TECHNICAL SPECIFICATIONS

FOR

2019 TREATED WATER IMPROVMENTS PROJECT
88TH AVENUE AT CATALINA APARTMENTS PRV VAULT REPLACEMENT

Project No. 19-37

January 30, 2024

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SECTION 011000
SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.

2. Work covered by Contract Documents.

3. Access to site.

4. Work restrictions.

5. Miscellaneous provisions.

1.2 PROJECT INFORMATION

A. Project Identification: 2019 Treated Water System Improvements, Project No. 19-37

1. Project Location: Approximately 350-feet west of 88th Avenue and Colorado Boulevard, Thornton, Colorado

B. Owner: City of Thornton

1. Owner's Representative: Tiffany Hess, 12450 Washington Street, Thornton, CO 80241-2405

C. Engineer: Olsson, 1525 Raleigh Street, Suite 400, Denver, CO 80402

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1.4 The Work includes furnishing and installing an underground 8-inch pressure reducing vault, electrical service, relocating a fire hydrant, connecting existing 8-inch water line, sidewalk and curb and gutter reconstruction, patching asphalt paving, erosion control, traffic control and landscape restoration.

1.5 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Limits of Construction.

1.6 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 4:00 p.m., Monday through Friday, unless otherwise approved by the City of Thornton.

1.7 MISCELLANEOUS PROVISIONS

A. Project is located in the City of Thornton. Contractor shall obtain all permits necessary to complete the work from the City of Thornton.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200
UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Work performed under a unit price contract.

1.2 DEFINITIONS

A. Unit price is applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Methods of measurement and payment for unit prices are specified in PART 3.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

BID ITEM 1. **Mobilization**

Mobilization shall be paid pursuant to the provisions of the Special Conditions. The lump sum price will include all of CONTRACTOR's costs. This BID item includes:

- Installing PROJECT signs
- Installing fencing/security items as deemed necessary by CONTRACTOR
- Securing, maintaining, and restoring staging area(s)
- Establishing CONTRACTOR's offices, buildings and other necessary facilities
- Obtaining permits
- Providing required bonds and insurance
- Preparing the PROJECT schedule
- Removing CONTRACTOR's equipment, supplies, excess materials, and cleaning up the site
- Providing all other related and necessary labor, equipment, and materials to complete the WORK

- Any other incidental expenses that cannot otherwise be attributed directly to the other Bid Proposal Pay Items.

Bid Item	Pay Unit
Mobilization	LS

BID ITEM 2. **Construction Surveying**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of CONTRACTOR's costs. This BID item includes staking horizontal and vertical alignments, overlot grading, subgrade elevations, and off-sets; setting temporary control points; re-establishing land monuments disturbed by construction; and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Payment will be based on the percentage of completed and accepted WORK.

Bid Item	Pay Unit
Construction Surveying	LS

BID ITEM 3. **Traffic Control**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of CONTRACTOR's costs. This BID item includes preparing, implementing, adjusting as necessary, and maintaining the approved Traffic Control Plan in accordance with the DRAWINGS and SPECIFICATIONS and accepted Traffic Control Plan; and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Payment will be based on the percentage of completed and accepted WORK. One-third of the lump sum price for this item will be paid after twenty-five percent (25%) of the original CONTRACT amount has been earned; the second third will be paid after fifty percent (50%) of the original CONTRACT amount has been earned; and the final third upon final acceptance of the PROJECT.

Bid Item	Pay Unit
Traffic Control	LS

BID ITEM 4. **9” Sediment Control Log**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The unit price will include all of CONTRACTOR's costs. This BID item includes preparing, implementing, adjusting as necessary, maintaining this item, removing when site is stabilized, and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Payment will be based on units installed and accepted.

Bid Item	Pay Unit
9” Sediment Control Log	LF

BID ITEM 5. **Rock Sock**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The unit price will include all of CONTRACTOR's costs. This BID item includes preparing,

implementing, adjusting as necessary, maintaining this item, removing when site is stabilized, and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Payment will be based on units installed and accepted.

Bid Item	Pay Unit
Rock Sock	EA

BID ITEM 6. **Concrete Washout**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The unit price will include all of CONTRACTOR's costs. This BID item includes preparing, implementing, adjusting as necessary, maintaining this item, removing when site is stabilized, and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Payment will be based on units installed and accepted.

Bid Item	Pay Unit
Concrete Washout	EA

BID ITEM 7. **Restore Landscape and Irrigation System**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of CONTRACTOR's costs to restore the landscaping and irrigation systems disturbed by construction to existing conditions or better. This BID item includes furnishing, and transporting all labor, equipment, and materials including:

- Replacing landscaping mulch and rock
- Providing and placing soil preparation and performing fine grading
- Furnishing and installing sod
- Furnishing and installing seed
- Removing existing trees, shrubs, and bushes, if applicable
- Protecting existing trees, shrubs, and bushes, if applicable
- Trimming trees, shrubs and bushes
- Repairing any trees damaged by construction
- Repairing or replacing any shrubs or bushes damaged by construction
- Mulching
- Weeding
- Spraying for insect and disease control
- Maintaining all plants
- Fertilizing
- Watering
- Replacing dead or diseased plants
- Repairing irrigation system components disturbed or damages by construction
- Providing all other related and necessary labor, equipment, and materials to complete the WORK and repair any landscaped areas damaged during construction.

Payment will be based on the percentage of completed and accepted WORK.

Bid Item	Pay Unit
Restore Landscape and Irrigation System	LS

BID ITEM 8. **Remove Concrete Pavement (Cross Pan)**
BID ITEM 9. **Remove Curb and Gutter**
BID ITEM 10. **Remove Pavement**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The unit price will include all of CONTRACTOR's costs. This BID item includes saw cutting, removing, hauling, and legally disposing of all concrete backfilling of excavations with suitable material; compacting; and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Payment will be based on units removed and accepted.

Bid Item	Pay Unit
Remove Concrete Pavement (Cross Pan)	SY
Remove Curb and Gutter	LF
Remove Pavement	SY

BID ITEM 11. **Remove Existing Electrical Components and Meter/Disconnect Unit**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of CONTRACTOR's costs to remove the electric meter, disconnect the existing electric lines from the existing vault and abandon the existing electric lines in-place in accordance with the DRAWINGS and SPECIFICATIONS, and providing all other related and necessary labor, equipment, and materials to complete the WORK

Bid Item	Pay Unit
Remove Existing Electrical Components and Meter/Disconnect Unit	LS

BID ITEM 12. **Concrete Pavement (Cross Pan)**
BID ITEM 13. **Curb and Gutter (Type 2 and Section IIM)**

The measurement for payment for these items will be the actual quantity, complete in place, as measured in the field or as otherwise directed by ENGINEER. No measurement for payment will be made for replacement of materials damaged by CONTRACTOR's operations. The unit price will include all of CONTRACTOR's costs. This BID item includes:

- Quality control testing
- Saw cutting concrete
- Furnishing, forming, and placing concrete
- Furnishing and installing fibermesh
- Furnishing and applying curing compounds
- Finishing and edging concrete surfaces
- Sawing or tooling joints
- Furnishing and installing dowels into existing concrete
- Furnishing and installing cold joint material
- Subgrade preparation
- Placing base course, if required

- Steel plate with non-slip raised pattern
- Providing all other related and necessary labor, equipment, and materials to complete the WORK

Payment will be based on units completed and accepted.

Bid Item	Pay Unit
Concrete Pavement (Cross Pan)	SY
Curb and Gutter (Type 2 and Section IIM)	LF
Curb and Gutter (Type 2 and Section IB)	LF

BID ITEM 14. **Asphalt Pavement (8" thick)**

The measurement for payment for this item will be based on the quantity placed in accordance with the DRAWINGS and SPECIFICATIONS or as otherwise directed by ENGINEER. Quantity will be based on weight tickets provided to OWNER or OWNER'S REPRESENTATIVE at time of delivery to the site. The unit price will include all of CONTRACTOR's costs. This BID item includes subgrade preparation, furnishing and placing aggregate, asphalt cement, asphalt recycling agent, additives, quality control testing, cores, excavation, preparation, tack coat of areas to be patched, and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Payment will be based on units completed and accepted.

Bid Item	Pay Unit
Asphalt Patch (8" thick)	TON

BID ITEM 15. **Sump Pump Discharge Box**
BID ITEM 16. **1 ¼" Galvanized Steel Pipe and Fittings (Sump Pump Discharge)**

No separate measurement for payment will be made for any labor, equipment, and materials required for these items. The lump sum price will include all of CONTRACTOR's costs. This BID item includes installing the sump pump discharge line, removal of existing sump discharge line as necessary and connection of new sump discharge line to the existing sump discharge manhole in accordance with the DRAWINGS and; and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Bid Item	Pay Unit
Connection to Existing Sump Discharge Manhole	LS
1¼" Galvanized Steel Pipe and Fittings (Sump Pump Discharge)	LS

BID ITEM 17. **Air Vent**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The unit price will include all of CONTRACTOR's costs. This BID item includes installing the air duct piping in accordance with the DRAWINGS and; and providing all other related and necessary labor, equipment, and materials to complete the WORK.

Bid Item	Pay Unit
Air Vent	EA

BID ITEM 18. **6” PVC C900**
BID ITEM 19. **8" PVC C900**

The measurement for payment for these items will be the actual quantity, complete in place, as measured in the field or as otherwise directed by ENGINEER. The unit price will include all of CONTRACTOR's costs. These BID items include:

- Locating and protecting all existing utilities in and along the pipe length
- Removing and disposing existing pipeline as required
- Furnishing, transporting, and installing all pipe and materials
- Installing tracer wire
- Adjusting location of existing small utilities and valves
- Furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the DRAWINGS and SPECIFICATIONS
- Excavating, including exploratory excavation
- Dewatering
- Joint restraints
- Constructing the specific bedding including the furnishing, placing, and compacting of sand, gravel and rock
- Furnishing and installing protective coatings or wrapping; pipe encasements
- Backfilling using flowable fill including furnishing, transporting, and placing material;
- Supporting trenches
- Protecting aboveground and underground utilities and service connections
- Disposing debris, pipe, excess excavated material, and damaged materials
- Quality control testing
- Testing, disinfection, and inspection
- Providing all other related and necessary labor, equipment, and materials to complete the WORK

Payment will be based on units completed and accepted.

Bid Item	Pay Unit
6” PVC C900	LF
8" PVC C900	LF

BID ITEM 20. **8" 45 Degree M.J. Bend with Thrust Block**
BID ITEM 21. **8” M.J. Sleeve**
BID ITEM 22. **6” M.J. Gate Valve with Box**
BID ITEM 23. **8" M.J. Gate Valve with Box**
BID ITEM 24. **6” X 8” M.J. Tee with Thrust Block**

The measurement for payment for this item will be the actual number of units installed, complete in place in accordance with the DRAWINGS and SPECIFICATIONS. The unit price will include all of CONTRACTOR's costs. These BID items include:

- Adjusting location of existing small utilities and valves
- Furnishing, transporting, and installing fittings, bends, megalugs, deformed bars, couplings, valves, etc.
- Furnishing, transporting, and installing thrust blocks and materials
- Excavating, including exploratory excavation

- Dewatering
- Constructing the specific bedding including the furnishing, placing, and compacting of sand, gravel and rock
- Furnishing and installing protective coatings or wrapping; pipe encasements
- Backfilling with flowable fill including furnishing, transporting, and placing material;
- Supporting trenches
- Protecting aboveground and underground utilities and service connections
- Disposing debris, pipe, excess excavated material, and damaged materials
- Quality control testing
- Testing, disinfection, and inspection
- Providing all other related and necessary labor, equipment, and materials to complete the WORK

Bid Item	Pay Unit
8" 45 Degree M.J. Bend w/ Thrust Block	EA
8" M.J. Sleeve	EA
6" M.J. Gate Valve with Box	EA
8" M.J. Gate Valve with Box	EA
6" X 8" M.J. Tee w/ Thrust Block	EA

BID ITEM 25. **Remove and Replace Existing Fire Hydrant Assembly**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of CONTRACTOR's costs. This BID item includes removing the existing fire hydrant and installing a new fire hydrant in the proposed location in accordance with the DRAWINGS and SPECIFICATIONS and providing all other related and necessary labor, equipment, and materials to complete the WORK including, but not limited to:

- All materials and work from the fire hydrant to the connection to the main
- Excavation and backfill
- Quality control testing
- Dewatering

Bid Item	Pay Unit
Remove and Replace Existing Fire Hydrant Assembly	LS

BID ITEM 26. **PRV Vault**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of CONTRACTOR's costs. This BID item includes furnishing and installing an underground pre-manufactured pressure reducing vault in accordance with the DRAWINGS and SPECIFICATIONS and providing all other related and necessary labor, equipment, and materials to complete the WORK including:

- Foundation design prepared by a Colorado registered Professional Engineer
- Excavation and backfill
- Quality control testing
- Dewatering

Bid Item	Pay Unit
PRV Vault	LS

BID ITEM 27. **Remove and/or Abandon Existing PRV Vault and Water Main**

No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of CONTRACTOR's costs. This BID item includes all labor, equipment and materials needed to abandon the existing PRV vault including:

- Removing the existing internal components and returning to the City of Thornton
- Removing the vault sump pump discharge line, vent pipes and external components that are in conflict with the installation of the new vault.
- Removing and disposing of asbestos cement water main pipes
- Fill the existing PRV vault, vent pipes, and water main with flowable fill

Bid Item	Pay Unit
Remove and/or Abandon Existing PRV Vault and Water Main	LS

BID ITEM 28. **1.5" PVC Schedule 40 Conduit**
BID ITEM 29. **2" PVC Schedule 80 Conduit**
BID ITEM 30. **#4 AWG XHHW Conductor**
BID ITEM 31. **#6 AWG XHHW Conductor**
BID ITEM 32. **Ground Rods**
BID ITEM 33. **Electric Service, Meter Pedestal and Main Breaker**

The measurement for payment for this item will be the actual number of units installed, complete in place in accordance with the DRAWINGS and SPECIFICATIONS. The unit price will include all of CONTRACTOR's costs. These BID items include:

- Furnishing and installing the new pedestal and meter
- Connecting the pedestal to the power source and PRV vault
- Installing ground
- Locating and protecting all existing utilities in and along the install length
- Removing and disposing existing conduit and electric lines, as required
- Furnishing, transporting, and installing all materials,
- Furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the DRAWINGS and SPECIFICATIONS
- Excavating, including exploratory excavation
- Dewatering
- Constructing the specific bedding including the furnishing, placing, and compacting of sand, gravel and rock
- Backfilling including furnishing, transporting, and placing material including flowable fill under asphalt; and compacting
- Supporting trenches
- Protecting aboveground and underground utilities and service connections
- Disposing debris, conduit, wire, excess excavated material, and damaged materials
- Providing all other related and necessary labor, equipment, and materials to complete the WORK

Payment will be based on units completed and accepted.

Bid Item	Pay Unit
1.5” PVC Schedule 40 Conduit	LF
2” PVC Schedule 80 Conduit	LF
#4 AWG XHHW Conductor	LF
#6 AWG XHHW Conductor	LF
Ground Rods	EA
Electric Service, Meter Pedestal and Main Breaker	EA

END OF SECTION 012200

SECTION 024119
SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected site elements.

2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 INFORMATIONAL SUBMITTALS

A. Pre-demolition Photographs or Video: Submit before Work begins.

1.4 CLOSEOUT SUBMITTALS

A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

3.2 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.3 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

2. Dispose of demolished items and materials promptly.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.4 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them.

1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

3.5 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 071800
TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Work consists of furnishing and applying pavement marking in accordance with these specifications, the Manual of Uniform Traffic Control Devices for Streets and Highways (MUTCD), the Colorado supplement, thereto, and in conformity to the lines, dimensions, patterns, locations, and details shown on the plans or established

PART 2 - PRODUCTS

2.1 PREFORMED PLASTIC PAVEMENT MARKINGS AND LEGENDS

A. General

1. The prefabricated markings described shall consist of white or yellow pigmented plastic films with reflective glass spheres, uniformly distributed throughout their entire cross-sectional area, and shall be capable of being affixed to bituminous or Portland cement concrete pavements by either a pressure sensitive precoated adhesive or a liquid contact cement. The markings shall be provided in complete, a form that shall facilitate rapid application and protect the markings in shipment and storage. The contractor shall use proper solvents and/or adhesives for application, all equipment necessary for proper application, and recommendations for application that shall assure an effective performance life. The marking film shall have resealing characteristics such that it shall fuse with itself and with previously applied marking materials of the same composition under normal conditions of use.
2. Prefabricated legends and symbols shall conform to the applicable shapes and sizes as outlined in the MUTCD.

B. Classification

1. The markings shall be highly durable retroreflective pliant polymer materials, designed for longitudinal and word/symbol markings subjected to high traffic columns and severe wear conditions, such as shear action from crossover, or encroachment on typical longitudinal configurations such as edge lines, barrier lines and lane lines.

C. Symbols, legends, long lines, skips, stop bars and crosswalks shall be 3M Series 270 ES or approved equal. For concrete pavement, long lines and skips shall be 3M Series 380I-5ES or approved equal.

2.2 MARKING PAINT

A. Marking paint generally will not be approved for permanent markings. The use of pure acrylic high solids for hot application and quick dry to paint centerlines and edgelines on roads, crosswalks, stop zones, parking lots, storage zones, aisles, etc. as approved by the City of Thornton Project Manager shall contain no lead and comply with the EPA's voluntary 30/50

program, and meet the performance standards of federal specifications TT-P-1952. Prior to application, surfaces must be thoroughly dry and free from dirt, loose paint, oil, grease, and other contaminants. Paint may be thinned if necessary up to two (2)%, thin per manufacturer's recommendation. The paint shall be applied at air, surface, and product temperature above 50° F or per manufacturer's specifications.

% solids by weight	77.5 +/- 3%
Viscosity	80 - 90 K.U.
Sheen	Flat
Wet film per coat	14 – 16 mils
Dry film per coat	8.4 – 9.6 mils
Application rate	1 gal / 100 sf
Unit weight	14 lbs / gal

2.3 THERMOPLASTIC MARKING

A. Shall be in conformance with CDOT SSRBC Section 713.12.

2.4 REFLECTORIZED GLASS BEADS

A. A blended material consisting of spheres containing refractive indices of 1.50 and 1.65 and conforming to the following specifications:

1. Manufactured from high grade optical crown glass of a composition designed to be highly resistant to traffic wear and to the effects of weathering.
2. Colorless, clean and transparent.

B. Material

1. The reflectorizing glass beads shall conform to the following:
   a. Refracture Index - When testing by the liquid immersion method at 77° F, 70% of the spheres shall have an average index of not less than 1.50, and 30% shall have an average index of not less than 1.65.

1.50 Index Glass Beads

U.S. Standard Sieve Number	% Passing by Weight
20	95 – 100
30	75 - 95
50	9 - 32
80	0 - 15

1.65 Index Glass Beads

U.S. Standard Sieve Number	% Passing by Weight
50	100
80	90 – 100
100	75 - 90
200	0 - 5

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The contractor shall field layout pavement markings for installation, via chalk or paint lines, for approval of owner prior to installation of material. Permanent pavement markings shall have an epoxy binder applied and be tape unless another material is approved in writing by the Traffic Engineer.

B. Pavement markings shall be so applied as to assure continuous uniformity in the dimensions of the stripe.

C. Laydown tolerances for each pavement marking shall be one (1) inch longitudinally and one quarter (1/4)-inch transversely.

D. Permanent pavement markings installed on new asphalt shall be inlaid and installed within four (4) hours of placement of the final lift of asphalt pavement. Pavement markings on existing and new concrete pavement shall be recessed in a one fourth (¼) inch groove not to exceed one half (½) inch wider nor two (2) inches longer than the tape being laid and shall be glued with an epoxy binder. Permanent pavement markings on existing asphalt shall have an epoxy binder applied and be tape.

E. The pavement marking shall be applied to the pavement either to the right or left of the application unit, dependent upon roadway lane being used. The unit shall not occupy more than one lane of roadway while operating.

F. The finished lines shall have well defined edges and be free of waviness. Tolerance shall be one (1) inch longitudinally and one fourth (¼) inch transversely. The minimum thickness of thermoplastic line shall be three thirty-seconds (3/32) inch at the edges, not less than one eighth (1/8) inch at the center. Measurements shall be taken as an average throughout any 10-foot section of the line. The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall bond itself to the old line in such a manner that no splitting or separation takes place. All of the equipment necessary to the preheating and application of the material shall be so designed that the temperature of the material can be controlled within the limits necessary to its pourability for good application.

G. The marking material as specified shall be installed at the manufacturer’s recommended temperature.

H. At the time of installation of thermoplastic materials, the pavement shall be clean, dry, and free of laitance, oil, dirt, grease, paint, or other foreign contaminants. Pavement and ambient temperatures shall be at least 50° F.

I. An epoxy resin primer shall be applied to concrete surfaces prior to the application of the thermoplastic pavement marking. The epoxy resin primer shall be installed per the thermoplastic manufacturer recommendations.

J. The marking material shall not be applied until the epoxy resin primer reaches the tacky stage. An infrared heating device may be employed to shorten the curing time of the epoxy.

K. If the City of Thornton Project Manager determines that a new asphalt surface has become soiled, prior to placement of the pavement markings, a pavement primer will be required and preformed plastic pavement markings shall be applied as approved.

L. The epoxy resin primer material may be accepted at the job site on the basis of a manufacturer's certification, or a sample may be sent to the laboratory for testing, in which case three (3) weeks shall be allowed between sampling and intended use.

END OF SECTION 071800

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SECTION 221113
WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Installation of new water mains

B. Adjusting existing water mains

1.2 RELATED SECTIONS

A. Section 012200: Unit Prices

B. Section 312300: Excavation and Fill

1.3 REFERENCES

A. AWWA C-104 Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water.

B. AWWA Standard C-111 Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings

C. AWWA C-150 Thickness Design of Ductile Iron Pipe.

D. AWWA C-151 Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-lined Molds for Water or Other Liquids.

E. AWWA C-600 Installation of Gray and Ductile Cast Iron Water Mains and Appurtenances.

F. AWWA C-900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 inches through 12 inches for water.

1.4 SHOP DRAWINGS AND PRODUCT DATA

A. Submit shop drawings and product data for all proposed materials.

B. Submit manufacturer's installation instructions.

1.5 REGULATIONS

A. Comply with all applicable City of Thornton requirements.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Materials furnished shall be new and undamaged. Everything necessary to complete all installations shall be furnished and installed whether shown on approved drawings or not, and all installations shall be completed as fully operational.

B. Materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality and fitness for the work.

C. Polyvinyl Chloride Pressure Pipe

1. All polyvinyl pipe for water mains 12 inches and less shall be manufactured in accordance with AWWA Standard C-900-07, "Polyvinyl Chloride (PVC) Pressure Pipe.", and shall meet the requirements for DR-25 for all distribution mains, and shall meet the requirements of DR-18 for hydrant leads.

2. Solvent cement joints are strictly prohibited.

3. Each length of pipe shall be a standard laying length of 20 or 12 feet. Random lengths shall only be acceptable at fittings and hydrant branch lines. PVC pipe must be laid with tracer wire (16-gauge wire only).

4. PVC must conform to cast iron outside diameters. Pipe stored outside which may be exposed to sunlight for more than 30 days, shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering. Sunburned pipe shall not be permitted for installation and shall be removed from the job site immediately.

5. The manufacturer shall furnish a certified statement that the inspection and specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer.

D. Ductile Iron Pipe

1. DIP shall be manufactured in accordance with AWWA Standard C-150 and C-151, "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-lined Molds for Water or Other Liquids", with the following additional requirements or exceptions:

   a. "Push-on single gasket" type conforming to applicable requirements of AWWA Standard C-111, "Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings".

   b. The grade of iron shall be 60-42-10 having a minimum tensile strength of 60,000 psi, minimum yield strength of 42,000 psi, and a minimum % of elongation of 10%.

   c. Pipe furnished under this specification shall conform to AWWA C-150 and C-151, and have nominal laying lengths of either 18 or 20 feet. Random lengths are not acceptable.

   d. Pipe furnished shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104, "Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water", and the exterior coating shall be the standard outside bituminous coating as specified in AWWA C-151.

   e. The manufacturer shall furnish a certified statement that the inspection and specified tests have been made and the results thereof comply with the

requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer.

f. Ductile iron water pipe shall be installed per AWWA C-600.

g. Corrosion protection shall be provided in accordance with Detail 200-15.

E. Granular Bedding Materials shall be squeegee, non-fractured, rounded, and shall conform to the gradation in Section 221113 when tested by means of laboratory sieves.

F. Tracer Wire: 16 ga. (HDPE Coated) Steel-Clad Copper Tracer wire, manufactured for direct bury service. Wire shall be continuous without breaks. Splices shall be made with petroleum-filled wire nut caps suitable for direct bury service. Bring tracer wire to surface as shown on the plans. Use with PVC water main.

G. Mechanically Restrained Joints: Megalugs, Cam-Lok or approved equal shall be used. Tie rods may be used as approved by the Engineer. If tie rods are used, they shall be mild steel, ASTM Standard Designation A-36. Hex nuts shall be ASTM Standard Designation A-307, grade A or B, Hexagon Heavy series. Tie rods shall be used at bends and fittings where thrust blocks cannot be used due to existing field conditions or where harness rods are specifically required by the Engineer. Harness rods shall have a bituminous coating for corrosion protection.

2.2 Fittings

A. Cast iron fittings shall be manufactured in accordance with the following AWWA standards: C-104, "Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water," C-150, "Ductile Iron Fittings" and C111, "Rubber Gasket Joints for Ductile Iron Pressure for Pipe and Fittings," with the following additional requirements or exceptions:

1. Fittings shall be furnished with a cement mortar lining of standard thickness as defined in referenced specifications and given a seal coat of bituminous material.

2. Fittings shall be furnished with mechanical joint, ring tite or flanged ends conforming to referenced specifications and, in addition, the tee-head mechanical joint bolts and hexagon nuts shall be fabricated from a high strength, stainless steel or approved equal. Swivel fittings as approved by the Engineer may also be utilized. Under no circumstances shall repair clamps be permitted on new installations.

3. Fittings shall be of the 250 psi pressure rating and shall conform to the dimensions and weights shown in the tables of referenced specifications.

4. The manufacturer shall furnish a certified statement that the inspection and specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer.

5. Corrosion protection shall be provided in accordance with Detail 200-15.

2.3 THRUST BLOCKS

A. Construct poured in place concrete thrust blocks for all fittings where changes of alignment occurs in accordance with the plan requirements and applicable portions of Section 03310 – Structural Concrete.

2.4 FIRE HYDRANTS

A. Fire hydrant assemblies shall be in accordance with the requirements on the plans.

2.5 VALVES AND VALVE BOXES

A. Valves and valve boxes shall be in accordance with the requirements on the plans.

2.6 WATER SERVICES

A. Water services shall be in accordance with the requirements on the plans.

B. Underground joints are not permitted in the copper service pipe between the corporation stop and the curb stop and/or meter.

PART 3 - EXECUTION

3.1 PREPARATION

A. Review layout requirements with other affected work. Coordinate locations of fittings to accommodate system.

B. Protect landscaping and other features remaining as final work.

C. Coordinate and schedule work with Owner and North Washington Water Users Association at least 24 hours before commencing work.

3.2 TRENCHING

A. Trench for water system piping per Section 221113.

B Keep trenches free of debris, material, or obstructions that may damage pipe.

C. Backfill per Section 221113.

3.3 INSTALLATION

A. Pipe shall be installed in accordance with AWWA C-900 along with the following provisions:

1. Pipe and fittings shall be loaded and unloaded by lifting so as to avoid shock or damage. Under no circumstances shall such material be dropped. Before the placing of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of foreign material, kept clean, and examined for cracks or defects before installation. No pipe shall be installed that is damaged by prolonged exposure to the sun or adverse weather conditions.

2. Joint lubricant shall be as supplied by the pipe manufacturer.

4. Whenever the pipe is left unattended, temporary plugs shall be installed at openings. Temporary plugs shall be watertight, standard cast iron, and of such design as to prevent children and animals from entering the pipe. Temporary plugs shall be subject to approval by the Engineer.

5. Pipe and appurtenant structures shall not be installed upon a foundation into which frost has penetrated or at any time when the Inspector deems there is a danger of ice formation or frost penetration at the bottom of the excavation. Pipe and appurtenant structures shall not be installed unless backfilling can be completed before the formation of ice and frost.

6. Immediately before joining two (2) lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. A thin film of gasket lubricant shall be applied according to the manufacturer's recommended practices to either the inside face of the gasket or the spigot end of the pipe or both.

7. The spigot end of the pipe shall be placed in the socket with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Stabbing shall not be permitted. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint.

8. Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing. 9. Non-disinfected mains which cannot be isolated shall not be connected to an existing, disinfected main. The Contractor shall assume any and all responsibility for damage done by heavily chlorinated water entering existing facilities due to negligence on his part. Water mains shall adhere to the following sequence of tests: (1) chlorine, (2) pressure tests, and (3) clearwater test.

B. Curb stops, valve boxes and fire hydrants shall be set plumb.

C. Install tracer wire with all water mains and provide junction boxes at fire hydrants, valves, and termination points. Tracer wire shall be secured to the top of the water main by tape a minimum of three times in each section of pipe. A continuous loop shall be installed to the top of all valve boxes. All wire shall be joined by use of a wire clamp. These connections shall be sealed and tamped to create a watertight connection.

D. Burial: The burial and bedding of pipe and fittings shall be in accordance with the project plans and specifications.

3.4 HANDLING

A. Pipe, fittings, and accessories shall be handled in a manner that will insure installation in sound, undamaged condition. Equipment, tools, and methods used in handling pipe and fittings in which cement lining has been damaged shall be replaced. Small and readily accessible damaged areas may be repaired.

3.5 INSPECTION

A. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; spigot ends shall be examined with particular care. All defective pipe and fittings shall be removed from the site of the work.

3.6 LAYING WATER MAIN

A. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed 1/2 of the manufactures maximum joint deflection, unless specially designed bells and spigots are provided.

B. Either shorter pipe sections or fittings shall be installed where the alignment or grade requires them.

C. All water mains shall be placed at the depth specified on the drawings.

D. Pipe shall be protected from lateral displacement by placing the specified pipe embedment material. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.

E. Pipe shall be laid with the bell ends facing the direction of laying except when reverse laying is specifically authorized by the Engineer.

F Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer, either above or below the sewer. At crossings, one full length of water pipe shall be located such that both joints will be as far from the sewer as possible.

G. Either shorter pipe sections or fittings shall be installed where the alignment or grade requires them.

3.7 CUTTING PIPE

A. Cuttings shall be done in a neat manner, without damage to the pipe. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting the end of the pipe, it shall be dressed with a file to remove all roughness and sharp corners.

3.8 CLEANING

A. The interior of all pipe and fittings shall be thoroughly cleaned of foreign material before being installed and shall be kept clean until the work has been accepted. Before jointing, all joint contact surfaces shall be wiped clean and kept clean until jointing is completed.

B. Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other materials shall not be placed in or allowed to enter the pipe.

C. Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug which will prevent trench water from entering the pipe.

D. If the pipe is flooded and/or filled with mud, the Contractor shall remove all foreign water and debris, flush main with potable water, then chlorinate the main for a 24-hour period.

3.9 FIELD JOINTS

A. Joints in buried locations shall be push-on type unless otherwise indicated on the drawings.

3.10 PUSH-ON-JOINTS

A. All instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations, shall be followed by the Contractor. All joints surfaces shall be lubricated with heavy vegetable soap suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

3.11 REACTION ANCHORAGE AND BLOCKING

A. All unplugged bell and spigot or all-bell tees, Y-branches, bends deflecting 22 1/2 degrees or more, and plugs which are installed in buried piping shall be provided with suitable reaction blocking, anchors, joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure.

3.12 Disinfection

A. Disinfection shall be accomplished using tablet form Hypochlorite. These shall be affixed to the inside (top) with an approved food grade adhesive such as Permatex Form-A-Gasket No. 2 and Permatex Clear RTV silicone adhesive sealant, or approved equivalent. Dosage shall be calculated for a 100 mg/liter chlorine concentration for volume of installed pipe (this is to allow for the refilling of pre-existing pipe attached to the installed sections). For calculating the weight of chlorine required, see Table 3-1. The chlorine solution shall remain in contact with the piping for a minimum of 24 hours.

TABLE 3-1
MINIMUM NUMBER OF HYPOCHLORITE TABLETS
OF 7 GRAM STRENGTH (5 GRAMS AVAILABLE CHLORINE) FOR A DOSE OF 100 MG/L

Length of Section (feet)	Diameter of Pipe (inches)									
	4	6	8	12	16	18	20	24	30	36
13	1	2	3	6	11	13	16	24	36	52
18	1	2	3	8	15	18	23	32	50	72
20	1	3	4	9	16	20	25	36	56	80
30	2	2	6	14	24	30	37	54	83	120
40	2	5	8	18	32	40	50	71	111	160

3.13 Flushing

A. After chlorination or disinfection of the pipeline, flushing shall commence to remove the chlorine solution. Flushing shall continue for a minimum of five (5) minutes beyond the time when chlorine residual is present at the same levels as normal distribution system residuals.

3.14 Hydrostatic Testing

A. No hydrostatic tests shall be made on any portion of the pipeline until field placed concrete has had adequate curing time as defined for thrust blocks in Detail 200-11 and compaction test results have been submitted to and approved by the Development Engineering Manager. Only potable water may be used in testing procedures.

B. The pipeline shall be tested in accordance with AWWA C-600 or C-900 except as follows:

C. The pipeline shall be tested with water at a pressure of 150 psi or 50 psi above working pressure, whichever is greater.

D. The Owner and North Washington Water Users Association shall be notified 24 hours in advance of testing. Acceptance testing shall be made in the presence of the Engineer only after the pipeline is in a state of readiness for testing.

E. Air in the line shall be properly purged. Where blowoffs or hydrants are not available or effective in purging air from the line, the Engineer may require a tap to purge the line. The location and size of the tap shall be at the Engineer's discretion. The cost for such a tap shall be included in the cost of the work.

F. No leakage is allowed through the bonnet of the line valve. Any valve leaking through the bonnet shall be removed and replaced.

G. The pressure test shall be a two (2) hour test taken at the high point in the line. Every time the water line pressure drops five (5) psi, the pump shall be started to bring the line pressure back to the initial pressure.

H. PVC or DIP shall be considered to have passed the pressure test when the total leakage in (24) hours is less than 11.5 gallons per inch of inside diameter per mile of pipeline. The Engineer shall direct the Contractor to repair specific leaks regardless of test results, if in his opinion they are serious enough to endanger the future service of the pipeline. Pipelines shall be tested in sections as rapidly as such section may be isolated.

3.15 Bacteriological Sampling

A. 24 hours after flushing, personnel from the City shall sample fire hydrants, fire lines, and blowoffs for bacteriological contamination. A minimum of two (2) samples shall be analyzed. Samples shall be collected in duplicate, that is, two (2) samples from each hydrant tested. . If the samples show no bacteriological growth and are free from excessive turbidity, the Thornton Water Quality Control Laboratory shall release the main for service and shall initiate the required forms. If samples do not warrant approval for main release from the Thornton Water Quality Control Laboratory, lines must be re-flushed. If again, samples do not warrant approval for main release after flushing, re-chlorination shall be required.

3.16 SEWER LINE CONFLICT

A. Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

B. Where a 10 foot separation between a sewer manhole and the water main cannot be maintained, the water main shall be cut as required so that a 20 foot length of pipe may be centered at the nearest point to the manhole.

3.17 ADJUSTMENT

A. Check and adjust accessories for smooth operation.

END OF SECTION

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SECTION 312300
EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This WORK shall consist of excavation, embankment fill, disposal of excess material, shaping, and compaction of all material encountered within the limits of WORK, including excavation and fill for structures. The excavation shall include, but is not limited to, the native soils which shall be excavated for the PROJECT WORK. All WORK shall be completed in accordance with these SPECIFICATIONS, the lines and grades, and typical cross-sections shown on the DRAWINGS.

B. All excavation shall be classified, "unclassified excavation," or "muck excavation" or "rock excavation," as hereafter described. All embankment shall be classified "embankment material" as hereafter described.

1.2 RELATED SECTIONS

A. The following is a list of SPECIFICATIONS which may be related to this section:

1. Section 312319, Dewatering.

2. Section 312333, Trenching and Backfilling.

1.3 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3)).

b. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

1.4 DEFINITIONS

A. Embankment Material shall consist of approved material acquired from excavation or from outside sources, hauled and placed in embankments.

B. Muck Excavation shall consist of the removal of mixtures of soils and organic matter not suitable for foundation material and replacement with approved material.

C. Rock Excavation shall consist of igneous, metamorphic and sedimentary rock which cannot be excavated without the use of rippers, and all boulders or other detached stones each having a volume of one-half (1/2) cubic yard or more, as determined by physical or visual measurement. It shall also include replacement with approved material as required.

D. Unclassified Excavation shall consist of the excavation of all materials of whatever character required of the WORK, obtained within the PROJECT limits.

1.5 QUALITY ASSURANCE

A. Final topography and/or cross-sections shall be surveyed of areas that are to finished grade and compared to the design section for accuracy.

B. Final grade shall match design grades within the tolerances discussed in PART 3 EXECUTION.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Embankment Material may consist of approved material acquired from excavations or material hauled from outside the PROJECT limits.

B. Suitable material identified onsite shall be used first for embankments and backfill.

C. Excess excavated native soils which are not used as embankment or backfill shall become the property of CONTRACTOR and shall be disposed of offsite by CONTRACTOR, in a location acceptable to ENGINEER.

D. Muck Excavation shall also include the replacement of excavated muck with uniformly graded rock, riprap, onsite or imported soils, or other material, whichever is most suitable for the specific situation encountered.

E. ENGINEER will determine which type of aggregate or other material which shall be used after observing the specific site conditions.

F. Structural Backfill:

1. When specified on the DRAWINGS or as required by ENGINEER, Class I structural backfill shall meet the following gradation requirements:

Sieve Size	**% By Weight Passing Square Mesh Sieves**
2-inch	100
No. 4	30 - 100
No. 50	10 – 60
No. 200	5 – 20

2. In addition, this material shall have a liquid limit not exceeding thirty-five (35) and a plasticity index of not over six (6).

3. Impervious structural backfill, where shown or specified, shall consist of material having one hundred percent (100%) finer than two (2) inches in diameter and a minimum of thirty-five percent (35%) passing a No. 200 U.S. Standard Sieve.

PART 3 - EXECUTION

3.1 GENERAL EXCAVATION/EMBANKMENT

A. General:

1. The excavation and embankment shall be finished to reasonably smooth and uniform surfaces.

2. Variation from the subgrade plane shall not be more than eight-tenths (0.08) foot in soil or more than eight-tenths (0.08) foot above or one-half (0.50) foot below in rock.

3. Where bituminous or concrete surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than four-tenths (0.04) foot.

4. Materials shall not be wasted without permission of ENGINEER.

5. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed.

6. Prior to beginning grading operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 31 11 00, Clearing and Grubbing, of these SPECIFICATIONS.

7. CONTRACTOR shall notify ENGINEER in sufficient time before beginning excavation or embankment such that the necessary topography and/or cross- sections may be taken. CONTRACTOR shall not excavate beyond the dimensions and elevations established, and material shall not be removed prior to surveying the site.

8. When CONTRACTOR's excavating operations encounter remains of prehistoric people's dwelling sites or artifacts of historical or archaeological significance, the operations shall be temporarily discontinued.

    a. ENGINEER will contact archaeological authorities to determine the disposition thereof.

    b. When directed, CONTRACTOR shall excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for delivery to the custody of the proper state authorities.

    c. Such excavation will be considered and paid for as extra WORK.

B. Excavation:

1. Unclassified:

    a. All excess suitable material excavated from the PROJECT site and not used for embankment shall be removed from the PROJECT site and become the property of CONTRACTOR.

    b. Where material encountered within the limits of the WORK is considered unsuitable for embankment (fills) on any portion of this PROJECT WORK, such material shall be excavated as directed by ENGINEER and replaced with suitable fill material.

c. All unsuitable excavated material from excavation consisting of any type of debris (surface or buried), excavated rock, bedrock or rocks larger than six (6) inches in diameter, and boulders shall be hauled from the PROJECT site and disposed of by CONTRACTOR at CONTRACTOR's expense.

d. Debris is defined as "anything that is not earth which exists at the job site."

2. Muck:

a. Where excavation to the finished grade section results in a subgrade or slopes of unsuitable soil, ENGINEER may require CONTRACTOR to remove the unsuitable materials and backfill to the finished graded section with approved material.

b. Disposal of the unsuitable material and replacement with suitable material shall be at CONTRACTOR's expense.

3. Good surface drainage shall be provided around all permanent cuts to direct surface runoff away from the cut face.

4. Rock:

a. Unless otherwise specified, rock shall be excavated to a minimum depth of 0.5 foot below subgrade within the limits of the channel area, and the excavation shall be backfilled with material shown on the DRAWINGS or as designated by ENGINEER.

b. Disposal of material and replacement with suitable approved material shall be at CONTRACTOR's expense.

C. Embankment Construction:

1. Embankment construction shall consist of constructing all fill areas, including preparation of the areas upon which they are to be placed, the placing and compacting of approved material within areas where unsuitable materials have been removed, and the placing and compacting of Embankment Material in holes, pits and other depressions within the PROJECT area.

2. Only approved materials shall be used in the construction of embankments and backfills.

3. Approved materials shall consist of clean onsite cohesive soils or approved imported soils.

4. Onsite cohesive soils or imported soils shall be placed and compacted in horizontal lifts, using equipment and procedures that produce recommended moisture contents and densities throughout the lift and embankment height. Onsite or imported cohesive soils shall be compacted within a moisture content range of two percent (2%) below, to two percent (2%) above optimum moisture content and compacted to ninety-five percent (95%) of the Maximum Standard Proctor Density (ASTM D698).

5. When embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when embankment is built one-half

(1/2) width at a time, the slopes that are steeper than four-to-one (4:1) when measured longitudinally or at right angles to the adjacent ground shall be continuously benched over those areas where it is required as the WORK is brought up in layers.

a. Benching shall be well "keyed" and where practical a minimum of eight (8) feet. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts.

b. Material thus cut out shall be recompacted along with the new Embankment Material at CONTRACTOR's expense.

6. The ground surface underlying all fills shall be carefully prepared by removing all organic matter, scarification to a depth of eight (8) inches and recompacting to ninety-five percent (95%) of the Maximum Standard Proctor Density (ASTM D698) at optimum moisture content + or - two percent (2%) prior to fill placement.

7. Embankment Material shall be placed in horizontal layers not exceeding8 inches (loose measurement) and shall be compacted to ninety five percent (95%) of the Maximum Standard Proctor Density (ASTM D698) at optimum moisture content + or - two percent (2%).

a. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting.

b. As the compaction of each layer progresses, continuous leveling and manipulating required to ensure uniform density.

8. For embankments which serve as berms, the downstream portion shall be keyed into the subsurface soils a minimum of three (3) feet to enhance the stability of the slope.

9. Materials which are removed from excavations beneath the water table may be over the optimum moisture content and shall be required to be dried out prior to reusing them.

10. Cross hauling or other action as appropriate will be ordered when necessary to ensure that the best available material is placed in critical areas of embankments, including the top two (2) feet of all embankments. No additional payment will be made for cross hauling ordered by ENGINEER.

11. Frozen materials shall not be used in construction of embankments.

12. During the construction of the channels, the channel bottom shall be maintained in such condition that it will be well drained at all times.

13. Excavation or embankment (fill), and structural backfill WORK either completed or in a stage of completion that is either eroded or washed away or becomes unstable as a result of either rains, snow, snow melt, channel flows, or lack of proper water control shall be either removed and replaced, recompacted, or reshaped as directed by ENGINEER and in accordance with the DRAWINGS and SPECIFICATIONS at CONTRACTOR's sole expense.

14. Removed unsuitable materials shall be hauled away and disposed of at CONTRACTOR's expense. Placing of replacement materials for removed unsuitable materials shall be purchased, placed, and compacted at CONTRACTOR's expense.

D. Proof Rolling:

1. Proof rolling with a heavy rubber tired roller shall be required, if designated on the DRAWINGS or when ordered by ENGINEER.

2. Proof rolling shall be done after specified compaction has been obtained. Areas found to be weak and those areas which failed shall be ripped, scarified, wetted if necessary, and recompacted to the requirements for density and moisture at CONTRACTOR's expense.

3. Proof rolling shall be done with equipment and in a manner acceptable to ENGINEER. Proof rolling as shown on the DRAWINGS or as ordered by ENGINEER shall not be measured and paid for separately, but shall be included in the unit prices bid for the WORK.

3.2 EXCAVATION AND BACKFILL FOR STRUCTURES

A. Poor foundation material for any of the WORK shall be removed, by CONTRACTOR, as directed by ENGINEER.

1. CONTRACTOR will be compensated for removal and replacement of such materials in accordance with Muck Excavation.

B. CONTRACTOR is cautioned that construction equipment may cause the natural soils to pump or deform while performing excavation WORK inside and on footings, structural floor slabs, or other structure foundation areas.

C. CONTRACTOR shall remove and replace at CONTRACTOR's expense any foundation materials which are:

1. Saturated by either surface or subsurface flows because of the lack of adequate water control or dewatering work by CONTRACTOR;

2. Frozen for any reason; or

3. Disturbed by CONTRACTOR's WORK or caused to become unacceptable for foundation material purposes by means of CONTRACTOR's equipment, manpower, or methods of WORK.

D. Dewatering shall not be conducted by pumping from inside footings, structural floor slabs, or other structure foundation limits. This may decrease the supporting capacity of the soils.

E. Care shall be taken when excavating the foundations to avoid disturbing the supporting materials. Excavation by either hand or careful backhoe soil removal, may be required in excavating the last few inches of material to obtain the subgrade of any item of the concrete WORK.

F. Any over-excavated subgrades that are due to CONTRACTOR's actions, shall be brought back to subgrade elevations, as indicated on the DRAWINGS, by CONTRACTOR and at CONTRACTOR's expense in the following manner:

G. For over-excavations of two (2) inches or less, either backfill and compact with approved granular materials; backfill with one-half (1/2) inch crushed rock; or fill with concrete at the time of the appurtenant structure concrete pour.

H. For over-excavations greater than two (2) inches, backfill and compact with an approved granular material.

1. All granular footings, structural floor slabs, or other structure areas shall be compacted with a vibratory plate compactor prior to placement of concrete, reinforcing, or bedding materials.

2. Backfill, and fill within three (3) feet adjacent to all structures and for the full height of walls, shall be selected non-swelling material. If fill location is under the roadway pavement section, flowable fill shall be used in accordance to Section 312323. Non-swelling material shall meet the requirements as follows:

a. It shall be granular, well graded, and free from stones larger than two (2) inches.

b. Material may be job excavated, but shall selectivity be required as determined by ENGINEER.

c. Stockpiled material, other than topsoil from the excavation, shall be used for backfilling unless an impervious structural backfill is specified.

d. The backfill material shall consist of either clean onsite granular material free of stones larger than two (2) inches in diameter with no more than twenty percent (20%) passing the No. 200 sieve, or equivalent imported materials.

e. All backfill around the structures shall be consolidated by mechanical tamping.

f. The material shall be placed in six-inch (6") loose lifts within a range of two percent (2%) above to two percent (2%) below the optimum moisture content and compacted to ninety-five percent (95%) of Maximum Standard Proctor Density (ASTM D698) for cohesive soils, or to seventy-five percent (75%) relative density for pervious material as determined by the relative density of cohesionless soils test, ASTM D4253.

3. Impervious structural backfill shall be placed in six-inch (6") loose lifts within a range of two percent (2%) above to two percent (2%) below the optimum moisture content and compacted to ninety-five percent (95%) of Maximum Standard Proctor Density for cohesive soils as determined by ASTM D698.

END OF SECTION

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SECTION 312319
DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes construction dewatering.

1.2 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing State and EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide temporary grading to facilitate dewatering and control of surface water.

B. Monitor dewatering systems continuously.

C. Protect and maintain temporary erosion and sedimentation controls during dewatering operations.

D. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.

2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

E. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

F. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

G. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

H. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

END OF SECTION 312319

SECTION 312323
FLOWABLE FILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. CONTRACTOR shall furnish and place controlled low strength material (CLSM) backfill where shown in the DRAWINGS. The pipeline trench shall be excavated to the proper lines, grades, and dimensions, pipe or structures installed, bedding installed and CLSM placed from bedding to top of pavement subgrade.

1.2 RELATED SECTIONS

A. The following is a list of SPECIFICATIONS which may be related to this section:

1. Section 312319, Dewatering.

2. Section 312333, Trenching and Backfilling.

1.3 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

a. C33, Standard Specification for Concrete Aggregates.

b. C94, Standard Specification for Ready-Mixed Concrete.

c. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.

d. C150, Standard Specification for Portland Cement.

e. C494/C494M Rev A, Standard Specification for Chemical Admixtures for Concrete.

f. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

g. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength (CLSM) Test Cylinders.

h. D5971, Standard Practice for Sampling Freshly Mixed Controlled Low- Strength Material.

i. D6023, Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM).

j. D6024, Standard Test Method for Ball Drop on Controlled Low-Strength Material (CLSM) to Determine Suitability for Load Application.

k. D6103, Standard Test Method for Flow Consistency of Controlled Low- Strength Material (CLSM).

1.4 SUBMITTALS

A. A minimum of two (2) days prior to starting CLSM WORK. Provide product data on the following:

1. CLSM mix design

2. Fly Ash

3. Admixtures

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. The CLSM bedding shall consist of a mixture of sand, coarse aggregate, cement and water.

2. Fly ash and approved admixtures may be used to obtain the required properties of the mix.

3. The mix shall have good workability and flowability with self-compacting and self-leveling characteristics.

4. No changes shall be made in the amounts or sources of the approved mix ingredients without the approval of ENGINEER.

5. Product inspection and field-testing of the approved mix may be made by, or on behalf of, OWNER.

B. Cement: All cement used shall be Type II Portland cement which shall conform to the requirements of ASTM C150.

C. Fly Ash: Fly ash may be either Class C or Class F. The fly ash shall conform to ASTM C618.

D. Aggregates:

1. Fine Aggregate: All fine aggregate shall conform to the grading and quality requirements of ASTM C33.

2. Coarse Aggregate: Coarse aggregate shall conform to the grading and quality requirements of ASTM C33 for size No. 476, No. 57, or No. 67.

E. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C94.

F. Admixtures:

1. Chemical admixtures that do not contain calcium chloride and conform to ASTM C494/C494M for concrete may be used in the CLSM mix.

2. All chemical admixtures shall be compatible with the cement and all other admixtures in the batch.

G. CLSM Proportions:

1. Strength: CLSM shall have a minimum twenty-eight (28) day compressive strength of one hundred (100) psi when molded and cured as in conformance with ASTM D4832.

2. The CLSM shall have a minimum cement content of fifty (50) pounds per cubic yard. The water-cementitious materials ratio of the mix shall not exceed three and one-half to one (3.5:1).

3. Air-Entrainment: All CLSM shall be air entrained to a total air content of approximately five percent (5%).

4. Slump: The minimum slump shall be six (6) inches and the maximum slump shall be eight (8) inches when tested in accordance with ASTM D6103.

5. Aggregate: Fine aggregate shall be between fifty percent (50%) and sixty percent (60%) by volume of the total aggregates in the CLSM mix.

6. Consistency:

a. The consistency of the CLSM slurry shall be such that the material flows easily into all openings between the pipe and the lower portion of the trench.

b. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent CLSM from flowing down the trench.

c. When a stiffer mix is used, vibration shall be performed to ensure that the CLSM slurry completely fills all spaces between the pipe and the lower portion of the trench.

PART 3 - EXECUTION

3.1 GENERAL

A. CLSM shall be placed as closely behind pipe laying operations as possible.

B. CLSM shall not be placed, if, in the judgment of ENGINEER, weather conditions are unsuitable.

C. CLSM shall not be placed when the trench bottom or walls are frozen or contain frozen materials.

D. CLSM shall not be placed when the air temperature is below forty degrees Fahrenheit (40°F) unless the air temperature is thirty-five degrees Fahrenheit (35°F) or more and the temperature is rising.

3.2 PLACEMENT

A. CLSM shall be deposited as nearly as practical in its final position and in no way disturb the pipe trench or cause foreign material to become mixed with the CLSM.

B. Soil backfill or asphalt shall not be placed until the CLSM has reached the initial set.

1. If backfill or asphalt is not to be placed over the CLSM within eight (8) hours, a six-inch (6") cover of moist earth shall be placed over the CLSM surface.

2. If the air temperature is fifty degrees Fahrenheit (50°F) or less, CLSM shall be adequately protected.

END OF SECTION

SECTION 312333
TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This WORK shall consist of all labor, equipment, and materials necessary for excavation, trenching, and backfilling for utility lines and other related WORK.

1.2 RELATED SECTIONS

A. The following is a list of SPECIFICATIONS which may be related to this section:

1. Section 312300, Excavation and Fill.

2. Section 312319, Dewatering.

3. Section 312323, Flowable Fill

4.

1.3 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3)).

b. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

2. Colorado Department of Transportation (CDOT).

3. Occupational Safety and Health Administration (OSHA).

1.4 SUBMITTALS

A. Submit certification that bedding and pipe zone material meets SPECIFICATION.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Muck Excavation:

1. Muck excavation shall also include the replacement of excavated muck with uniformly graded rock ranging from three-quarter (3/4) inch to one and one-half (1-1/2) inches or as required by ENGINEER.

2. ENGINEER shall determine which type of aggregate or other material shall be used after observing the specific site conditions.

B. Bedding and Pipe Zone Materials:

1. Well-Graded Sand:

Sieve Size	Total Percent Passing by Weight
⅜ - inch	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 10

2. Squeegee Sand:

Sieve Size	Total Percent Passing by Weight
⅜ - inch	100
No. 200	0 - 5

3. CDOT #67:

Sieve Size	Total Percent Passing by Weight
1 inch	100
¾ - inch	90 - 100
⅜ - inch	20 - 55
No. 4	0 - 10
No. 8	0 - 5

a. It shall be the responsibility of CONTRACTOR to locate material meeting the SPECIFICATIONS, to test its ability to consolidate to at least seventy- five percent (75%) relative density, and to secure approval of ENGINEER before such material is delivered to the PROJECT.

b. Relative density shall be determined as stipulated in ASTM D4253.

C. Backfill:

1. Use only backfill for trenches which is free from rocks, large roots, other vegetation or organic matter, and frozen material.

2. No rocks greater than three (3) inches in diameter shall be allowed.

3. Backfill under roadway asphalt shall be Flowable Fill in accordance to Section 312323.

D. Cut-Off Walls:

1. Clay Cut-Off Walls: More than fifty percent (50%) shall pass a No. 200 Sieve. The plasticity index shall be greater than twelve (12).

2. Controlled Low Strength Material Backfill: (Flowable-Fill, See Section 312323, Flowable Fill).

PART 3 - EXECUTION

3.1 GENERAL

A. The following procedures shall be followed by CONTRACTOR in sequencing the WORK:

1. No more than one hundred fifty (150) feet of trench shall be left open at any time.

2. The entire trench shall be backfilled to within fifty (50) feet of the open trench upon conclusion of each day's WORK.

3. The trench shall not be backfilled until the pipe installation is found acceptable by ENGINEER.

4. Trench shall be backfilled within one hundred (100) feet of the pipe installation at all times.

5. Clean-up shall be maintained within four hundred (400) feet of the trench excavation.

B. Prior to placement in the trench, all pipes, fittings, and appurtenances shall be cleaned and examined for defects by CONTRACTOR.

1. If found defective, CONTRACTOR shall reject the defective pipe, fitting, or appurtenance.

2. CONTRACTOR shall advise ENGINEER of all defective materials.

C. Surplus Excavation:

1. All surplus excavation shall be placed, in an orderly manner.

2. If material is stockpiled on private property, written permission shall be obtained from the property owner and provided to ENGINEER.

3.2 OBSTRUCTIONS AND DISPOSAL OF WASTE MATERIAL

A. CONTRACTOR shall remove obstructions that do not require replacement from within the trench or adjacent areas such as tree roots, stumps, abandoned piling, buildings and concrete structures, frozen material, logs, and debris of all types without additional compensation.

B. ENGINEER may, if requested, make changes in the trench alignment to avoid major obstructions, if such alignment changes can be made within the WORK limits without adversely affecting the intended function of the facility.

C. Excavated materials unsuitable for backfill or not required for backfill shall be disposed of in accordance with local regulations.

3.3 TRENCH EXCAVATION

A. All existing asphalt or concrete surfacing shall be saw cut vertically in a straight line, and removed from the job site prior to starting the trench excavation. This material shall not be used in any fill or backfill.

B. Clearance:

1. The trench shall be excavated so that a minimum clearance of six (6) inches is maintained on each side of the pipe for proper placement and densification of the bedding or backfill material.

2. The maximum clearance measured at the spring line of the pipe shall be eighteen (18) inches regardless of the type of pipe, type of soil, depth of excavation, or the method of densifying the bedding and backfill.

C. Except as otherwise dictated by construction conditions, the excavation shall be of such dimensions as to allow for the proper pipe installation and to permit the construction of the necessary pipe connections.

D. Care shall be taken to ensure that the excavation does not extend below established grades.

1. If the excavation is made below such grades, the excess excavation shall be filled in with sand or graded gravel deposited in horizontal layers not more than six (6) inches in thickness after being compacted and shall be moistened as required to within two percent (2%) of the optimum moisture content required for compaction of that soil.

2. After being conditioned to have the required moisture content, the layers shall be compacted to the required density.

E. CONTRACTOR shall stockpile excavated materials in a safe manner. Stockpiles shall be graded for proper drainage.

F. CONTRACTOR shall place and grade the trench base to the proper grade ahead of pipe laying. The invert of the trench shall be compacted to provide a firm unyielding support along entire pipe length.

G. Surplus excavation shall be disposed of by CONTRACTOR at CONTRACTOR's expense.

3.4 PROTECTION

A. Sheeting and Shoring:

1. CONTRACTOR shall protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent any excessive widening or sloughing of the trench

which may be detrimental to human safety, to the pipe or appurtenances being installed, or to existing facilities or structures.

2. The latest requirements of OSHA shall be complied with at all times including trenching and confined space entry requirements.

3. CONTRACTOR shall be responsible for underpinning adjacent structures which may be damaged by excavation WORK, including service utilities and pipe chases.

B. Weather and Frost:

1. CONTRACTOR shall protect bottom of excavations and soil adjacent to and beneath foundations from frost.

2. Do not place backfill, fill, or embankment on frozen surfaces.

3. Do not place frozen materials, snow, or ice in backfill, fill, or embankments.

4. Do not deposit, tamp, roll, or otherwise mechanically compact backfill in water.

C. Drainage and Groundwater:

1. The excavation shall be graded to prevent surface water runoff into trench or excavation.

2. Maintain excavations and trenches free from water during construction.

3. Remove water encountered in trenches to the extent necessary to provide a firm subgrade, to permit joints to be made in the dry, and to prevent the entrance of water into the pipeline.

4. Divert surface runoff and use sumps, gravel blankets, well points, drain lines, or other means necessary to accomplish the above.

5. Maintain the excavation or trench free from water until the structure, or pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

6. Prevent water from entering into previously constructed pipe.

7. Do not use the pipe under construction for dewatering.

3.5 FOUNDATIONS ON UNSTABLE SOILS

A. If the bottom of the excavation is soft or unstable, and in the opinion of ENGINEER, cannot satisfactorily support the pipe or structure, a further depth and width shall be excavated and refilled to six (6) inches below grade with rock or other approved material, uniformly graded between three-quarter (3/4) inch and one and one-half (1-1/2) inches to provide a firm foundation for the pipe or structure. From six (6) inches below grade to grade, the appropriate bedding material shall be placed to provide support for the pipe or structure.

3.6 PIPE BEDDING

A. After completion of the trench excavation and proper preparation of the foundation, six (6)

inches of bedding material shall be placed on the trench bottom for support under the pipe.

B. Bell holes shall be dug deep enough to provide a minimum of two (2) inches of clearance between the bell and the bedding material.

C. All pipes shall be installed in such a manner as to ensure full support of the pipe barrel over its entire length.

D. After the pipe is adjusted for line and grade and the joint is made, the bedding material shall be carefully placed and tamped under the haunches of the pipe.

E. For all types of pipe, the limits of bedding shall be as shown on the trench section details on the DRAWINGS.

F. Bedding shall be compacted to seventy five percent (75%) relative density in accordance with ASTM D4253. Care shall be exercised to ensure sufficient tamping under the pipe to achieve uniform support.

3.7 BACKFILL AND COMPACTION

A. All muck excavation, bedding, and pipe zone material shall be imported unless otherwise designated by OWNER's geotechnical engineer.

B. Pipe:

1. The pipe trench shall be backfilled to the limits as shown on the DRAWINGS.

2. Where the backfill area is under roadway asphalt paving, Flowable Fill shall be installed in accordance with Section 312323.

3. The backfill in all areas shall be compacted by vibrating, tamping, or a combination thereof to seventy five percent (75%) relative density for sand material as determined by the relative density of cohesionless soils test, ASTM D4253, or to ninety five percent (95%) of the Maximum Standard Proctor Density for cohesive soils as determined by ASTM D698.

4. All backfill shall be brought up to equal height along each side of the pipe in such a manner as to avoid displacement.

5. Bedding shall be distributed in 6-inch (6") maximum lifts over the full width of the trench.

6. Wet, soft or frozen material, asphalt chunks, or other deleterious substances shall not be used for backfill.

7. If the excavated material is not suitable for backfill, as determined by ENGINEER, suitable material shall be hauled in and utilized and the rejected material hauled away and disposed of.

8. Backfilling shall be conducted at all times in a manner to prevent damage to the pipe or its coating and shall be kept as close to the pipe laying operation as practical.

9. Backfilling procedures shall conform to the additional requirements, if any, of appropriate agencies or private right-of-way agreements.

C. Unsurfaced Areas: All surface cuts shall be, as a minimum, restored to a condition equal to that prior to construction.

D. Surfaced Areas:

1. All surface cuts shall be, as a minimum, restored to a condition equal to that prior to construction.

2. All gravel or paved streets shall be restored in accordance with the regulations and requirements of the agency having control or jurisdiction over the street, roadway, or right-of-way.

E. Grassed or Landscaped Areas:

1. In landscaped or agricultural areas, topsoil, to a depth of twelve (12) inches, shall be removed from the area of general disturbance and stockpiled.

2. After installation of all pipelines, appurtenances and structures and completion of all backfill and compaction, the stockpiled topsoil shall be redistributed evenly over all disturbed areas.

3. Care should be taken to conform to the original ground contour or final grading plans.

3.8 FIELD QUALITY CONTROL

A. In-place moisture density tests will be performed to ensure trench backfill complies with specified requirements. The following minimum tests will be performed.

1. Trench Bedding: One per two hundred (1 per 200) feet.

2. Backfill: One per two hundred (1 per 200) feet.

B. Backfill Compaction Tests:

1. Backfill compaction tests will be performed until compaction meets or exceeds requirements.

2. The cost of "passing" tests will be paid by OWNER.

3. Costs associated with "failing" tests shall be paid by CONTRACTOR.

C. Pipe bedding will be tested prior to placement of backfill.

D. Testing of all bedding and backfill material will be done in compliance with Occupational Safety & Health Administration (OSHA) - Excavations.

3.9 RESTORATION

A. Scarify surface, reshape, and compact to required density completed or partially completed areas of WORK disturbed by subsequent construction operations or by adverse weather.

B. Maintain and correct backfill, fill, and embankment settlement and make necessary repairs to

pavement structures, seeding, and sodding which may be damaged as a result of settlement for the guarantee period.

C. Such maintenance and correction may be performed by subcontract.

D. Upon completion of the WORK, all plants, rubbish, unused materials, concrete forms, and other like material shall be removed from the job site.

E. The site shall be left in a state of order and cleanliness.

END OF SECTION

SECTION 321216
ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Additional information concerning asphalt paving may be found on the civil drawings, and in the geotechnical engineering study. In case of conflict between the drawings, jurisdictional criteria and the information specified herein, the more stringent requirements shall govern.

C. Additional information concerning earth moving may be found in the geotechnical investigation report by Olsson Associates, dated January 13, 2020 (Project No. 019-23650). All requirements of this report shall be followed. The information shown in this report is for information and it shall be the contractors responsibility to field verify conditions indicated.

1.2 SUMMARY

A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving overlay.
4. Asphalt surface treatments.
5. Grinding or “milling” of existing hot-mix asphalt pavement.

B. Related Sections include the following:

1. Section 312300, Excavation and Fill for soil materials, excavating, backfilling and site grading.

C. References:

1. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition and all appropriate standard special provisions.

1.3 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. CDOT: State of Colorado Department of Transportation.

C. CDOT Specifications: Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition and all appropriate standard special provisions.

1.4 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving in accordance with Section 401 of the CDOT Specifications.

1. Standard Specification: CDOT Specifications.

2. Measurement and payment provisions and safety program submittals included in CDOT Specifications do not apply to this Project.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated, include technical data and tested physical and performance properties.

B. Job-Mix Designs: For each job mix proposed for the Work.

C. Material Test Reports: For each paving material.

D. Material Certificates: For each paving material, signed by providers.

1.6 QUALITY ASSURANCE

A. Manufacturer and Installer Qualifications:

1. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.

2. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Testing Agency:

1. Quality Assurance testing and inspections will be performed by an independent testing and inspection agency employed by the Owner.

2. Quality Assurance inspections and tests are not a substitute for the Contractor's Quality Control responsibilities or its testing and inspection program.

C. Testing Requirements: Asphalt Paving shall be tested for gradation, asphalt content and inplace density in accordance with CDOT Specifications, the current edition of CDOT Field Materials Manual, and local Regulatory Agency requirements, whichever are the most stringent.

D. Preconstruction Conference: Conduct conference at Project site as directed by Owner's Representative.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Tack Coats: Minimum surface or air temperature in the shade of 60 deg F (15 deg C).

2. Slurry Coat: Comply with weather limitations of ASTM D 3910.

3. Asphalt Base Course: Minimum surface or air temperature in the shade of 40 deg F and rising at time of placement.

4. Asphalt Surface Course: Minimum surface or air temperature in the shade of 50 deg F and rising at time of placement.

B. Coordination and Scheduling:

1. Cooperate with other trades and arrange scheduling to avoid damage to other work, including grading, site utilities and piping, exterior concrete, landscaping and irrigation systems.

2. Before commencing pavement operations, ascertain that utility lines, site lighting and wiring, piping, curb and gutter work, general grading and heavy trucking is complete so that such operations will not damage paving work.

3. Mask off and protect exposed building surfaces and abutting concrete from damage or staining by tack coat and paving operations.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations meeting the requirements of the CDOT Specifications.

B. Asphalt Concrete Aggregate: Clean, hard, durable particles of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the requirements of Subsection 703.04 of the CDOT Specifications and Grading SX and S (Table 703-4).

C. Mineral Filler: Rock dust, slag dust, hydrated lime, hydraulic cement, or other suitable mineral material conforming to the requirements of Subsection 703.06 of the CDOT Specifications.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: The asphalt cement to be used on this project shall be PG 64-22 conforming to the requirements of Subsection 702.01 of the CDOT Specifications.

B. Tack Coat: AASHTO M 140, emulsified asphalt or AASHTO M 208, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

C. Fog Seal: AASHTO M 140, emulsified asphalt or AASHTO M 208, cationic emulsified asphalt, slow setting, diluted at the factory in water, of suitable grade and consistency for application.

D. Water: Potable.

2.3 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes. Furnish job-mix formulas for each pavement type, conforming to the requirements of Subsection 401.02 of the CDOT Specifications. Mix aggregates and bituminous materials in accordance with the requirements of Subsection 401.15 of the CDOT Specifications. Use approved job mix formulas. Mix to comply with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Base Course: Grading S.

3. Surface Course: Grading SX.

B. Emulsified-Asphalt: Shall conform to AASHTO M140 or M208 in accordance with Subsection 702.03 of the CDOT Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is unfrozen, free of water, snow, and ice otherwise in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction. Scarify, regrade and recompact surface of subgrade that is pumping or deforming as required to provide true levels, uniform slopes and proper total thickness of paving as required in Division 31 Section “Excavation and Fill.”

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted aggregate base before applying paving materials.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.20 gal./sq. yd. (0.2 to 0.8 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated on the plans or as directed by Geotechnical Report. Maximum lift thickness shall be 3-inches. Minimum lift thickness shall be 1½-inches for Grading SX and 2-inches for Grading S.

2. Place hot-mix asphalt surface course in single lift. Maximum lift thickness shall be 2inches.3. Spread mix at minimum temperature of 235 deg F (113 deg C) per in accordance with Subsection 401.15 of the CDOT Specifications, Table 401-5.

4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150mm).

3. Offset transverse joints, in successive courses, 6 to 12 inches (150-300 mm).

4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."

5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. When paving surface temperature falls below 185 deg F (85 deg C) no further compaction effort will be permitted unless approved.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hotmix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density in accordance with Subsection 401.17 of the CDOT Specifications.

1. Pavement shall be compacted to a density of 92% to 96% of the maximum theoretical density, determined according to Colorado procedure 51. Field density determination will be in accordance with Colorado Procedure 44 or 81.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus ¼ inch (6 mm).

2. Surface Course: Plus ¼ inch (6 mm), no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: ¼-inch (6 mm).

2. Surface Course: 3/16-inch (5 mm).

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is ¼-inch (6 mm).

3.7 MANHOLE FRAME ADJUSTMENTS

A. Set frames for manholes and other such units within areas to be paved to ¼-inch minimum to ½-inch maximum below final grade as part of this work. Include existing frames or new frames furnished under other sections of these specifications.

B. Set cover frames to ¼-inch minimum and ½-inch maximum below surface of adjacent pavement. Surround frames set to grade with a ring of compacted asphaltic concrete base prior to paving. Place asphaltic concrete mixture up to 1-inch below top of frame, slope to grade, and compact with hand tamping. Adjust frames as required for paving.

C. Provide temporary closures over openings until completion of rolling operations. Remove closures at completion of work.

3.8 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.7 L/sq. m) to existing asphalt pavement and allow to cure. With a fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.9 FIELD QUALITY CONTROL

A. Contractor shall engage a qualified testing and inspecting agency to provide Quality Control testing.

B. Owner will engage a qualified independent testing and inspecting agency to perform Quality Assurance field tests and inspections and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 350 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.

    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Asphalt Content and Gradation. Testing agency will take sample of uncompacted paving mixtures at a minimum frequency of every 1,000 tons according to Colorado Procedure – Laboratory CPL-5120 and Colorado Procedure CP-31.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements. Conforming to the specified requirements will be in according with Subsection 105.03 of the CDOT Specifications.

3.10 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 321216

SECTION 321600
SIDEWALKS, CURBS, AND GUTTER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete WORK shall consist of air entrained Portland cement constructed on a prepared subgrade in accordance with these SPECIFICATIONS. The completed WORK shall conform to the thicknesses and typical cross-sections shown on the DRAWINGS. The completed WORK shall conform to the lines and grades shown on the DRAWINGS or to those established by ENGINEER at the job site.

1.2 RELATED SECTIONS

A. The following is a list of SPECIFICATIONS which may be related to this section:

1. Section 312300, Excavation and Fill.

2. Section 312319, Dewatering.

3. Section 312333, Trenching and Backfilling.

1.3 REFERENCES

A. The following is a list of standards which may be referenced in this section:

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

a. M6, Standard Specification for Fine Aggregate for Hydraulics Cement Concrete.

b. M80, Standard Specification for Coarse Aggregate for Hydraulics Cement Concrete.

c. M148, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

d. M154, Standard Specification for Air-Entraining Admixtures for Concrete.

e. M171, Standard Specification for Sheet Materials for Curing Concrete.

f. M182, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.

g. M194M/M194, Standard Specification for Chemical Admixtures for Concrete.

h. T22, Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens.

i. T23, Standard Method of Test for Making and Curing Concrete Test Specimens in the Field.

j. T26, Standard Method of Test for Quality of Water to Be Used in Concrete.

k. T27, Sieve Analysis of Fine and Coarse Aggregates

l. T96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

m. T11, Standard Method of Test for Clay Lumps and Friable Particles in Aggregate.

n. T119M/T119, Standard Method of Test for Slump of Hydraulic Cement Concrete.

o. T121M/T121, Standard Method of Test for Density (Unit Weight), Yield,

p. T141, Standard Method of Test for Sampling Freshly Mixed Concrete.

q. T152, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.

r. T176, Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test.

s. T199, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Chace Indicator.

2. ASTM International (ASTM):

a. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

b. C920, Standard Specification for Elastomeric Joint Sealants.

3. Colorado Department of Transportation (CDOT):

a. Section 703.01, Fine Aggregate for Concrete.

b. CP30, Sampling of Aggregates.

c. CP31A, Sieve Analysis of Fine and Coarse Aggregates.

d. CP60, Determining Surface Moisture in Fine and Coarse Aggregates.

1.4 SUBMITTALS

A. CONTRACTOR shall cooperate with ENGINEER in obtaining and providing samples of all specified materials.

B. CONTRACTOR shall submit certified laboratory test certificates for all items required in this section.

C. Contractor shall submit mix design for concrete in writing to ENGINEER for approval prior to placement of concrete.

D. CONTRACTOR shall submit batch tickets for each load of concrete. Tickets shall show weight of all materials and additives used in each batch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Conformance:

1. Concrete shall conform to City of Thornton Standards and Specifications for the Design and Construction of Public and Private Improvements, Section 600 – Concrete 4500 PSI CDOT Class D concrete with fibrous reinforcing.

C. Concrete Curing Materials and Admixtures:

1. Curing Materials: Curing materials shall conform to the following requirements as specified:

a. Burlap Cloth made from Jute or Kenaf: AASHTO M182.

b. Liquid Membrane-Forming Compounds Curing Concrete: AASHTO M148.

c. Sheet Materials for Curing Concrete: AASHTO M171.

d. Straw shall not be used for curing unless approved by ENGINEER.

2. Air-Entraining Admixture: Air-entraining admixtures shall conform to the requirements of AASHTO M154. Admixtures which have been frozen will be rejected. No chloride containing additives shall be permitted.

3. Chemical Admixtures: Chemical admixtures for concrete shall conform to the requirements of AASHTO M194M/M194. Admixtures which have been frozen will be rejected.

4. Joint Fillers: The joint fillers shall meet the requirements of ASTM C920.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. The subgrade shall be excavated or filled to the required grades and lines. All soft, yielding, or otherwise unsuitable material shall be removed and replaced with suitable material with ENGINEER's approval. Filled sections shall be compacted and compaction shall extend a minimum of six (6) inches outside the form lines.

B. The moisture content of the subgrade shall be brought within +/- two percent (2%) of optimum moisture content and compacted to ninety-five percent (95%) of the maximum standard Proctor density (ASTM D698) for subgrade materials classified as A-4 through A-7 or ninety five percent (95%) of modified proctor density for materials classified as A-1 through A-3.

3.2 CONCRETE PLACEMENT

A. General:

1. Concrete transported in truck mixers or truck agitators shall be delivered to the site of the WORK and completely discharged within a period of ninety (90) minutes after the cement comes in contact with the mixing water or with the combined aggregates containing free moisture in excess of two percent (2%) by weight.

2. The concrete shall be placed either by an approved slip form/extrusion machine, by the formed method, or by a combination of these methods.

3. The subgrade shall be conditioned to provide a uniformly moist surface when concrete is placed.

B. Machine Placement: The slip form/extrusion machine shall be so designed to place, spread, consolidate, screed, and finish the concrete in one (1) complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogenous concrete section. The machine shall shape, vibrate, and/or extrude the concrete for the full width and depth of the concrete section being placed. It shall be operated with as nearly a continuous forward movement as possible. All operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the machine held to a minimum.

C. Formed Method:

1. The vertical face of previously sawed and adjacent asphalt pavement may NOT be used as a forming surface. CONTRACTOR shall use forms on front and back of all curb and gutter, sidewalks and crosspans.

2. The forms shall be of metal or other suitable material that is straight and free from warp, having sufficient strength to resist the pressure of the concrete without displacement and sufficient tightness to prevent the leakage of mortar. Flexible or rigid forms of proper curvature may be used for curves having a radius of one hundred (100) feet or less. Division plates shall be metal. Where directed by ENGINEER, CONTRACTOR shall use a thin metal back form to preserve landscaping, sprinklers, etc. Form shall be straight and rigid and shall be approved by ENGINEER prior to use on PROJECT.

3. The front and back forms shall extend for the full depth of the concrete. All of the forms shall be braced and staked so that they remain in both horizontal and vertical alignment until their removal. No wooden stakes will be allowed. They shall be cleaned and coated with an approved form-release agent before concrete is placed against them. The concrete shall be deposited into the forms without segregation and then it shall be tamped and spaded or mechanically vibrated for thorough consolidation. Low roll or mountable curbs may be formed without the use of a face form by using a straight edge and template to form the curb face. When used, face forms shall be removed as soon as possible to permit finishing. Front and back forms shall be removed without damage to the concrete after it has set.

4. Should the removal of adjacent asphalt pavement be required beyond that shown in the asphalt patch detail to properly correct failed concrete sections, CONTRACTOR shall remove and replace said asphalt pavement to such an extent as to provide a smooth repair. ENGINEER shall be notified prior to commencing any additional asphalt removal.

3.3 FINISHING

A. The plastic concrete shall be finished smooth by means of a wood float and then it shall be given final surface texture using a light broom or burlap drag. Concrete that is adjacent to forms and formed joints shall be edged with a suitable edging tool to the dimensions shown on the DRAWINGS.

3.4 JOINTING

A. Contraction Joints:

1. Contraction and construction joints shall be placed at the standard spacing of ten (10) feet in curb, gutter, sidewalks, crosspans, trickle channel, etc. A minimum spacing of five (5) feet shall be allowed for repairs.

2. Transverse weakened-plane contraction joints shall be constructed at right angles to the curb line at intervals not exceeding ten (10) feet for curb and gutter or five (5) feet for sidewalk. Joint depth shall average at least one-fourth (1/4) of the cross-section of the concrete.

3. Contraction joints may be sawed, hand-formed, or made by one-eighth inch (1/8") thick division plates in the formwork. Sawing shall be done early after the concrete has set to prevent the formation of uncontrolled cracking. The joints may be hand-formed either by (1) using a narrow or triangular jointing tool or a thin metal blade to impress a plane of weakness into the plastic concrete, or (2) inserting one-eighth inch (1/8") thick steel strips into the plastic concrete temporarily. Steel strips shall be withdrawn before final finishing of the concrete. Where division plates are used to make contraction joints, the plates shall be removed after the concrete has set and while the forms are still in place.

B. Expansion Joints:

1. Expansion joints shall be constructed at right angles to the curb line at immovable structures and at points of curvature for short radius curves. Filler material for expansion joints shall conform to requirements of the requirements of ASTM C920 and shall be furnished in a single one-half inch (1/2") thick piece for the full depth and width of the joint.

2. Expansion joints in a slip-formed curb or curb-and-gutter shall be constructed with an appropriate hand tool by raking or sawing through partially set concrete for the full depth and width of the section. The cut shall be only wide enough to permit a snug fit for the joint filler. After the filler is placed, open areas adjacent to the filler shall be filled with concrete and then troweled and edged. CONTRACTOR may choose to place the filler and pour the concrete around it.

3. Alternately, an expansion joint may be installed by removing a short section of freshly extruded curb-and-gutter immediately, installing temporary holding forms, placing the expansion joint filler, and replacing and reconsolidating the concrete that was removed. Contaminated concrete shall be discarded.

4. Construction joints may be either butt or expansion-type joints. Curbs or combined curbs-and-gutters constructed adjacent to existing concrete shall have the same type of joints as in the existing concrete, with similar spacing; however, contraction joint spacing shall not exceed ten (10) feet.

3.5 PROTECTION

A. CONTRACTOR shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper or plastic sheeting. For slip-form construction, materials such as wood planks or forms to protect the edges shall also be required. Concrete damaged by rain shall be required to be removed and replaced at CONTRACTOR's expense.

B. Concrete being placed in cold weather during which the temperature may be expected to drop below thirty-five degrees Fahrenheit (35°F), shall be suitably protected to keep the concrete from freezing until it is at least ten (10) days old. Concrete injured by frost action shall be required to be removed and replaced at CONTRACTOR's expense.

C. CONTRACTOR shall be responsible for correcting any vandalism or defacement (graffiti) that occurs on the concrete prior to final acceptance.

3.6 CURING

A. Concrete shall be cured for at least seven (7) days after placement to protect against loss of moisture, rapid temperature change, and mechanical injury prior to any overlay or reconstruction work. Moist burlap, waterproof paper, white polyethylene sheeting, white liquid membrane compound, or a combination thereof may be used as the curing material. Membrane curing shall not be permitted in frost-affected areas when the concrete will be exposed to deicing chemicals within thirty (30) days after completion of the curing period.

3.7 BACKFILLING

A. The spaces in front and back of curbs shall be refilled with suitable material to the required elevations after the concrete has set sufficiently. The fill material shall be thoroughly tamped in layers.

3.8 SEALING

A. Where required, concrete shall be sealed with a mixture of one-half (1/2) linseed oil and one-half (1/2) diesel fuel, unless otherwise specified by ENGINEER.

3.9 TOLERANCE

A. Forms shall not deviate from true line by more than one-quarter (1/4) inch at any point.

B. Mixed concrete shall be not less than fifty degrees Fahrenheit (50°F), nor more than eighty degrees Fahrenheit (80°F) at the time of placement in forms, unless otherwise directed.

C. If air temperature is thirty-five degrees Fahrenheit (35°F) or less at the time of placing, ENGINEER shall require water and/or aggregate heated to not less than seventy degrees Fahrenheit (70°F), or more than one-hundred fifty degrees Fahrenheit (150°F).

D. Finished joints shall not deviate more than one-quarter (1/4) inch in the horizontal alignment from a straight line.

E. Any localized humps and or depressions greater than one-quarter (1/4) inch shall require removal and replacement of the WORK in question at CONTRACTORS expense.

F. No ponding of water greater than three-eighths (3/8) inch shall be allowed.

G. Combination curb, gutter and walk and/or vertical curb and gutter flowline depth shall not vary from adopted standards by more than +/- one-half (1/2) inch, measured vertically from the top of curb to the gutter invert.

H. Pedestrian walks shall have a minimum of two percent (2.0%) and a maximum of two and one half percent (2.5%) slope toward the roadway.

I. Heave or settlement of sidewalk, relative to separate curb pour, greater than one-half (1/4) inch shall be cause for corrective action. This provision shall not apply to transverse sidewalk joints.

3.10 QUALITY CONTROL

A. Contractor shall engage a qualified testing and inspecting agency to provide Quality Control testing.

B. Testing: Concrete testing and testing laboratory services required shall conform to the following unless otherwise determined by ENGINEER.

Section Type of Test	**Project Acceptance Frequency**	**Point of Sampling Acceptance**	**Procedures**	
			Test Sampling	**Project Testing**
Sidewalks (Concrete Aggregate Gradation)	1/1000 square yards or fraction thereof for size aggregate of concrete placed	Stockpile, Belt or Bin	CDOT CP30	CDOT CP31A
Curbing (Concrete Aggregat	1/2000 lineal feet or fraction thereof for each size aggregate of concrete placed		CDOT CP30	CDOT CP31A
Moisture Content	1 per day and as often as needed for quality control		CDOT CP30	CDOT CP60

Section Type of Test	**Project Acceptance Frequency**	**Point of Sampling Acceptance**	**Procedures**	
			Test Sampling	**Project Testing**
Moisture Content (Coarse Aggregat	1 per day min. where moisture content is greater than +0.5% from SSD condition	Stockpile, Belt or Bin	CDOT CP30	CDOT CP60

Slump	1 set of tests for every 1000 square yards or fraction thereof of concrete placed per a day	The slump, air content, unit weight and compressive strength tests shall be carried out on the first truck of concrete for the daily placement and thereafter in conformance with this table by sampling from the mixer discharge or pumper truck discharge hose	AASHTO T141	AASHTO T119M/ T119
Air Content	1 set of tests for every 1000 square yards or fraction thereof of concrete placed per a day		AASHTO T141 T199	AASHTO T152
Yield and Cement	4 tests for every 2000 lineal feet or fraction thereof of concrete placed per		AASHTO T141	AASHTO T121M/ T121
Compressive (Sidewalks)	1 set (4) of cylinders per 1000 square yards or fraction thereof of concrete placed per		AASHTO T141 T23	AASHTO T22
Compressive (Curbing)	1 set (4) of cylinders per 2000 lineal feet or fraction thereof of concrete placed per		AASHTO T141 T23	AASHTO T22

C. Repair:

1. Prior to backfilling and after forms are removed, honeycombed, defective or damaged areas of concrete shall be repaired. Repairs shall be made within seven (7) days after the forms are removed.

2. At the time of final acceptance inspection, the repair of all cracks shall be completed.

   a. Cracks that are less than one-quarter (1/4) inch wide, exhibit no horizontal or vertical shifting, and do not meet the conditions in 2, 3, and 4, below may, at the discretion of the OWNER, be sealed by routing approximately three-quarter (3/4) inch to one (1) inch deep by one-quarter (1/4) inch wide and filling with Sikaflex 1-A or equivalent.

   b. Any crack that extends through a joint shall require removal and replacement of the entire cracked area.

   c. Any longitudinal cracked section of concrete shall require complete removal and replacement of that section between joints.

   d. Repair action for hairline cracks as determined in 1, above, may be waived at the discretion of OWNER. For the purpose of this section, a hairline crack is one that is reasonably immeasurable and without separation as determined by ENGINEER.

3.11 CLEAN-UP

A. The surface of the concrete shall be thoroughly cleaned upon completion of the WORK

and prior to the substantial completion walk through, and the site left in a neat and orderly condition.

END OF SECTION

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SECTION 13560

INSTRUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for communications and networking equipment.

1.3 GENERAL

A. Supplementing this Section, the drawings provide installation details for instruments and sensors.

PART 2 - PRODUCTS

2.1 WEIGHTED FLOAT-TYPE LIMIT SWITCHES

A. Weighted Float-Type Level Switches shall comply with the following requirements:

1. Switch: Single Pole, double throw mercury switch.

2. Contact Rating: 5A (minimum) at 120 VAC

3. Housing: Encapsulated in plastic, NEMA 6 rated.

B. Manufacturers: Provide B/W Controls, Dwyer FSW, Consolidated Electric, or approved equal.

2.2 PRESSURE INDICATING TRANSMITTER

A. The gage and differential pressure indicating transmitters shall be a two wire 4-20 mA linear transmitting device proportional to the applied direct pressure. Each transmitter shall have the following standard features:

1. Independent zero and span adjustments

2. Adjustable dampening 0.0 to 36.0 seconds

3. Integral solid state circuitry, RFI filtering and shielding

4. 100 to 1 turndown elevated zero range of 100% upper limit, capability to drive 0 to 500 ohm loads at 24 VDC.

B. The transmitter shall have an accuracy of +/- 0.075% of span. Minimum operating temperature range shall be -40 to 185°F.

C. Process Connection

1. Process Wetted Parts shall be 316 Stainless Steel.

2. Process flanges and diaphragm seals shall be 316 stainless steel; except for use in chemical room applications.

3. Process connections shall be 1/2" NPT.

4. The transmitter shall be setup with the proper span and a zero suppression (or elevation).

5. The transmitter shall have instrument mounted 4-digit LCD meter with HART programming.

D. Pressure transmitters shall be supplied with 316 SS block and bleed valves for maintenance and calibration. Process wetted materials shall be 316 SS with Viton seals. Block and bleed valves shall be Hex HB50 Series, Anderson Greenwood M25 Series or equal.

E. Chemical feed applications shall utilize Hastelloy C, with seats compatible with the connected process fluid.

F. Differential pressure transmitters shall be supplied with 316 SS, three way valve manifolds for maintenance and calibration. Process wetted materials shall be compatible for the service application specified. Three valve manifolds shall be Hex, Anderson Greenwood M1 Series or equal.

G. Pressure snubbers shall be provided for all air service transmitters. Snubbers shall be 316 stainless steel. Snubbers shall be Aschroft or equal.

H. Pressure Transmitter shall be Siemens Sitrans P DSIII, Rosemount 3051, Endress Hauser.

2.3 INTRUSION SENSORS

A. Intrusion Sensors shall comply with the following requirements:

1. Intrusion sensor contacts shall be surface mount, sealed aluminum enclosure, and armored stainless steel cable with wire leads.

2. Magnetic limit switches shall provide a normally closed dry contact for SCADA indication. This shall provide for an energized circuit when the doors are closed.

B. Intrusion sensors shall be General Electric 2500 Series or equal.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 13570
CONTROL PANELS

PART 1 - GENERAL

1.4 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.5 SUMMARY

A. This Section includes requirements for communications and networking equipment.

1.6 GENERAL

A. Control panels shall be used to house RTUs and other electrical control equipment. All control panels shall consist of an enclosure and removable sub-panel. All equipment and wiring shall be mounted on the removable sub-panels.

B. Every effort should be made to minimize downtime at startup. Sub-panels shall be pre-assembled, wired, and tested prior to startup. See specification requirements for Factory Acceptance Testing.

C. Supplementing this Section, the drawings indicate the architecture of the system and control panel internal power distribution.

PART 2 - PRODUCTS

2.1 CONTROL ENCLOSURES

A. Contractor shall provide and install a mounting system for all control enclosures.

B. Contractor shall be responsible for sizing of control enclosures. Control Enclosures must be sized appropriately to allow for adequate air flow and manufacturer recommended spacing of devices for adequate heat dissipation.

C. Contractor shall provide strip heaters as indicated on the drawings. Strip heaters shall be sized to prevent condensation within the enclosure and to maintain equipment above its minimum operating temperature. Strip heaters shall be located to avoid overheating electronic equipment or producing large temperature fluctuations. Strip heaters shall be controlled by a thermostat, internal or external. A circuit disconnect switch shall be provided within the enclosure.

D. Control enclosures and sub panels shall be Hoffman, Wiegmann, or equal.

2.2 TERMINAL BLOCKS

A. Terminal blocks for power distribution and digital signals shall comply with the following requirements:

1. Terminal blocks shall be UL rated for 600V, 30A minimum.

2. Terminal blocks shall have a compression-style screw clamp connection.

3. Terminal blocks shall be capable of accepting #12 AWG wire.

4. Terminal blocks directly associated with digital I/O signals shall be two-tier with pre-manufactured jumper bars for distribution of common signals.

B. Terminal blocks for analog signals shall comply with the following requirements:

1. Terminal blocks shall be UL rated for 300V, 20A minimum.

2. Terminal blocks shall have a compression-style screw clamp connection.

3. Terminal blocks shall be capable of accepting #16 AWG wire.

4. Terminal blocks shall be three-tier sensor blocks for termination of signal positive, negative, and shield with pre-manufactured jumper bars for distribution of common signals.

5. Terminal blocks directly associated with analog inputs shall have surge suppression built-in. They shall be Phoenix Contact TT-2-PE-24DC, or approved equal.

C. Fuse blocks shall comply with the following requirements:

1. Fuse blocks shall be UL rated for 600V, 10A minimum.

2. Fuse blocks shall incorporate a hinged lever that accepts 5x20 mm fuses.

3. Fuse blocks shall have a compression-style screw clamp connection.

4. Fuse blocks shall be capable of accepting #12 AWG wire.

5. Fuse blocks shall contain blown-fuse indication through the use of a neon lamp or an LED.

D. All terminal blocks and fuse blocks shall be designed for DIN rail mounting.

E. Contractor shall provide terminal block end sections and end stops as necessary for a complete installation.

F. Terminal blocks and fuse blocks shall be provided with snap-on label strips. Stick-on labeling is not acceptable. Labeling shall be consistent with Contractor's control panel drawings. Contractor shall clearly label all terminal blocks in every control panel; unlabeled terminal blocks are not acceptable.

G. Terminal blocks and fuse blocks shall be ABB, Allen-Bradley, or equal.

2.3 INTERPOSING RELAYS

A. Interposing relays shall comply with the following requirements:

1. Relays shall be plug-in style with a DIN-rail mountable base.

2. Relays shall have LED-based on/off indication.

3. Relays shall have a manual operator.

B. Interposing relays shall be used for all RTU or Radio digital outputs.

C. Interposing relays shall be 10A, SPDT with coil voltage to match circuit requirements

D. Interposing relays shall be Allen Bradley 700-HA series, IDEC RH series, or equal.

2.4 UNINTERRUPTIBLE POWER SUPPLY

A. All RTU-based control panels shall incorporate an Uninterruptible Power Supply (UPS) consisting of a 24VDC Power Supply, 24VDC UPS Power Module, and a 24VDC Battery. The UPS shall provide full power to the RTU in the event of AC power loss.

B. UPS equipment shall be sized by the Contractor to provide a minimum of 30 minutes runtime upon loss of AC power. Contractor shall submit UPS loading calculations for approval.

C. UPS equipment shall be SolaHD SDU DC Series or approved equal.

2.5 CONTROL PANEL SURGE SUPPRESSION

A. Each control panel shall incorporate a transient-voltage surge suppressor on the incoming line. Surge suppressors shall be properly sized by the Contractor based upon the maximum current draw of the control panel.

B. Surge suppressors shall be Innovative Technology, Leviton, or equal.

PART 3 - EXECUTION

3.1 CONTROL PANEL CONSTRUCTION

A. The Contractor shall design control panels to allow sufficient space for all interior mounted equipment and wiring. Control panels shall be sized for ease of maintenance.

B. All control panels shall have 10% spare terminal blocks and fuse blocks, with a minimum of 20 spare terminal blocks and 6 spare fuse blocks. Spare terminal blocks and fuse blocks shall be labeled.

C. The Contractor shall develop and submit to the Engineer a to-scale layout drawing of each control panel.

3.2 CONTROL PANEL WIRING PRACTICES

A. All internal control panel wiring shall be a minimum of #16 AWG. Power distribution wiring shall be stranded copper with MTW insulation, rated 600V. Digital input/output wiring shall be stranded copper UL 1061, rated 300V. Analog input/output wiring shall be stranded copper, twisted, shielded pair, #24 AWG minimum, rated 300V.

B. Every effort shall be made to segregate analog signals from power distribution and

digital signal wiring. Where analog wiring must cross other wiring, it shall cross at right (90 degree) angles.

C. All wires entering or leaving the control panel shall attach to the terminal strip.

D. Wiring color continuation shall be:

120 VAC control power	RED
Neutral	WHITE
Ground	GREEN
Power from remote source	YELLOW
24 volt DC (+)	BLUE
24 volt DC (-)	BLUE W/WHITE STRIPE

E. All wiring shall be firmly supported inside the control panel. A cable management system such as Panduit shall be utilized in each control panel. Wire ties shall be used as needed to support cabling and to provide a clean installation. The Contractor shall size the cable management systems to allow ample space for both internal control panel wiring and field wiring.

F. All wiring in each control panel shall be clearly labeled with the same designation on both ends. Wire labels shall be easily matched to the control panel drawings.

G. All wiring shall be in compliance with the National Electrical Code and other applicable state and local building codes.

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APPENDIX A

GEOTECHNIAL ENGINEERING REPORT

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