed in control joints where shown on the Drawings.
3. The joints shall be made by forming the concrete on one side of the joint and allowing it to set before concrete is placed on the other side of the joint. Coat the surface of the concrete first placed at the contraction joint with curing compound, or other approved bond breaker, before the concrete on the other side of the joint is placed. Protect reinforcement and waterstop from application of curing compound so that reinforcement and waterstop does not become coated with curing compound. The curing compound shall conform to the requirements of Section 03300: Cast-In-Place Concrete.

C. Control joints:

1. Construct control joints using the same procedures as contraction joints. Coat the surface of the concrete first placed at the contraction joint with curing compound, or other approved bond breaker, before the concrete on the other side of the joint is placed. Protect reinforcement and waterstop from application of curing compound so that reinforcement and waterstop does not become coated with curing compound. The curing compound shall be as specified in Section 03300: Cast-In-Place Concrete.
2. Waterstop shall be installed in control joints where shown on the Drawings.

3. The language in these specifications regarding control joints takes precedence over the language in the referenced American Concrete Institute Document entitled “Joints in Concrete Construction”.

D. Expansion Joints:

1. Expansion joints are joints provided to allow for expansion and contraction between two adjacent concrete members.
2. Structural reinforcement shall not be continuous across any expansion joint.
3. Expansion joint filler shall be installed between adjacent concrete members where an expansion joint is required in accordance with manufacturer's instructions.
4. The expansion joints shall be constructed by forming the concrete on one side of the joint and allowing it to set before concrete is placed on the other side of the joint. The surface of the concrete first placed at the joint shall be coated with curing compound before the joint filler is installed and the concrete on the other side of the joint is placed. The curing compound shall conform to the requirements of Section 03300: Cast-In-Place Concrete.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel bars and accessories for cast-in-place concrete, and epoxy dowels.

1.2 REFERENCES

A. American Society of Testing and Materials International (ASTM)

1.	ASTM A 615	Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.

B. American Concrete Institute (ACI)

1.	ACI 301	Standard Specifications for Structural Concrete for Buildings.
2.	ACI 315	Details and Detailing of Concrete Reinforcement.
3.	ACI 318	Building Code Requirements for Structural Concrete.

C. Concrete Reinforcing Steel Institute (CRSI)

1.	CRSI	Manual of Standard Practice.
2.	CRSI 63	Recommended Practice for Placing Reinforcing Bars.
3.	CRSI 65	Recommended Practice for Placing Bar Supports, Specifications, and Nomenclature.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Reinforcement Placement Drawings:

1. Indicate bar sizes; spacings; locations and quantities of reinforcing steel; bending and cutting schedules; and supporting and spacing devices.
2. Show locations of splices. Proposed reinforcing splices not indicated on the Drawings will require written approval by the Engineer.

C. Mill Test Reports:

1. Submit certified copies of mill test reports of reinforcement material analyses.

D. Smooth dowel coating.

E. Epoxy adhesive manufacturers installation instruction for epoxy dowels.

1.4 QUALITY ASSURANCE AND QUALITY CONTROL

A. Perform concrete reinforced work in accordance with the CRSI Manual of Standard Practice and Document 63 and 65.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid rusting.

B. Protect from contaminants such as grease, oil, and dirt.

C. Provide identification after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel and Foundation Anchors: ASTM A 615; billet steel deformed bars; uncoated finish; Grade 60.

B. Smooth Steel Dowels

1. Dowels: ASTM A615, Grade 60 round smooth steel bars, size as shown on the Drawings.
2. Bond Breaking Compound: Use a bond-breaking compound approved by the Engineer.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions, in accordance with CRSI Manual of Standard Practice. Use of concrete block, rocks, or other items for reinforcement support will not be allowed.

C. Dowel Epoxy Adhesive: Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System (HIT HY-150), or approved equal.

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with ACI 315.

B. Reinforcing splices have been located on the Drawings. Additional splices must be reviewed and approved in writing by the Engineer.

C. Welding reinforcing bars is not permitted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Before placing concrete, clean reinforcement of loose rust, loose mill scale, dirt, grease, and other substances, which would impair bond with concrete. Remove rust by vigorous rubbing with burlap cloth or wire brushing.

B. Accommodate formed openings.

C. Place, support, and secure reinforcement against displacement. Do not deviate from required position.

D. Place reinforcement in accordance with the Drawings, the Contractor's reinforcing steel placement submittals and CRSI 65.

E. See Drawings for structural notes, and for reinforcement cover requirements.

F. Splice reinforcing bars by lapping and securely wiring together. Splices at locations other than those indicated are subject to written approval by the Engineer and shall conform, to the requirements of ACI 318. Do not use mechanical splices. Do not weld or tack weld reinforcing bars.

G. Place and secure embedded metalwork and conduit so as to not interfere with reinforcement installation.

H. Field bending of reinforcement is not allowed unless approved by the Engineer in writing.

I. Place reinforcement with clear distance of 1-inch, minimum, between reinforcement and anchor bolts, form ties, or other embedded metalwork unless otherwise shown on Drawings.

J. Tolerances:

1. Maintain concrete cover over reinforcement within 1/2 inch of specified cover where specified cover is greater than 2-1/2 inches.
2. Maintain concrete cover over reinforcement within 1/4 inch of specified cover where specified cover is 2-1/2 inches or less.
3. Maintain spacing of reinforcing bars within 1 inch of required spacing.

3.2 EPOXY DOWEL INSTALLATION

A. Install epoxy dowels only where shown on the Drawings or otherwise approved by the Engineer.

B. Install epoxy dowels in strict accordance with the manufacturers written instructions, including hole drilling and hole size, hole cleaning and preparation, epoxy injection, dowel placement, and cure times.

3.3 INSPECTION

A. Notify the Engineer at least 24-hours in advance of a requested concrete reinforcement inspection. Provide sufficient time in the schedule for the Engineer to inspect the reinforcing steel prior to placement of concrete. Concrete placed without inspection and approval by the Engineer may be subject to rejection and removal at no additional cost to the Owner.

B. The Engineer’s inspection of steel reinforcing prior to concrete placement will not relieve the Contractor from responsibility to conform to the Drawings and Specifications.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cast-in-place structural concrete for spillway construction, toe drain manhole slabs, and other miscellaneous cast-in-place concrete structures shown on the Drawings.

1.2 REFERENCES AND DEFINITIONS

A. American Concrete Institute (ACI)

1.	ACI 117	Standard Tolerances for Concrete Construction and Materials (ACI 117) and Commentary (ACI 117R-06)
2.	ACI 301	Specification for Structural Concrete.
3.	ACI 302.1R	Guide for Concrete Floor and Slab Construction.
4.	ACI 304.2R	Placing Concrete by Pumping Methods.
5.	ACI 305R	Hot Weather Concreting.
6.	ACI 306.1	Standard Specification for Cold Weather Concreting.
7.	ACI 306R	Cold Weather Concreting.
8.	ACI 308.1	Standard Specification for Curing Concrete.
9.	ACI 308R	Guide to Curing Concrete.
10.	ACI 309R	Guide for Consolidation of Concrete
11.	ACI 309.2R	Identification and Control of Consolidation-Related Surface Defects in Formed Concrete.
12.	ACI 318	Building Code Requirements for Structural Concrete.

B. American Society for Testing and Materials International (ASTM)

1.	ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
2.	ASTM C 33	Standard Specifications for Concrete Aggregates.
3.	ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
4.	ASTM C 42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5.	ASTM C 94	Standard Specifications for Ready-Mixed Concrete
6.	ASTM C 114	Standard Test Methods for Chemical Analysis of Hydraulic Cements
7.	ASTM C 138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
8.	ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
9.	ASTM C 150	Standard Specifications for Portland Cement.
10.	ASTM C 171	Standard Specification for Sheet Materials for Curing Concrete.
11.	ASTM C 231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

12. ASTM C 260 Standard Specification for Air Entraining Admixtures for Concrete.
13. ASTM C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
14. ASTM C 441 Standard Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
15. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete.
16. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
17. ASTM C 1017 Standard Specification for Chemical for Use in Producing Flowing Concrete
18. ASTM C 1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
19. ASTM C 1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

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

1. AASHTO M182 Burlap Cloth Made from Jute or Kenaf.

D. American National Standards Institute (ANSI)

1. ANSI/NSF 61 Drinking Water System Components–Health Effects

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Material Approval Data

1. Mix Design: For each concrete mix design submit proposed mix designs in accordance with ACI 301 for review and approval.
2. Name and manufacturer of each cementitious material, aggregate source, admixture, and curing compound.

a. The Engineer reserves the right to require submission of manufacturer's test data and certification of compliance with specification.
b. The Engineer reserves the right to require submission of samples of concrete materials for testing before or during use in concrete.

3. Cementitious materials certifications and test reports:

a. Manufacturer's certification and test reports for each lot from which shipments are drawn.

1) Certify materials were tested during production or transfer in accordance with specified reference specification.
2) Submittal of certification and test reports shall not relieve Contractor of responsibility for furnishing materials meeting specified requirement.

C. Concrete Placement Drawings:

1. Drawings for each individual concrete placement. An individual concrete placement is defined as a portion of concrete Work placed in one continuous operation between specified lines or joints.
2. Show locations, dimensions, blockouts, openings, recesses, waterstops, and finishes. Identify construction joints, control joints, contraction joints and expansion joints.
3. Show details of items embedded in or associated with placement except reinforcing steel.
4. Include a separate drawing showing placement sequence.
5. Place a title block with Contractor's name, contract title and number, placement identification, and identifying drawing number in lower right hand corner of each drawing.
6. List reference drawings from which details shown on placement drawing were obtained on each drawing.
7. Reference related steel reinforcement drawings associated with placement on each drawing.

D. Concrete Placement Schedule:

1. Complete, detailed concrete placement schedule showing the Contractor's plan for placement of individual features, units, and other elements of concrete work.
2. Detail as necessary to show location, sequence, and date of concrete placements scheduled for each item of concrete work.
3. Show submittal of detail drawings and placement of reinforcement and embedded items.

1.4 QUALITY ASSURANCE AND QUALITY CONTROL

A. Include quality control required for Section 03100: Concrete Formwork in Contractor Quality Control Plan.

B. Include provisions for hot or cold weather concrete in Contractor Quality Control plan.

C. Perform Work in accordance with provisions of all applicable ACI standards.

D. Obtain materials from same source throughout the Work.

E. Project Record Documents

1. Accurately record as-built concrete dimensions and tolerances and locations of embedded utilities and components on placement drawings.

F. Sequencing and Scheduling

1. Notify the Engineer at least 48 hours prior to commencing concrete Work.
2. Allow the Engineer to perform an immediate inspection of concrete surfaces upon removal of forms.
3. Notify the Engineer upon discovery of any honeycombing, foreign-embedded items, and/or defective concrete.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C 150 Portland Cement, Type II;

1. Meet equivalent alkalies requirements of ASTM C 150 – Table 2.
2. Meet false-set requirement of ASTM C 150 – Table 4.

B. Pozzolan: ASTM C 618, Class F, Except,

1. Sulfur trioxide, maximum: 4.0 percent.
2. Loss on ignition, maximum: 2.5 percent.
3. Test for effectiveness in controlling alkali-silica reaction under optional physical requirements in Table 2 of ASTM C 618. Use low-alkali cement for test.
4. Does not decrease sulfate resistance of concrete by use of pozzolan.
5. Demonstrate pozzolan will have an "R" factor less than 2.5.

    a. R = (C-5)/F
    b. C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C 114.
    c. F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C 114.

6. Pozzolan when tested in accordance with ASTM C 441, shall conform to the following: 65 percent minimum reduction in mortar expansion at 14 days, and 0.02 percent maximum mortar expansion at 14 days. Expansion shall be less than control sample expansion.
7. Pozzolan content shall be 20 percent plus or minus 5 percent by weight of the total cementitious materials.
8. Pozzolan and cement shall be stored and batched separately.

C. Aggregates:

1. Fine aggregate: ASTM C 33.
2. Coarse aggregate ASTM C 33, Size No. 67
3. Fine and coarse aggregate shall not be of a carbonate-based rock. Coarse and fine aggregates shall not contain any materials that are deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of mortar or concrete. The amount of coal and lignite in the fine aggregate shall be less than 0.5 percent.

D. Water: Water for concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or reinforcement in accordance with ASTM C 1602, including optional requirements of Table 2.

2.2 ADMIXTURES

A. Air Entraining Admixture:

1. ASTM C 260.

2. Use a neutralized vinsol resin formulation for air-entraining admixture used with ASTM C 494, Type F or G; and ASTM C 1017, Type I or II chemical admixtures.

B. Other Admixtures: Use only when approved and at no additional cost to the Owner. Conform to ASTM C 494:

1. Accelerators: Approval does not relax cold-weather placement requirements. Calcium chloride is prohibited.
2. Set-retarders or stabilizers: Approval does not relax hot-weather placement requirements.
3. Water reducers: Type A, D, E, F or G, to achieve workability without exceeding specified water/cement ratio and slump.
4. Mineral admixtures to be used or furnished under this Specification shall be certified to comply with this Specification by the supplier. Certification shall include test results on Specifications, source, and location.

2.3 FIBER REINFORCEMENT

A. If shown or specified, fiber reinforcement shall conform to ASTM. C 1116 Type III (Synthetic Fiber).

B. Synthetic fibers shall be commercially available polypropylene fibers or chemically inert equivalent. Fiber content in concrete shall be between 0.1 and 0.2 percent by volume to produce a mix designed to control plastic shrinkage.

2.4 CURING MATERIALS

A. Water: ASTM C 1602, including optional requirements of Table 2.

B. Curing Compound: ASTM C 309

C. Polyethylene Film: ASTM C171.

2.5 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C 94.

B. Select proportions for normal weight concrete in accordance with ACI 301 and ACI 318.

C. Provide structural concrete to the following criteria:

1. Compressive Strength (28 days): 4000 psi concrete for all structures.
2. Acceptance Criteria:

a. In accordance with ASTM C 94, plus the following

1) 90 Percent of test cylinders exceed specified compressive strength at 28 days.
2) Compressive strength may also be in accordance with ASTM C 42 for concrete cores.
3) Concrete in an area represented by core tests will be considered structurally adequate when average compressive strength of

three cores is equal to at least 3,400 lb/in^2 and no single core has a compressive strength of less than 3,000 lb/in^2.

3. Slump: In accordance with ASTM C 143 - 3 inches ±1 inch at point of placement. For concrete with ASTM C 1017, Type I or II chemical admixtures, use slump appropriate for placing conditions, with a maximum slump of 8 inches. Test slump prior to addition of ASTM C 107, Type I or II chemical admixtures to assure that slump prior to admixture addition meets the 3 inches ±1 inch requirement.
4. Entrained Air: 4% to 7% at point of placement in accordance with ASTM C 231.
5. Maximum water/cementitious material ratio: 0.45.

D. Use accelerating admixtures in cold weather only when approved by the Engineer in writing. Use of admixtures will not relax cold weather placement requirements.

E. Use of calcium chloride is not permitted.

F. Use set retarding admixtures during hot weather only when approved by the Engineer.

G. Use set-controlling admixtures to increase allowable concrete delivery and placement restrictions in accordance with applicable provisions of this Section only when approved by the Engineer.

H. Add other approved admixtures (water reducer/superplasticizer, etc.) in accordance with the manufacturer's recommendations.

I. If a superplasticizer is used, the admixture shall be added to the concrete trucks at the site and the following requirements shall be followed:

1. The manufacturer's recommendations for dosage, mixing, and use.
2. A calibrated field dispenser shall be used. Records of dosage for each concrete truck shall be recorded by the Contractor and provided to the Engineer.
3. Each truck shall be mixed after dosing with the minimum number of drum rotations in accordance with the requirements of ACI and the admixture manufacturer.
4. Field concrete tests (air content, temperature, and slump) shall be performed on each truck before and after adding the admixture.

J. Concrete mix shall meet all specified requirements. Failure to meeting any one specified requirement shall be sufficient cause for rejection.

2.6 BACKFILL CONCRETE

A. Backfill concrete shall be an unreinforced concrete complying with the requirements of Concrete Mix in paragraph 2.5 in this section with the following exceptions:

1. Compressive Strength (28 days): 3000 psi
2. Entrained Air: 0 to 10 %.
3. Maximum water/cementitious material ratio: 0.45.

B. Backfill Concrete is used for leveling foundations and filling defects and voids under the reinforced spillway concrete in accordance with Section 02310: Rock Foundation Preparation.

2.7 CONCRETE TEMPERATURE

A. Concrete temperature at point of placement: 50 to 90 degrees F.

2.8 CONCRETE CONSOLIDATION EQUIPMENT

A. Consolidation equipment shall be flexible, electric or pneumatic-drive immersion-type vibrators with an operating speed of 7000 rpm when immersed in concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joint locations conform to the approved placement drawings.

B. Verify requirements for concrete cover over reinforcement.

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

D. Verify appropriate mix design for designated placement.

E. Engineer inspection and approval of foundations is required prior to any concrete being placed. Verify with the Engineer that all surfaces on which concrete is to be placed has been inspected and is adequate for concrete placement.

3.2 PREPARATION

A. Remove standing water, ice, mud, and debris from foundation surfaces to be covered by concrete.

B. Prepare rock surfaces free from oil, objectionable coatings, and loose, semi-detached, and unsound fragments. Immediately before placement of concrete, wash rock surfaces with an air-water jet and dry to a uniform surface-dry condition.

C. Prepare earth foundations free from frost or ice.

D. Thoroughly moisten surfaces of absorptive foundations to be covered with concrete so that moisture will not be drawn from fresh concrete.

E. Remove hardened concrete, wood chips, ice, and other debris from the interior of forms.

F. Place form release agent or wet forms just prior to placing concrete. Form release agent or any other deleterious material is not acceptable on concrete surfaces.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 304, ACI 309 and ACI 318.

B. Notify the Engineer a minimum of 48 hours prior to commencement of operations. The Engineer shall inspect all surfaces on which concrete is to be placed.

C. No concrete shall be placed until all formwork, installation of items to be embedded, and preparation of surfaces involved in the placement have been approved. Formwork and foundation surfaces on which cast-in-place concrete is placed shall be moistened and kept moist until overlying concrete is placed.

D. Place concrete in as nearly a continuous operation as practical and in a manner to produce a concrete mass with sufficient continuity and continuance so that it shall harden and act as a monolithic mass with no discontinuous joints or potential places of separation or weakness.

E. Concrete shall be placed in near horizontal layers; the depth of each layer shall not exceed 20 inches. Place mixture on prepared foundation or previously completed concrete materials with spreading equipment that prevents segregation and that produces layers of widths and thicknesses as necessary for compaction to the required dimensions. Place each successive layer as soon as practicable after the preceding layer is completed.

F. Ensure reinforcement, inserts, embedded parts, and waterstops are not disturbed during concrete placement.

G. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

H. Deposit concrete as close as practicable to its final position. Concrete shall be placed by methods that do not cause segregation. Do not drop concrete more than 3 feet.

I. Do not re-temper concrete.

1. Provide sufficient concrete placing capacity and equipment to deliver and place concrete without undue delay; do not permit cold joints to occur. Discharge concrete into forms within 90 minutes following the first introduction of water and cement or cement and aggregates, whichever occurs first. If the air temperature is 85° F or higher, the time limit specified above shall be reduced to 60 minutes unless the Engineer's approval has been obtained for means to maintain acceptable concrete quality without such time reduction. The Engineer may approve longer placement times provided no water is added after the specified time period above, and the approved concrete mix contains a water reducing and retarding admixture.

J. Cast-in-place concrete shall not be placed during heavy rain (more than 0.3 inch per hour or 0.03 inch in 6 minutes as defined by the Weather Bureau Glossary of Meteorology). If unusual adverse weather such as heavy rain, severe cold, heavy snow, high wind, or other adverse weather occurs, or is forecast to occur during placement, an interruption in placing operations may be approved or directed. All placed concrete materials shall be fully compacted before stopping Work. Allow for construction schedule risk and added expense that could occur as a result of adverse weather. Weather delays shall not be cause to receive no additional compensation. Conform to ACI 306R for additional cold weather placement requirements.

K. Consolidate concrete in accordance with ACI 309. Do not place vibrator against reinforcing or forms or use vibrator to transport concrete within forms. Have one extra vibrator and one extra generator on site at all times during placement of concrete to be used in the event of breakdown of primary equipment.

L. Do not use concrete which has been subjected to more than 250 total revolutions of any combination of mixing and agitating equipment following the first introduction of aggregates to the mixer.

M. Contractor may place concrete by pumping, at Contractor's option. Appropriate mix design provisions must be included in Contractor's approved concrete submittal before any concrete is placed by pumping methods. Concrete placement by pumping methods shall be performed in accordance with applicable provisions of ACI 304.2R.

N. Maintain concrete cover around reinforcement as indicated on the Drawings and in accordance with ACI 318.

O. Place concrete continuously between predetermined construction, contraction, control and expansion joints. Do not break or interrupt successive pours such that cold joints occur.

P. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the Engineer upon discovery of honeycombs or embedded debris.

Q. Wait at least 3 days between adjacent placements of sections of structures with control joints, including abutment and spillway training walls.

3.4 CONCRETE FINISHING

A. Finish all exposed concrete as follows:

1. All exterior slab surfaces shall be sloped a minimum of 1/8 inch in 1 foot or as indicated on the drawings. All exterior slab surfaces shall have a troweled finish as defined in ACI 301.
2. All smooth, exposed, exterior vertical surfaces shall have a smooth form finish.
3. Edges:

    a. Chamfer edges of permanently exposed concrete, except slabs, with a 45 degree bevel ¾ inch by ¾ inch unless otherwise shown on the drawings.
    b. Tool exposed edges of slabs and top edges of walls to a radius of ¼ inch unless shown otherwise on the drawings.

B. All other exposed concrete surfaces on the project shall be as follows:

1. Formed surfaces shall be smooth form surfaces as defined in ACI 301.
2. All unformed surfaces shall have a floated finish as defined in ACI 301.

C. Broomed Finish: Provide where determined by the Engineer, or as indicated on the Drawings.

1. First provide a monolithic finish as specified above, except immediately after steel troweling brush surface with a stiff bristle brush.
2. Brush in parallel strokes at right angles to the normal flow of traffic.

D. Tolerances for Concrete Construction:

1. Tolerances are defined as allowable variations from specified lines and grades, and dimensions and as the allowable magnitude of the surface irregularities. Allowable variations from specified lines, grades, and dimension shall be in accordance with ACI 301 and ACI 117. Additionally:

   a. Abrupt irregularities shall be measured within 1 in. of the irregularity.
   b. Gradual surface irregularities shall be measured by determining the gap between concrete and near surface of a 5 ft straightedge, measured between contact points.
   c. Abrupt irregularities and gradual surface irregularities shall be no more than +1/8 in if concrete is exposed to view.
   d. Abrupt irregularities and gradual surface irregularities shall be no more than +1/4 in if concrete is to be backfilled.

3.5 CURING AND PROTECTION

A. Cure fresh unformed concrete surfaces immediately, and formed surfaces following the removal of forms, for a minimum of 7 days, and as described in ACI 308.1 using one of the following methods as approved by the Engineer:

1. Using an approved clear membrane compound.
2. Other methods specified in ACI 308.1 submitted and approved by the Engineer.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

3.6 FIELD QUALITY CONTROL

A. Furnish a batch ticket (delivery ticket) with each load of concrete. Concrete delivered without a batch ticket containing complete information as specified shall be rejected. Collect and complete the batch ticket at the placement site and deliver all batch tickets to the Engineer on a daily basis. The Engineer shall have access to the batch tickets at any time during the placement. The following information shall be provided on each batch ticket:

1. Supplier’s name and date
2. Truck number
3. Project number and location
4. Concrete class designation and item number
5. Cubic yards batched
6. Time batched
7. Mix design number
8. Type, brand, and amount of each admixture
9. Type, brand, and amount of cement and pozzolan
10. Mass (weights) of fine and coarse aggregates
11. Moisture of fine and coarse aggregate
12. Gallons of batch water (including ice)

B. Add the following information to the batch ticket at the placement site:

1. Gallons of water added by truck operator plus quantity of concrete in the truck each time water is added
2. Number of revolutions of drum at mixing speed (for truck mixed concrete)
3. Discharge time
4. Location of batch in placement
5. Water cement ratio

C. The Contractor will be allowed to add water to the batched concrete once at the site, based upon concrete supplier approval and direction and provided that the specified water to cement ratio is not exceeded and the amount of water withheld at the batch plant is on the delivery ticket.

D. Maintain records of placed concrete items. Record truck number, date, start and stop times, location of placed concrete, quantity, air temperature, concrete placement temperature, slump, air content, admixture quantities, test samples collected and times, and cast test cylinder numbers.

E. Perform Work in accordance with ACI 301.

F. Maintain one copy of each document on site.

G. Acquire cement from same source for all Work.

H. Acquire aggregate from same source for all Work.

I. Conform to ACI 305R when concreting during hot weather.

J. Conform to ACI 306R when concreting during cold weather.

K. Concrete to be placed directly on earth or bedrock will not be placed without written approval by the Engineer that the earth or bedrock foundation has been prepared suitably for concrete placement.

L. Perform quality assurance inspection and testing using the contractors approved independent testing firm. Provide access and samples as required by the Engineer.

M. The Contractor's independent testing agency shall prepare 5 concrete test cylinders for each 50 or less cubic yards or at least once each day of concrete placement.

1. Test cylinders shall be made in accordance with ASTM C 31 and tested in accordance with ASTM C 39.
2. Note on Record Drawings placement location represented by cylinders.
3. Test 2 cylinders from each set at 7 days, and 2 from each set at 28 days. Maintain the last cylinder from each set for testing in the event the 28-day tests fall below the required strength.

N. One additional test cylinder will be taken during cold weather concreting and cured on jobsite under the same conditions as the concrete it represents.

O. One slump test will be taken for each truck and for each set of test cylinders taken. Slump of concrete shall be determined at point of discharge from the mixer in accordance with ASTM C 143.

P. Air content (ASTM C 231), Unit Weight (ASTM C 138), and temperature (ASTM C 1064) shall be taken for each set of test cylinders taken.

3.7 PATCHING

A. Allow the Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Honeycombing or embedded debris in concrete is not acceptable. Notify the Engineer upon discovery, and repair as determined by the Engineer.

C. Patch imperfections if approved by the Engineer in accordance with Section 03930: Concrete Repair.

3.8 DEFECTIVE CONCRETE

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

B. Defective concrete will be determined by the Engineer and repaired or replaced at no additional cost to the Owner. Repair shall be made in accordance with Section 03930: Concrete Repair.

C. Repair of Hardened Concrete Not Within Specified Tolerances: Hardened concrete that is not within specified tolerances shall be repaired to bring it within those tolerances. Such repair shall be accomplished in a manner approved by the Engineer. Concrete repair to bring concrete within tolerances shall be done only after consultation with the Engineer regarding the repair method. The Engineer shall be notified as to the time when repair shall be performed.

D. Concrete that shall be exposed to public view shall be repaired in a manner that shall result in a concrete surface with a uniform appearance. Grinding of concrete surfaces exposed to view shall be limited in depth such that no aggregate particles are exposed more than 1/6 inch in cross section at the finished surface. Where grinding has caused or shall cause exposure of aggregate particles greater than 1/6 inch in cross section at the finished surface, concrete shall be repaired by excavating and replacing the concrete at no additional cost to the Owner.

E. Prevention of Repeated Failure to Meet Tolerances: When concrete placements result in hardened concrete that does not meet specified tolerances, the Contractor shall, upon request, submit to the Engineer an outline of all preventative actions, such as modifications to forms, modified procedure for setting screeds, and different finishing techniques, to be implemented by the Contractor to avoid repeated failures. The Engineer reserves the right to delay concrete placements until the Contractor implements such preventative actions that are approved by the Engineer.

F. Modify or replace concrete not conforming to required levels and lines, details, and elevations.

G. Repair or replace concrete not properly placed or not of the specified type.

3.9 PROTECTION

A. Protect finished Work under provisions of ACI 301.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical damage in accordance with the applicable provisions of ACI.

C. Unless otherwise approved by the Engineer, protect curing concrete from freeze thaw cycles until concrete has attained a compressive strength of 3500 psi. Control rate of temperature drop per day in accordance with ACI 306.1 and 306R and as required to prevent temperature cracking. Contractor shall provide high-low digital temperature thermometers, infrared temperature gun, and any other instrumentation required to show concrete temperatures are acceptable.

D. Maintain concrete with minimal moisture loss at relatively constant temperature for the period necessary for hydration of cement and hardening of concrete.

E. Removal of formwork shall conform to requirements of Section 03100: Concrete Formwork.

END OF SECTION

SECTION 03930
CONCRETE REPAIR

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes general provisions for preparing concrete surfaces and furnishing and placing concrete repair materials in damaged areas of new concrete when approved by the Engineer.

B. Report all damage to the Engineer promptly upon discovery.

C. Damage to newly-placed concrete is the Contractor's responsibility and shall be repaired or replaced as directed by the Engineer at no additional cost to the Owner.

D. Since repair types in most cases cannot be accurately determined in advance, the Engineer will assess damaged concrete and prescribe the method of repair and materials to be used. The Engineer's written approval is required before starting any concrete repairs.

1.2 REFERENCES

A. American Concrete Institute (ACI)

1.	ACI 546R	Concrete Repair Guide.

B. American Society for Testing and Materials International (ASTM)

1.	ASTM C31	Practice for making and curing concrete test specimens in the field.
2.	ASTM C33	Specifications for Concrete Aggregates.
3.	ASTM C150	Specification for Portland Cement.

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

1.	AASHTO M182	Burlap Cloth Made from Jute or Kenaf.

D. U.S. Army Corps of Engineers (USACE)

1.	EM 1110-2-2002	Evaluation and Repair of Concrete Structures, U.S. Army Corps of Engineers, 30 June 1993.

E. U.S. Department of the Interior, Bureau of Reclamation (Reclamation)

1.	Reclamation-97	Guide to Concrete Repair, 1997
2.	M-47	Standard Specifications for Repair of Concrete, Reclamation, 1996.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Product Data.

1. Indicate product standards, physical and chemical characteristics, technical specifications, limitations, placement instructions, maintenance instructions, and general recommendations regarding repair materials.
2. Manufacturers certificates for products supplied or proposed.

C. Equipment Data

1. Submit data for equipment to be used for saw cutting, removing, and cleaning concrete.

D. Schedule and Plan of Repairs

1. Submit the proposed schedule and method of repairs. Include a description of the proposed equipment for mixing and applying concrete and other repair materials, the proposed mix design including all admixtures, the procedure for preparing the concrete surface prior to repair, and the method of repair.

E. Repair Record Documents

1. Accurately record locations of repairs, modifications, and type of repair.

1.4 QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor quality assurance and quality control shall be in accordance with the requirements of Section 01450: Quality Control.

B. Mockup

1. Provide sample placement of each type of typical patch. The location of the sample shall be as directed by the Engineer.
2. Prepare sample of each type of patching procedure.
3. Sample of mockup may remain as part of the Work if satisfactory repair is attained, as directed by the Engineer.

C. Delivery, Storage, and Handling

1. Deliver, store, protect and handle products to prevent damage to the products, and provide safety to the workers.
2. Comply with instructions for storage, shelf life limitations, and handling as specified by manufacturers.

PART 2 PRODUCTS

2.1 GENERAL

A. Repair materials shall be as selected by the Engineer for a particular repair and may include some or all of the products and materials listed below.

2.2 REPAIR MATERIALS

A. Manufactured Materials: Suitable for the particular repair and site conditions as determined by the Engineer.

B. Portland Cement: As specified in Section 03300: Cast-in-Place Concrete.

C. Water: As specified in Section 03300: Cast-in-Place Concrete, for all types of repairs.

D. Aggregates: Conforming to ASTM C33.

E. Dry Pack Grout:

1. Two parts Type II cement, ASTM C-33 fine aggregate, and clean water, or
2. Pre-packaged standard ASTM C1107, non-metallic, non-shrink grout.

F. Crack Repair: Submit proposed materials and instructions for Sikadur or equal system designed for concrete crack repair.

2.3 ACCESSORY MATERIALS

A. Curing Materials.

1. Liquid membrane-forming type: ASTM C309, Type 1, Class A or B.
2. Curing paper, polyethylene film, or polyethylene-coated burlap complying with ASTM C171.
3. Absorptive burlap cloth made from Jute or Kenat, approximately 9 ounces per square yard, complying with AASHTO M182, Class 3 or 4.
4. Tarpaulins: FS K-P-146.

PART 3 EXECUTION

3.1 GENERAL

A. The Engineer will delineate the type of repair to be used and the extents of repair areas.

B. Prepare concrete surfaces and apply repair materials in accordance with this Section or manufacturers instructions, whichever is stricter as determined by the Engineer.

3.2 PREPARATION

A. Removal

1. Minimum depth of removal and repair is 1-inch.
2. Remove damaged, deteriorated, loosened, or unbonded portions of existing concrete by water blasting, bush hammering, jack hammering, chipping hammer, or other Engineer-approved equipment or methods that avoid or minimize micro-fracturing or other damage concrete outside the defined area of repair. Remove damaged concrete to sound concrete surface.
3. Concrete removal processes involving the use of jack hammers in excess of 30 pounds, dry sandblasting, or scrabblers shall not be used without approval by the Engineer.
4. Repair micro-fractured surfaces using contained shotblasting, wet sandblasting, or water blasting to remove any micro-fractured surfaces resulting from the initial removal process.

B. Cleaning

1. Clean repair surface after removal of concrete with pressure washer (3000 psi minimum) to remove loose particles and dirt. Remove any contamination,

including oil, solvent, dirt accumulation, or foreign material by additional wet sandblasting and air-water jet cleanup.

2. Unless otherwise recommended by the repair material manufacturer, prepare the surfaces to receive repair materials as a construction joint in accordance with Section 03150: Concrete Joints and PVC Waterstops.
3. After the concrete has been prepared and cleaned, keep the surface in a clean, condition until the repair has been completed.

C. Saw Cut Edges

1. Unless otherwise directed by the Engineer, saw cut perimeters of repair areas perpendicular to the concrete surface to a minimum depth of 1-inch. Feather-edge repairs to concrete will not be permitted. Core drill corners to prevent over-cutting.

D. Reinforcing Steel

1. Remove all loose scale, rust, corrosion by products, or concrete from exposed reinforcing steel. Reinforcing steel exposed for more than one-third of its perimeter circumference shall be completely exposed to provide 1-inch minimum clearance between the steel and the repair materials. Remove extensively damaged or deteriorated reinforcing steel and replaced with adhesive dowels as directed by the Engineer.

3.3 PLACING, FINISHING, AND CURING

A. Place repair materials to the full depth of repair and such that the repaired surface matches the original structure dimensions.

B. Prepare surfaces to receive repair materials by wetting to a surface saturated dry condition and remove standing water.

C. Finish and cure repair materials in accordance with the manufacturers instructions and as determined by the Engineer.

3.4 CRACK REPAIR

A. Place materials in accordance with the manufacturer’s written instructions and as directed by the Engineer.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installing metal fabrications as shown on the Drawings and as specified herein.

1.2 REFERENCES

A. American Institute of Steel Construction (AISC), Code of Standard Practice for Steel Buildings and Bridges.

B. American Society for Testing and Materials (ASTM) Standards

1.	ASTM A 36	Standard Specification for Carbon Structural Steel.
2.	ASTM A 53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
3.	ASTM A 123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4.	ASTM A 167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
5.	ASTM A 240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
6.	ASTM A 276	Standard Specification for Stainless Steel Bars and Shapes.
7.	ASTM A 307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
8.	ASTM A 500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
9.	ASTM A 563	Standard Specification for Carbons and Alloy Steel Nuts.
10.	ASTM F 436	Standard Specification for Hardened Steel Washers.
11.	ASTM F 593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
12.	ASTM F 594	Standard Specification for Stainless Steel Nuts.

C. American National Standards Institute (ANSI).

1.	ANSI Z49.1	Safety in Welding and Cutting.

D. American Welding Society (AWS).

1.	AWS B2.1	Welding Procedure and Performance Qualification.
2.	AWS D1.1	Structural Welding Code.

E. National Association of Architectural Metal Manufacturers (NAAMM)

1. Metal Bar Grating Manual.

F. Occupational Safety and Health/ American Nation Standards Institute (OSHA/ANSI)

1. OSHA/ANSI 3124 Stairways and Ladders

G. International Code Council (ICC)

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Shop Drawings and product data for all fabricated or manufactured items.

1. Indicate materials, profiles, sizes, connection attachments, reinforcing, anchorage, hardware, size and type of fasteners and accessories.
2. Include assembly drawings, sections, elevations and details where applicable.
3. Indicate welded connections using standard AWS welding symbols; indicate net weld lengths and proposed field welds.
4. Submit proposed location of all field welds. Approval required from Engineer for all field welds.

C. Design: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. For each paint system, furnish a Paint System Data Sheet (PSDS), the manufacturer's Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system.

E. Welder certifications of qualification showing date of qualification; qualification grade and rating; and notarized signature of inspector.

F. Before delivery of materials, provide:

1. Certified laboratory test reports of materials.
2. Paint inspection records where applicable.
3. Manufacturer’s installation instructions for manufactured items.
4. Anchors: Manufacturer’s data sheets, handling and installation instructions; and ICC reports.

1.4 QUALITY ASSURANCE

A. Qualifications for Welding Work:

1. Performed by welders and welding procedures certified to requirements of AWS D1.1 or D1.2 as applicable.
2. When welder or welding procedures certification tests are required, testing shall be performed by independent testing agency accepted by Engineer.

B. Field measurements: Take field measurements prior to fabrication to ensure proper fitting of the work. Allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the work.

1.5 JOB CONDITIONS, STORAGE AND HANDLING

A. Store materials in a dry area off the ground and floor. Do not leave materials exposed to the weather.

B. Protect existing construction at all times from potential damage caused by construction operations, including delivery of materials, construction traffic, and installation. Patch, repair and refinish damage to the satisfaction of the Engineer.

PART 2 PRODUCTS

2.1 GENERAL

A. Verify critical dimensions at the jobsite before product fabrication begins. Field fabrication will not be permitted.

2.2 MATERIALS

A. Structural Steel

1. Pipe or Pipe Sleeves: ASTM A53, Schedule 40, black or galvanized.
2. Plates, Shapes and Bars: Carbon steel, ASTM A36.
3. Tubing: ASTM A500, Grade B; ASTM A501, Grade B.

B. Stainless Steel

1. Type: AISI Type 304, unless otherwise indicated.
2. Finish: Mill finish unless otherwise specified.
3. Bar Stock: ASTM A276.
4. Plate: ASTM A167 or A240.
5. Sheet: ASTM A167.
6. Pipe: ASTM A312.

2.3 FASTENERS, ANCHORS, AND STUDS

A. Steel Fasteners:

1. Bolts: ASTM A307, Grade A, galvanized.
2. Nuts: ASTM A563, galvanized.
3. Washers: ASTM F436, galvanized.

B. Stainless Steel Fasteners

1. Bolts: ASTM F593.
2. Nuts: ASTM F594.
3. Washers: ASTM F594.

C. Welding stud anchors: AWS D1.1, Section 4, Part F. Size and type as shown on the Drawings.

D. Stainless Steel Epoxy/Adhesive Anchors:

1. Anchor Rod and Fasteners:

a. Stainless steel threaded rod ASTM 593.

b. Diameter as shown on the Drawings unless otherwise specified.
c. Length as required to provide minimum depth of embedment shown.
d. ASTM F593/594 Nuts and Washers.
e. Clean and free of grease, oil, or other deleterious material.

2. Adhesive:

a. Provide adhesive that conforms to ASTM C 881.
b. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
c. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.
d. Nonsag, with selected viscosity based on installation temperature and overhead application where applicable.

3. Packaging:

a. Disposable, self-contained cartridge system capable of dispensing both components in the proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.

4. Cartridge Markings: Include manufacturer's name, product name, material type, batch or serial number, and adhesive expiration date.
5. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System (HIT HY-150) or approved equal.

E. Antiseizing Lubricant: Use on all stainless steel threads. Containing substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper. Loc Tite Co., Permatex.

F. All parts shall be hot-dip galvanized after fabrication in accordance with ASTM A123.

2.4 LOCKING CLEANOUT CAP

A. Fabricated from structural steel pipe and plate, diameter and dimensions as shown on the Drawings, equipped with a hinged locking cap suitable for a padlock.

B. Coating as specified herein.

2.5 FABRICATION

A. Fabricate items with joints tightly fitted and secured.

B. Fit and shop assemble in largest practical sections for delivery to site.

C. Remove burrs from all exposed cut edges, remove spatter and grind exposed welds to match adjacent surface.

D. Supply all components required for anchoring metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, except where specifically noted otherwise.

E. Weld connections

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

2.6 COATINGS

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153 for steel and iron hardware and with ASTM A 123 for other steel and iron products.

B. Painting: Locking Cleanout Cap: (confirm color with Owner)

1.	Surface preparation:	SSPC-SP-3
2.	Service	Severe Exposure
3.	First Coat: Alkyd Metal Primer	1.5 to 2.5 mils DFT
4.	Second Coat: Alkyd Semi- Gloss Enamel	1.5 - 2.5 mils DFT
5.	Third Coat: Alkyd Semi- Gloss Enamel	1.5 - 2.5 mils DFT
6.	Total DFT	4.5 – 7.5 Mils

PART 3 EXECUTION

3.1 GENERAL PREPARATION

A. Examine surfaces for defects which would impair installation.

B. Obtain Engineer’s approval before site cutting, field welding, or making nonscheduled adjustments.

C. Clean steel items to bare metal where site welding is scheduled.

D. Provide for erection loads with temporary bracing; keep Work in alignment.

E. Supply setting templates for items required to be cast into concrete.

3.2 GENERAL INSTALLATION

A. Provide anchor bolts and manufacturer's templates as required.

B. Install items in accordance with manufacturer's published instructions and as shown on the Drawings.

C. Install items plumb and level, accurately fitted, and free from distortion or defects.

D. Perform field welding in accordance with AWS D1.1.

E. After installation, touch-up field welds and scratched or damaged painted and galvanized surfaces in accordance with Paragraph 2.10 of this Section.

END OF SECTION

SECTION 13420
PACKAGED METERING MANHOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installing one packaged metering manhole to monitor seepage flow from the toe drain.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM)

1.	ASTM C 581:	Practice for Determining Chemical Resistance of Chemical Thermosetting Resins Used in Glass-Fiber Reinforced Structures Intended for Liquid Service.
2.	ASTM D 638:	Standard Test Method for Tensile Properties of Plastics.
3.	ASTM D 695:	Standard Test Methods for Compressive Properties of Rigid Plastics.
4.	ASTM D 790:	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
5.	ASTM D 2583:	Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
6.	ASTM D 2584:	Standard Test Method for Ignition Loss of Cured Reinforced Resins.
7.	ASTM D 3753:	Standard Specification for Glass-Fiber Reinforced Polyester Manholes.
8.	AASHTO H-20:	Axial Loading.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.
B. Product Data: Test results of representative fiberglass reinforced plastic laminate.

C. Shop Drawings: Show:

1. Critical dimensions, jointing and connections, fasteners and anchors.
2. Materials of construction.
3. Sizes, spacing, and location of structural members, connections, attachments, openings, and fasteners.

D. Color(s).

1. Samples: 8-inch square sample of representative fiberglass reinforced plastic laminate.

E. Manufacturer’s installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products indoors or in weather protected area until installation. Protect from construction traffic and damage.

B. During the loading, unloading, and storage, care should be taken to ensure that the manhole is not dropped or otherwise damaged.

C. The manhole should be stored on a smooth surface free of sharp objects.

D. Use nylon or fabric slings in conjunction with a spreader bar to lift or move the manhole. Under no circumstances should cables or chains be used.

E. If the manhole is stored horizontally, place in such a way as to avoid damage to the flume, cover, and end adapters.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Furnish a packaged metering manhole manufactured by TRACOM, Inc.; 6575-A Industrial Way, Alpharetta, Georgia 30004; Toll-Free Voice (877) 435-8637, Toll-Free Fax (866) 435-8637, www.tracomfrp.com.

B. Warranty: Manholes shall be warranted to be free of defects in workmanship and materials for a period of two years from shipment.

2.2 METERING MANHOLES

A. Configuration: Provide packaged metering manhole(s) of the following size(s):

1. Size: 48-inch diameter, 10.3 feet high to invert.

B. Construction:

1. One-piece construction.

C. Materials:

1. Fiberglass reinforced plastic, complying with ASTM D 3753, and latest edition.
2. Factory-assembled, ready for installation except for field-installed equipment.
3. The exterior surface shall be relatively smooth with no sharp projections. The surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show.
4. The interior surfaces shall be resin rich with no exposed fibers. The interior surface shall be smooth for improved corrosion resistance and reduced sludge build-up. The surface shall be free of crazing, delamination, blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth.
5. Minimum 0.480 inches wall thickness.
6. Integral fiberglass ladder bolted and glassed to the manhole wall with 1-1/2 inch diameter pultruded fiberglass rungs with a photoluminescent high visibility non-slip top surface and reinforced with threaded T-304 5/6 inch diameter stainless steel rods and solid 1-1/4 inch diameter pultruded fiberglass spacers.
7. Inlet and outlet end connections molded to the flume and laminated to the manhole barrel. The end connections shall be provided with:

    a. 18- inch diameter PVC or fiberglass pipe stubs with flexible PVC boots and stainless steel bands

8. Furnish a 3/4 inch thick expanded polystyrene bead board and place under the manhole on the concrete slab.

9. A 4-inch wide FRP integral mounting flange shall be molded to the base of the manhole barrel for anchoring to the manhole to the concrete slab.
10. An OSHA approved "Confined Space Entry" sign shall be applied to the interior surface of the manhole on the underside of the manhole top.

D. Materials:

1. The resins used shall be unsaturated, supplier certified, isophthalic polyester resins. Mixing lots of resin from different manufacturers or "odd-lotting" of resins shall not be permitted. Quality assurance records on the resin shall be maintained. Non-pigmented resin (with U.V. inhibitors) to allow for light or "sand" color of manhole surface in order to facilitate easy from grade interior inspection.
2. 15 mil gray isophatlic U.V. resistant gel coat on all exterior surfaces.
3. Reinforcing materials shall be high performance commercial grade with a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
4. The manhole laminate shall consist of multiple layers of glass matting and resin. The surface exposed to the sewer / chemical environment shall be resin rich and shall have no exposed fibers.
5. The flume laminate shall be a minimum of 3/16 thick with a 15 mil isopthalic U.V. resistant gel coat, with those portions of the flume extending outside the manhole sufficiently thickened and reinforced as necessary to withstand the forces of the intended application.

E. Material Properties:

1. Manhole Barrel and Reducer:

a. Flexural strength (ASTM D 790):

1) 15,400 PSI (reducer - hoop).
2) 17,200 PSI (reducer - axial).
3) 22,500 PSI (reducer - hoop).
4) 14,300 PSI (reducer - axial).

b. Compressive Strength (ASTM D 695): 18,900 PSI (barrel)
c. Barrel Stiffness (ASTM D2412):

1)

Manhole Length (ft.)	PSI
3-6	0.72
7-12	1.26
13-20	2.01
21-25	3.02
26-35	5.24

d. Flume:

1) Tensile strength (ASTM D 638): 14,000 PSI.
2) Flexural strength (ASTM D 790): 27,000 PSI.
3) Flexural modulus (ASTM D 790): 1,000,000 PSI.
4) Barcol hardness (ASTM D 2583): 50.

F. Manhole Type: Provide metering manholes of the following types(s):

1. Aluminum Hatch:

a. 24 inch x 30 inch, watertight aluminum hatch rated for a 300 P.S.F. pedestrian load. The hatch shall be mounted to a reinforced fiberglass cover and shall be fabricated from reinforced 1/4 inch thick aluminum diamond plate with T-316 stainless steel hardware. The hatch shall be provided with an automatic locking hold open arm, a stainless steel, recessed lift handle, and a staple for a user supplied padlock. The hatch shall be warranted against defects in materials and workmanship by the hatch manufacturer (10) years.

b. Aluminum Hatch Options:

1) Compression spring assist.

G. Flume Type and Size:

1. 3" Parshall size flume with integral inlet and outlet end connections. Capable of measuring flows from 4 to 834 GPM.

2.3 MANHOLES OPTIONS

A. Anchor Bolts: T-304 stainless steel anchor bolts (1/2 inch diameter x 4-1/2 inches long – minimum).

2.4 FLUME OPTIONS

A. Laminated, high visibility staff gauge:

1. Graduated in 1/10 foot and 1/100 foot increments.

2.5 CONCRETE AND GROUT

A. Concrete for Pad: In accordance with Section 03300: Cast-In-Place-Concrete.

B. Non-Shrink Grout: Premixed non-ferrous, minimum 5000-psi compressive strength at 28 days – Master Builder's Masterflow 713; Euclid Chemical Co. NS Grout; Burke Non-Ferrous-Non-Shrink Grout; or equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that the flume dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until condition deficiencies have been corrected.

3.2 INSTALLATION

A. Install products in accordance with Engineer's instructions, plans, blueprints, etc, local codes, and in a manner consistent with the submitted installation instruction and recommendation of the manufacturer.

B. Ensure that the product is installed plumb and true, free of twist or warp, within the tolerances specified by the manufacturer and as indicated in the contract documents.

C. Nylon or fabric slings should be used in conjunction with a spreader bar to lift or move the manhole. Under no conditions should chains or cables be used.

D. Excavate an area large enough to contain the manhole and the concrete pad while allowing for sufficient space to allow for a safe work environment.

E. Follow all OSHA requirements for open trench construction.

F. Place concrete foundation pad as shown on the Drawings to provide sufficient width and length to support all of the manhole, the flume, and the connecting piping. The thickness of the pad shall be the minimum thickness shown on the Drawings and shall be sized to ensure that proper loading is observed and that the manhole will not float. The surface of the concrete pad shall be level to within 1/8 inch.

G. Clean the concrete slab of all sharp objects and debris before laying the foam pad provided with the manhole.

H. If PVC boots are provided, install them on the manhole pipe stubs before lowering the manhole into the opening.

I. Lower the manhole onto the pad.

J. Drill holes in the base mounting flange, foam, and concrete pad to accept the stainless steel anchor bolts.

K. Check to ensure that the flume is level from side to side and from front to back, adjust the pad and anchor bolts, shimming if necessary.

L. Connect and secure piping.

M. Do not lubricate the PVC boots.

N. Grout the areas between the flume and the concrete pad outside of the manhole. Mix, place, and cure nonshrink grout in accordance with grout manufacturer's written instructions.

O. Backfill with common fill furnished and placed in accordance with Section 02330: Earthwork. Remove all particles larger than 1 inch within 1 foot of the manhole during placement.

P. Metering manholes may be classified as confined space entry locations. Consult all appropriate local, state, and federal regulations before entering.

3.3 ADJUST AND CLEAN

A. Clean surfaces in accordance with the manufacturer’s instructions.

B. Remove trash and debris, and leave the site in a clean condition.

END OF SECTION

SECTION 13500
DAM INSTRUMENTATION

PART 1 GENERAL

1.1 SUMMARY

A. This section covers requirements to raise existing piezometers, installing new piezometers, and furnishing and installing new movement monuments and structural survey points.

1.2 SUBMITTALS

A. Submit in accordance with Section 01330: Submittals.

B. Piezometer Modification Plan: Procedures for protecting and raising piezometers to the Engineer for approval.

C. Manufacturer's data for all materials and equipment.

D. Piezometer As-Built Diagrams: Submit as-built drawings showing pre and post piezometer elevations, dimensions in relation to existing and final ground surface, and survey coordinates of modified piezometers and new piezometers.

E. Survey Data: Survey data for new monuments, raised piezometers, and new piezometers, including horizontal coordinates and vertical elevations, using the same vertical and horizontal datum as is used in development of the Drawings.

1.3 DEFINITIONS

A. Movement Monuments: Bronze caps installed in concrete on the embankment dam to monitor for movement and settlement of the dam.

B. Piezometer: A groundwater measuring device drilled and installed with a plastic casing and slotted section screened across a water-bearing zone allowing water to rise in the casing to measure the hydraulic potential (water level) at a specific point in the subsurface.

PART 2 PRODUCTS

2.1 PIEZOMETER MODIFICATION MATERIALS

A. CMP Protective Casing: 10-inch galvanized steel corrugated metal pipe (CMP).

B. CMP Protective Casing Infill: Pre-packaged standard ASTM C1107, non-metallic, non-shrink grout.

C. Relocated Protective Steel Casing: Salvage existing casing and reinstall when fill placement and grading is complete.

D. PVC Well Riser Casing Extension: Schedule 80, sized to match existing casing, with suitable solvent welded couplers for extension piece.

E. Concrete: In accordance with Section 03300: Cast-In-Place Concrete constructed as shown on the Contract Drawings.

2.2 NEW PIEZOMETER MATERIALS

A. Piezometer End Caps: 2 inch diameter, schedule 80 threaded PVC caps to be installed at the bottom of the open standpipe piezometer.

B. Piezometer Slip Caps: 2 inch diameter, schedule 80 PVC caps to be installed at the top of the open standpipe piezometer.

C. Piezometer Riser Pipe: 2 inch diameter, schedule 80 PVC pipe with flush jointed threads

D. Bentonite pellets: Pellets with a maximum ¼-inch diameter and a dry bulk density of 82 pounds per cubic foot. Bentonite-Pi pellets manufactured by Piezometer Research and Development Corporation or approved equal.

E. Protective Steel Casing: 6 inch diameter, Schedule 80 threaded steel pipe

F. Piezometer Slotted Pipe: 2 inch diameter, schedule 80 PVC pipe with flush jointed threads and slot sizes less than 0.04".

2.3 MOVEMENT MONUMENTS

A. Bronze caps, 2-inch diameter, as manufactured by Berntsen International, Inc., Madison, Wisconsin, or approved equal, set on a Number 4 rebar embedded in structural concrete as shown on the Drawings.

B. No. 4 Rebar, 4 feet. long.

C. Structural Concrete: In accordance with Section 03300: Cast-In-Place Concrete.

2.4 STRUCTURAL SURVEY POINTS

A. Bronze caps, 2-inch diameter, as manufactured by Berntsen International, Inc., Madison, Wisconsin, or approved equal.

B. Epoxy adhesive: Hilti HIT 150 or equal.

2.5 BRONZE CAP MARKINGS

A. Use a permanent stamp to indent the bronze caps with a minimum letter height of ¼ inch.

B. All stamping shall deform the disk surface by a minimum of 1 millimeter (0.0394 in).

C. Stamp each monument with the point designation shown on the Drawings, or as directed by the Engineer.

PART 3 EXECUTION

3.1 PIEZOMETER MODIFICATION

A. All materials and equipment used in contact with piezometers shall be clean and free of chemical contamination of any kind.

B. Protect all existing piezometers, including those to be modified, from equipment at all times.

C. Install an inflatable packer in well riser below and before any cutting of the PVC pipe to prevent debris from falling into the well casing.

D. Protect exposed PVC well casing with CMP as shown on the Drawings during fill placement. Centralize PVC riser in the CMP casing and place grout in accordance with the manufacturers written instructions for fluid mix consistency.

E. Raise piezometers to the final elevations of the downstream dam slope shown or indicated on the Drawings.

F. Raise the existing piezometers in accordance with the typical detail shown on the Drawings. If the existing covers cannot be salvaged supply a new locking style cover equal to the existing cover as approved by the Engineer.

G. Carefully remove concrete and salvage the existing protective steel surface casing using methods that do not damage the PVC well riser pipe. Protect the existing well sealing material.

H. Maintain a cap on the well riser pipe at all times during piezometer modification to prevent extraneous material or substances from falling into the casing.

I. Centralize PVC riser in the CMP casing and place grout infill as shown on the Drawings in accordance with the manufacturers written instructions for fluid mix consistency.

J. Set the relocated protective steel casing securely in concrete installed to the dimensions shown on the Drawings.

K. After completion of a piezometer modification, survey the location and elevations of the riser pipe (north side) and ground surface.

3.2 NEW PIEZOMETER INSTALLATION

A. Pour filter sand into the drill casing equal to 1 foot of thickness and wait until it settles to the bottom of the borehole.

B. Lower the slotted pipe and piezometer riser pipe into the drill casing and allow the piezometer to rest on the piezometer sand cushion as described above. The total length of the pipes shall extend approximately 2 feet above the ground surface. Special care shall be taken to ensure that all connections are watertight.

C. Pour filter sand into the drill casing between the drill casing and the riser pipe in increments of 1.5 feet, raising the drill casing 1 foot after each increment. Do not raise the drill casing above the level of the sand in the drill casing. Agitate the sand and allow the sand to settle after each installation increment. Continue this procedure until the piezometer sand is 2 feet above the top of the slotted interval.

D. Pour bentonite pellets into the drill casing between the drill casing and the riser pipe in increments of 1.5 feet, raising the drill casing 1 foot after each increment. Continue this procedure until the layer of bentonite pellets is 2 feet thick. Hydrate pellets. Continue this procedure until the grout reaches 1 foot below elevation for bottom of upper piezometer tip.

E. Pour piezometer sand into the drill casing equal to 1 foot of thickness and wait until it settles.

F. Lower the slotted pipe and piezometer riser pipe into the drill casing and allow the piezometer to rest on the piezometer sand cushion as described above. The total length of the pipes shall extend approximately 2 feet above the ground surface. Special care shall be taken to ensure that all connections are watertight.

G. Pour piezometer sand into the drill casing between the drill casing and the riser pipe in increments of 1.5 feet, raising the drill casing 1 foot after each increment. Do not raise the drill casing above the level of the sand in the drill casing. Agitate the sand and allow the sand to settle after each installation increment. Continue this procedure until the piezometer sand is 2 feet above the top of the slotted interval.

H. Pour bentonite pellets into the drill casing between the drill casing and the riser pipe in increments of 1.5 feet, raising the drill casing 1 foot after each increment. Continue this procedure until the layer of bentonite pellets is 2 feet thick. Hydrate pellets. Repeat placement and hydration of bentonite pellets in 2 foot thick layers until the pellets reach the ground surface.

I. Lower the protective steel casing over the piezometer riser pipe and embed the protective steel casing approximately 2 feet into the bentonite. The protective steel casing shall extend approximately 3 to 6 inches above the top of the piezometer riser pipe.

J. Provide removable cap on top of riser pipe and provide a threaded cover on the protective steel casing.

3.3 MOVEMENT MONUMENTS

A. Install movement monuments at the locations shown on the Drawings.

B. Install movement monuments using the following procedures.

1. Drill an 8-inch diameter hole, 6 feet below the ground surface.
2. Clean the hole with appropriate drilling and cleaning methods.
3. Place concrete in the hole.
4. Insert a 4-foot long, No. 4 Rebar with a bronze cap so that the cap is level with the ground surface.
5. Consolidate concrete by rodding.
6. Trim excess concrete near top of hole where it exceeds the 8-inch diameter hole.

3.4 STRUCTURAL SURVEY POINTS

A. Install structural survey points on the spillway at the locations shown on the Drawings.

B. Drill a hole of suitable diameter in accordance with the epoxy manufacturer’s instructions in the concrete and install bronze cap. Bronze caps may also be wet stabbed into fresh concrete with the Engineer’s approval.

3.5 QUALITY CONTROL

A. Survey the coordinates and elevations of raised piezometers, new piezometers and new movement monuments and structural survey points in accordance with Section 01720: Layout of Work and Surveying

B. In the event that any piezometer being modified is damaged and requires abandonment, the Contractor shall seal the boring or structure in accordance with the Colorado State regulations

for piezometer abandonment. The Contractor shall install another piezometer in accordance with the Colorado State regulations adjacent to the abandoned structure at a location approved by the Engineer using materials and procedures as approved by the Engineer.

END OF SECTION