STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS

VOLUME 2

City of Federal Heights, Colorado
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TABLE OF CONTENTS

VOLUME 1 - DESIGN STANDARDS AND STANDARD DRAWINGS

STORM AND SEWER SYSTEMS STANDARD DRAWINGS

4-1 Curb Inlet - Type R
4-2a Curb Inlet - Type R
4-2b Curb Inlet - Type R
4-3 Manhole Base Design/Detail
4-4 Drop Manhole
4-5 Pipe Bedding for Sewer Mains
4-6 Pipe Bedding Classes for Sewer Mains
4-7 Standard Manholes
4-8 Trench Patching
4-9 Standard Cleanout Detail
4-10 Jacking Detail
4-11 Typical Underdrain Cleanout
4-12 Standard Sanitary Sewer Underdrain Cleanout

VOLUME 2 - CONSTRUCTION SPECIFICATIONS

Chapter 8 - Construction Specifications

TABLE OF CONTENTS

CHAPTER 8
CONSTRUCTION SPECIFICATIONS

SECTION 01050

ABBREVIATIONS AND SYMBOLS

1.01 RELATED REQUIREMENTS

A. Drawings for Symbols

B. Drawings or Schedules for Abbreviations

1.02 ABBREVIATIONS

Reference in Contract Documents to trade associations, technical societies, recognized authorities and other institutions include following organizations, which are sometimes referred to only by corresponding abbreviations:

AASHTO	American Association of State Highway and Transportation Officials (Note: AASHTO "T" references for compaction shall mean maximum density at optimum moisture.)
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWPI	American Wood Preservers' Institute
AWWA	American Water Works Association
AWS	American Welding Society
AWPA	American Wood Preservers' Association
BIA	Brick Institute of America (Successor to SCPI)
CDOT	Colorado Department of Transportation
CBMA	Certified Ballast Manufacturers' Association
CISPI	Cast Iron Soil Pipe Institute
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
CSI	Construction Specifications Institute
DFPA	Douglas Fir Plywood Association (APA)

FS	Federal Specification
FM	Factory Mutual
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IPCEA	Insulated Power Cable Engineers' Association
JIC	Joint Industry Conferences of Hydraulic Manufacturers
MGPEC	Metropolitan Government Pavement Engineers Council
MIL	Military Specification
NBFU	National Board of Fire Underwriters
NBS	Nation Bureau of Standards
NEC	National Electric Code (of NFPU)
NEMA	National Electrical Manufacturers' Association
NESC	National Electric Safety Code
NFPA	National Forest Products Association
NFPA	National Fire Protection Association
NLMA	National Lumber Manufacturers' Association
OECI	Overhead Electrical Crane Institute
OSHA	Occupational Safety and Health Administration
PS	Product Standard (U.S. Department of Commerce)
RLM	RLM Standards Institute, Inc.
SPR	Simplified Practice Recommendation (U.S. Dept of Commerce)
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufacturers' Association
UBC	Uniform Building Code
UL	Underwriters' Laboratories, Inc.
UPC	Uniform Plumbing Code

END OF SECTION

SECTION 01060

MEASUREMENT AND PAYMENT (CITY CONTRACTS ONLY)

PART 1 GENERAL:

1.1 SECTION INCLUDES

For each bid item, the work will be measured and paid for on either a unit price basis or on a lump sum basis. The quantities provided on the bid are estimates of the actual quantities of work only, and are included solely for the purpose of determining the probable cost of work. The actual quantities of work may differ from the bid quantities. The basis of measurement and payment for all unit price bid items will be the actual amount of work completed and accepted. All labor, equipment, materials, and any incidentals required to complete the work will be considered subsidiary to that bid item and will not be measured or paid for separately. Contractor agrees to make no claim for damages, loss of anticipated profits, or otherwise, due to differences between the actual work quantities and the estimated bid quantities.

Payment will be made only for those items included in the bid that have been accomplished. No work will be paid for which is not completed in accordance with the drawings and specifications, and accepted by engineer. Except as may be otherwise stipulated, no labor, equipment, materials, or any incidentals required to complete the work will be furnished by owner. The basis of measurement and payment for each bid item is described below. A general listing of bid items, accompanied by a brief summary of the work, is provided below. It is not intended to completely describe all work. Refer to the drawings and specifications for detailed information on each bid item.

1.2 BID ITEMS

A. Mobilization

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:

- Mobilization to and from Site
- Installing temporary fencing/security items as deemed necessary by contractor
- Establishing contractor's necessary facilities
- Provide Residents and Businesses written notification
- Obtaining permits
- Permit Fees
- Providing required bonds and insurance.
- Preparing the project schedule
- Provide all construction surveying required to build the project to the

dimensions shown on the drawings

- Removing contractor's equipment, supplies, excess materials, and cleaning up the site
- Prepare As-Constructed Drawings (Hard Copy and Electronic Autocad File)
- 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. Fifty percent (50%) of the lump sum price will be paid at the time of the first monthly progress payment; an additional thirty percent (30%) will be paid when one-half the original contract amount is earned. The remaining twenty percent (20%) will be paid upon initial acceptance of the project. The total amount for mobilization will not exceed eight percent (8%) of the total bid.

Bid Item	Pay Unit
Mobilization	LS

B. Erosion and Sediment Control

No separate measurement for payment will be made for any labor, materials, and equipment 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 Erosion and Sediment Control Plan in accordance with the drawings and specifications and accepted Erosion 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 initial acceptance of the project.

Bid Item	Pay Unit
Erosion and Sediment Control	LS

C. 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. This work includes:

- Construction, Warning, Regulatory Signs
- Barricades with lighting: Delineators, Drums, Cones, Type 4 Concrete Barriers
- Safety Fencing
- Certified Flaggers
- Arrow Boards (where required)
- Message Boards (if required)
- Daily Traffic Control Monitoring by Traffic Control Supervisor

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 initial acceptance of the project.

Bid Item	Pay Unit
Traffic Control	LS

D. Surveying, Utility Locates & Potholing

The contractor is responsible for construction surveying, utility locates and utility potholing. This work is considered incidental and shall be included in the bid price. There is no separate pay item for this work.

E. Removal of Structures and Obstructions

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 which are not specifically measured and paid for under other bid items. This bid item includes removing, hauling, and disposing of structures and obstructions (except as noted) including, but not limited to, existing pipe/culverts, inlets, concrete, asphalt, and any structures and obstructions which interfere with the work; backfilling of excavations for removal of structures and obstructions with suitable material; compacting; 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
Removal of Combination Curb, Gutter & Sidewalk	LF
Removal of Curb Ramp	EA
Removal of Concrete Street Crosspan	SF

Removal of Concrete Gutter	LF
Removal of Concrete Vertical Curb & Gutter	LF
Removal of Concrete Sidewalk	SF
Removal of Manhole (Return Frame & Cover to City)	EA
Removal of Cleanout (Return Frame & Cover to City)	EA
Removal of Gate Valve (Return to City)	EA
Removal of GV Box & Cover (Return to City)	EA
Removal of Fire Hydrant Assembly (Return to City)	EA
Removal of Asbestos Pipe Sections (Location)	EA
Removal of Residential CMP Meter Vault	EA
Removal of Water Meter Yoke (incl. meter removal) EA	
Removal of Concrete Inlet (Return Frame & Grate to City)	EA
Asphalt Pavement removal (beyond req'd. for trench excavation)	SY

F. Storm Sewer (Pipe, Manholes, Inlets, Service Connection, Etc.)

The measurement for payment for each of these items will be the actual number of linear feet of pipe installed, complete in place, measured along the center line of the pipe from the end of one fitting to the end of another or to a given station or from one from given station to another given station. The unit price will include all of Contractor's costs. These bid items include:

- Pipe measurement shall not be made through fittings and other appurtenances
- Locating and protecting all existing utilities in and along the pipe length.
- Furnishing, transporting, and installing all pipe and materials.
- Furnishing, transporting, and installing jointing materials, special fittings and other miscellaneous items
- Removing surfacing materials (asphalt,), as required.
- Excavating and Trenching, including exploratory excavation
- Constructing the specified bedding includes furnishing, placing, and compaction
- Furnishing and installing protective coatings or wrapping, or pipe encasements
- Backfilling including furnishing, transporting, placing material and compaction
- Supporting trenches
- Protecting above ground and underground utilities and service connections.
- Disposing debris, pipe, excess excavated material and damaged materials.
- Videoing & furnishing a DVD copy to the City
- Adjusting location of existing small utilities and valves
- Furnishing, transporting, and installing jointing materials including: O-rings, gaskets, bolts, concrete collars, connecting bands and other miscellaneous items

- Temporary Trench Surfacing (3”HBP or 6” Asphalt Millings) Not Separate Pay Item
- 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
_” Class _ RCP or PVC	LF
_” PVC SDR _	LF
_” CSP	LF
Connections to Structures/Pipe	EA
_” Inch Concrete Manhole	LF
_” __º Bend RCP	EA
_” __º Bend PVC	EA
Concrete Encasement	CY

G. Curb Inlet

The measurement for payment for each of these items will be on a per-each basis, complete in place in accordance with the DRAWINGS and SPECIFICATIONS or as otherwise directed by ENGINEER. The unit price will include all of CONTRACTOR's costs. This BID item includes:

- Furnishing; transporting; and installing all materials including concrete, reinforcing steel, grout, and curb box or open throat box, and any necessary connections
- Access frames and covers will be furnished by the City of Federal Heights. Contractor to pick up from East Jordan Iron Works
- Excavating, backfilling and compacting, including imported backfill material if no suitable on-site material is available
- 2 foot asphalt width remove and replace
- Removing pavement, base course, subbase material, sod, and other surfacing material outside of the prescribed trench width, which is not paid for under another section of these SPECIFICATIONS
- 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
Curb Inlet – __’ Type ‘R’	EA

H. Water (Pipe, Valve, Fitting, Service Connection, Etc.)

The measurement for payment for each of these items will be the actual number of linear feet of pipe installed, complete in place, measured along the center line of the pipe from the end of one fitting to the end of another or to a given station or from one from given station to another given station. The unit price will include all of Contractor's costs. These bid items include:

- Pipe measurement shall not be made through fittings and other appurtenances
- Locating and protecting all existing utilities in and along the pipe length.
- Furnishing, transporting, and installing all pipe and materials.
- Furnishing, transporting, and installing jointing materials, special fittings and other miscellaneous items
- Excavating and Trenching, including exploratory excavation
- Constructing the specified bedding including the furnishing, placing, & compaction
- Furnishing and installing protective coatings or wrapping
- Backfilling including furnishing, transporting, placing material & compaction
- Tracer Wire on all water main
- Supporting trenches
- Underground utility marker tape
- Protecting above ground and underground utilities and service connections.
- Disposing debris, pipe, excess excavated material, and damaged materials.
- Testing – Flushing main, Chlorination, Pressure, Clear Water
- Disinfecting of water main and fittings
- Fire Hydrant Assembly includes Fire Hydrant, 6" GV, 6" DIP, Support (FH & GV), drainage gravel, restraints, thrust block and 6" concrete slab around Fire Hydrant @ grade
- Tees, Fittings and Gate Valves include support, restraints (Meg-A-Lugs, Rods, etc.), thrust blocking
- ¾" type K copper service line includes tapping saddle and corporation stop
- New meter yoke includes reinstalling existing meter
- Concrete sectional meter vault (includes removal and replacement of private concrete/asphalt areas around existing meter vault)
- Temporary Trench Surfacing (3"HBP or 6" Asphalt Millings) Not Separate Pay Item
- 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
__" Inch PVC (C900) Water Piping	LF
__" Type K Copper	LF

Tees	EA
Gate Valves	EA
Fire Hydrant Assembly	EA
Fittings (Plug, Bends, Flanges)	EA
Foster Adapter	EA
Meter Yoke	EA
Concrete Meter Vault	EA
Blow-Off Valve (Temporary & Permanent)	EA
Curb Stop	EA
Solid Sleeve	EA
Tracer Wire Test Port	EA
Vaults	EA
__" PRV w/inline Strainer	EA

I. Sanitary Sewer (Pipe, Manholes, Service Connections, Etc.)

The measurement for payment for each of these items will be the actual number of linear feet of pipe installed, complete in place, measured along the center line of the pipe from the center of one manhole to the center of another (less inside ID of manholes)or to a given station or from one from given station to another given station . The unit price will include all of Contractor's costs. These bid items include:

- Pipe measurement shall not be made through manholes, fittings and other appurtenances.
- Protecting all existing utilities in and along the pipe length.
- Furnishing, transporting, and installing all manholes, pipe and materials.
- Furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and specifications
- Furnishing, transporting, and installing required jointing materials
- Removal of existing pavement material
- Excavating, & Trenching, including exploratory excavation
- Constructing the specified bedding including the furnishing, placing, and compaction
- Backfilling including furnishing, transporting, placing material and compaction
- Underground utility marker tape
- Furnishing and installing protective coatings or wrapping; pipe encasements
- By-pass pumping or other means of maintaining sanitary sewer service
- Supporting trenches
- Protecting above ground and underground utilities and service connections.
- Disposing debris, pipe, excess excavated material, and damaged materials.

- Videoing & furnishing a DVD copy to the City
- Connection to existing structures shall include core drilling or other approved method and modifying existing manhole channel
- Sanitary Sewer Service Reconnection shall include all required materials (4" service wye, pipe (10 ft-each), coupling, fittings, etc.)
- Manhole shall include concrete base, precast concrete sections, frame & cover
- Temporary Trench Surfacing (3"HBP or 6" Asphalt Millings) Not Separate Pay Item
- 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
__" Inch PVC SDR 35	LF
__" Inch Concrete Manhole	EA
Connections to Structures	EA
Sanitary Sewer Service Reconnection	EA
Concrete Encasement	CY

J. Concrete Curb, Gutter & Sidewalk, Drainage CrossPan

The measurement for payment for this item will be the actual number of lineal feet, complete in place, in accordance with the Drawings and specifications or as otherwise directed by engineer. No measurement for payment will be made for sidewalk replaced outside of that specified on the Drawings and specifications. No measurement for payment will be made for replacement of materials damaged by Contractor's operations. Contractor must furnish duplicate copy of truck trip tickets. The unit price will include all of Contractor's costs. This bid item includes:

- Removing and disposing all damaged and broken concrete, or other surface debris
- Furnishing and placing concrete, including coloring
- Forming and edging
- Curb pedestrian ramp with truncated domes (plate or stamped pattern)-Red Concrete
- Fiber reinforcement
- Furnishing and installing expansion joints
- Furnishing and applying the curing compounds
- Saw cutting control joints and existing concrete as required
- Furnishing and compacting all materials required for a stable subbase
- Backfilling and compacting
- Providing all other related and necessary labor, equipment, and materials

to complete the work.

Payment will be based on units complete and accepted.

Bid Item	Pay Unit
Concrete Combination Curb, Gutter & Sidewalk	LF
Concrete Vertical Curb & Gutter	LF
Concrete Sidewalk	SF
Concrete Modified Rolled Curb	LF
Colored HC Curb Ramp w/Truncated Domes	EA
Street Drainage Cross Pan	SF

K. Concrete Flow-Fill

The measurement for payment for this item will be the actual number of cubic yards, complete in place, in accordance with the Drawings and specifications or as otherwise directed by engineer. Contractor must furnish duplicate copy of truck trip tickets. The unit price will include all of Contractor's costs.

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

Bid Item	Pay Unit
Concrete Flow-fill	CY

L. Hot Bituminous Pavement – Patching/Paving

The measurement for payment for this item will be the actual square yards, complete in place, in accordance with the Drawings and specifications or as otherwise directed by engineer. No measurement for payment will be made for replacement of materials damaged by Contractor's operations. Contractor must furnish duplicate copy of truck trip tickets. The unit price will include all of Contractor's costs. This bid item includes:

- Quantity based on a trench/excavation width of 3 feet plus 2 feet on each side of trench or excavation (T-Patch)
- Excavation width exceeding the quantity basis without prior approval, that result in a larger quantity of patching material will be at Contractor's expense
- Patching quantity for replacing damaged or broken pavement as result of construction activity will be at Contractor's expense
- Saw cutting existing pavement as required
- Removing and disposing all damaged and broken pavement, or other surface debris
- Furnishing and placing Tack Coat & Hot Bituminous Pavement

- Furnishing and compacting all materials required for a stable subbase (includes scarifying and recompacting)
- Providing all other related and necessary labor, equipment, and materials to complete the work.

Payment will be based on units complete and accepted.

Bid Item	Pay Unit
Hot Bituminous Pavement Patching - __" Thick	SY
Hot Bituminous Pavement Paving - __" Thick	SY

M. Site Restoration

No separate measurement for payment will be made for any labor, materials, and equipment required for this item. The lump sum price will include all of contractor's costs. This bid item includes all site restoration in accordance with the specifications and providing all other related and necessary labor, equipment, and materials to complete the work. This bid item includes:

- Restoring material storage and vehicle parking areas
- Damaged landscape areas, including irrigation systems
- Damaged private concrete areas (includes areas around meter vaults)
- Damaged concrete curb, gutter, sidewalk
- Damaged pavement
- Damaged pavement striping

Payment will be based on acceptance of site restoration.

Bid Item	Pay Unit
Site Restoration	LS

END OF SECTION

SECTION 01070

FIELD ENGINEERING (CITY CONTRACTS ONLY)

PART 1 - GENERAL

1.01 RELATED WORK

A. Related Documents: Construction Plans, General and Special Conditions of the Contract apply to work of this section.

1.02 SUMMARY

A. General: This Section specifies administrative and procedural requirements for field engineering services, including, but not necessarily limited to, the following: Survey and Layout Work (horizontal and vertical control)

1.03 SUBMITTALS

A. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of the Contract Documents.

B. As-Built Drawings and electronic as-built Autocad file.

1.04 QUALITY ASSURANCE

A. Surveyor: Engage a land surveyor with a minimum 5 years experience in layout and survey work, registered in the State where the project is located, to perform layout and surveying services required.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 INSPECTION

A. The city will identify existing control points indicated on the Drawings.

B. Verify layout information shown on the Drawings, in relation to the existing benchmarks before preceding to layout the work. Locate and protect existing benchmarks and control points, Preserve permanent reference points during construction.

1. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost of destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.
2. Promptly replace lost or destroyed project control points. Base replacements of the original survey control points.

C. Establish and maintain a minimum of two permanent benchmarks on the site, referenced to data established by survey control points.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

D. Existing Utilities and Equipment: The existence and location of underground and

other utilities and construction indicated as existing are not guaranteed, before beginning site work, investigate and verify the existence and location of underground utilities and other construction.

3.02 PERFORMANCE

A. Working from lines and elevations established by the existing conditions survey, establish benchmarks and markers to set lines and levels as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.

1. Advise entities engaged in construction activities, of marked lines and elevations provided for their use.

2. As construction proceeds, check every major element for line, level and plumb.

B. Surveyor's Log: Maintain a surveyor's log of control and other survey Work. Make this log available for reference.

1. Record deviations from required lines and levels, and advise the City when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.

C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.

D. Existing Utilities: Furnish information necessary to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in, or affected by construction, Coordinated with local authorities having jurisdiction.

END OF SECTION

SECTION 01300

SUBMITTALS (CITY CONTRACTS ONLY)

PART 1: GENERAL

1.1 REQUIREMENTS:

Where required by the Specifications, the Contractor shall submit descriptive information that will enable the City to determine whether the Contractor's proposed materials, equipment, or methods of work are in general conformance to the design concept and in accordance with the Drawings and Specifications. The information submitted may consist of drawings, specifications, descriptive data, certificates, samples, test results, product data, and such other information, all as specifically required in the Specifications. In some instances, specified submittal information describes some, but not all, features of the material, equipment, or method of work. Features not requiring submittals shall be as specified.

Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment, or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the requirements of the Specifications and Drawings. The Contractor shall ensure that there is no conflict with other submittals and notify the City in each case where its submittal may affect the Work of another Contractor or the City. The Contractor shall ensure coordination of submittals among the related crafts and subcontractors.

Submittals will be reviewed for overall design intent and returned to Contractor with action to be indicated by the City. It shall be the Contractor's responsibility to assure that previously accepted documents are destroyed when they are superseded by a resubmittal as such.

It shall be the Contractor's responsibility to insure that required items are corrected and resubmitted. Any work done before approval shall be at the Contractor's own risk.

1.2 SUBMITTAL PROCEDURE:

Unless a different number is called for in the individual sections, three copies of each submittal and sample are required, all of which will be retained by the City. Contractor shall submit in addition, whatever copies he wants returned to him.

Submittals that are related to, or affect each other, shall be forwarded simultaneously as a package to facilitate coordinated review. Uncoordinated submittals will be rejected.

If the items or system proposed are acceptable but the major part of the individual drawings or documents are incomplete or require revision, the submittal will be returned with requirements for completion.

The right is reserved for the City to require submittals in addition to those called for in individual sections.

Submittals regarding material and equipment shall be submitted directly to the City and will be accompanied by a transmittal form. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete Sections, for which the submittal is required. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.

A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX-Y;" where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals (i.e., A, B, or C being the first, second, and third resubmittals, respectively). Submittal 25B, for example, is the second resubmittal of Submittal 25. Submittals containing operating and maintenance information shall include the letters "O&M" following the submittal number.
If the Contractor proposes to provide material, equipment, or method of work that deviates from the Contract Documents, it shall indicate so under "deviations" on the transmittal form accompanying the submittal copies.

Submittals that do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.

1.3 REVIEW PROCEDURE**:**

Submittals are specified for those features and characteristics of materials, equipment, and methods of operation that can be selected based on the Contractor's judgment of their conformance to the requirements of the Drawings and Specifications. Other features and characteristics are specified in a matter that enables the Contractor to determine acceptable options without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform to the Drawings and Specifications. Review shall not extend to means, methods, techniques, sequences, or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the Specifications) of a separate item, and as such, will not indicate approval of the assembly in which the item functions.

Unless otherwise specified, within 14 calendar days after receipt of the submittal, the City shall review the submittal and return copies. The returned submittal shall indicate one of the following actions:

1. If the review indicates that the material, equipment, or work method complies with the Specifications, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.

2. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in Operation and Maintenance data, a corrected copy shall be provided.

3. If the review indicates that the submittal is insufficient or contains incorrect data, copies will be marked "REVISE AND RESUBMIT." Except at its own risk, the Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted, and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

4. If the review indicates that the material, equipment, or work method do not comply with the Specifications, copies of the submittal will be marked "REJECTED." Submittals with deviations that have not been identified clearly may be rejected. Except at its own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

1.4 SHOP DRAWINGS:

The term "shop drawings" includes drawings, diagrams, layouts, schematic, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by Contractor to explain in detail specific portions of the work required by the Contract.

Contractor shall coordinate all such drawings, and review them for legibility, accuracy, completeness and compliance with contract requirements and shall indicate his approval thereon as evidence of such coordination and review. Shop drawings submitted to the City without evidence of Contractor's approval will be returned for resubmission.

Shop drawings shall be clearly identified with the name and project number of this contract, and references to applicable specification paragraphs and contract Drawings. When catalog pages are submitted, applicable items shall be clearly identified.

Contractor shall stamp his approval on Shop Drawings prior to submission to the City as indication of his checking and verification of dimensions and coordination with interrelated items. Stamp shall read:

> "(Contractor's Name) represents that we have determined and verified all field dimensions and measurements, field construction criteria, materials, catalog numbers, and similar data, and that we have checked with the requirements of the Specifications and Drawings, the Contract Documents, and General Conditions".

Marks on drawings by Contractor shall not be in red. Any marks by Contractor shall be duplicated on all copies submitted.

If shop drawings show variations from contract requirements, Contractor shall describe such variations in writing, separate from the drawings, at time of submission. All such variations must be approved by the City. If the City's representative approves any such variations, he shall issue an appropriate Contract modification, except that, if the variation is minor and does not involve a change in price or in time of performance, a modification need not be issued.

Should the Contractor propose any item on his Shop Drawings, or incorporate an item into the work, and that item should subsequently prove to be defective or otherwise unsatisfactory, (regardless of the City's preliminary review), the Contractor shall, at his own expense, replace the item with another item that will perform satisfactorily.

1.5 OPERATION AND MAINTENANCE MANUALS:

For those items called for in individual sections, three copies of operation and maintenance manuals shall be furnished. Each manual shall be bound in three-ring notebooks with permanent covers, and separators with index tabs. Operation and Maintenance Manuals shall include installation instructions, operating instructions, schematic for electrical and hydraulic systems, maintenance literature, lubrication requirements, and parts lists.

1.6 CERTIFICATES:

For those items called for in individual sections, three certificates of compliance from manufacturers or suppliers shall be furnished certifying that materials or equipment being furnished under the Contract complies with the requirements of these specifications.

1.7 SAMPLES:

Samples shall be sufficient size to clearly illustrate functional characteristics and full range of color, texture, and pattern.

1.8 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS:

Review of Drawings, data, methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of its responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the City, or by any officer or employee thereof, and the Contractor shall have no claim under the Contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the City has no objection to the Contractor, upon its own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

END OF SECTION

SECTION 01400

QUALITY CONTROL (CITY CONTRACTS ONLY)

1.1 DESCRIPTION

A. This Section covers the responsibilities for project staking and for performing the tests required by these specifications.

1.2. CONSTRUCTION STAKE OUT

A. General.

1. All Construction stakes shall be provided by CONTRACTOR using qualified, competent personnel.
2. The grade and alignment shall be maintained by the use of suitable surveying instruments or laser equipment operated continuously during construction.

B. Grade Stakes.

1. Utility lines shall be staked on the center lines of the utility lines, at all fittings and angle points, any other points necessary for establishing the line. Cuts will be established at all main fittings to insure proper depth of the line.

C. Survey Notes.

1. Enter all survey notes and construction stake out cut notes into bound, hard cover field books.
2. All survey data developed by the CONTRACTOR in performing the Work shall be available throughout the construction period.

1.3. TESTS AND INSPECTIONS

A. The City will contract with an independent testing agency to perform City quality assurance tests to determine compliance with the specifications for the following:
1. Soil compaction control.
2. Cast-in-place concrete
3. Asphalt Pavement Density

B. The City may contract with a consultant engineering firm to supplement City's quality control inspections.

C. The CONTRACTOR shall conduct the following tests under the observation of

and to the statisfaction of the CITY REPRESENTATIVE.

1. Video taping of sanitary and storm sewers
2. Pressure and leakage tests for water system

CONTRACTOR shall pay for all re-tests of items which fail to pass initial tests specified in paragraph A. above as well as for all tests CONTRACTOR requires for control of his own construction operations.

END OF SECTION

SECTION 01410

TESTING

1.1 GENERAL

B. Provide such equipment and facilities as the City Representative may require for conducting field tests and for collecting and forwarding samples. Do not use any materials or equipment represented by samples until tests, if required, have been made and the materials or equipment are found to be acceptable. Any product, which becomes unfit for use after approval hereof shall not be incorporated into the work.

B. All materials or equipment proposed to be used may be tested at any time during their preparation or use. Furnish the required samples without charge and give sufficient notice of the placing of orders to permit the testing. Products may be sampled either prior to shipment or after being received at the site of the work.

B. Tests shall be made by an accredited testing laboratory and approved by the City Representative. Except as otherwise provided, sampling and testing of all materials and the laboratory methods and testing equipment shall be in accordance with the latest standards and tentative methods of the American Society for Testing Materials (ASTM).

B. Where additional or specified information concerning testing methods, sample sizes, etc., is required, such information is included under the applicable sections of the Specifications. Any modification of, or elaboration on, these test procedures which may be included for specific materials under their respective sections in the Specifications shall take precedence over the procedures referenced in C. above.

1.2 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall be responsible for the following:
   1. Video of utility pipelines, which include sanitary and storm sewers (DVD disk, -R format, speed not to exceed 2hrs per disk, on screen graphics shall be readable, audio narrative is required)
   2. Water line pressure testing
   3. Water line bacteriological testing
   4. An independent testing agency contract by the City of Federal Heights will perform soil, concrete and asphalt quality assurance testing. The contractor will be responsible for notification of testing agency.

B. In addition to those inspections and tests called for in the General Conditions, Contractor shall also be responsible for the following:
   1. Cost of retesting for Work or materials found defective or unsatisfactory.
   2. Cost associated with calling for testing, but work has not progress sufficiently for testing.

1.3 CONTRACTOR'S QUALITY CONTROL SYSTEM

A. General: The Contractor shall establish a quality control system to perform sufficient inspection and tests of all items of work, including that of his subcontractors, to ensure conformance to the functional performance of this project. This control shall be established for all construction except where the Contract Documents provide for specific compliance tests by testing laboratories employed by the City. Contractor's control system shall specifically include all testing required by the various sections of the Technical Specifications.

B. Contractor's quality control system is the means by which he assures himself that his construction complies with the requirements of the Contract Documents. Controls shall be adequate to cover all construction operations and should be keyed to the proposed construction schedule.

C. Records: Maintain correct records on an appropriate form for all inspections and tests performed, instructions received from City Representative and actions taken as a result of those instructions. These records shall include evidence that the required inspections or tests have been performed (including type and number of inspections or test, nature of defects, causes for rejection, etc.) proposed or directed remedial action, and corrective action taken. Document inspections and tests as required by each section of the Technical Specifications. Provide copies to City Representative weekly.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1.1 TEMPORARY UTILITIES

A. Construction Water.

1. Construction water is available as stated in the Project Special Condition.

2. Contractor shall be responsible for providing pumps, hose, equipment, transportation, and labor to obtain and utilize the construction water.

B. Temporary Electric Power.

1. Contractor shall make arrangements for temporary electric power installation and will pay all costs associated with the temporary electric power.
2. Temporary electric power installation shall be completed in a manner that does not impede power requirements or operation of the remainder of the facility.
3. Temporary electric power installation shall meet the construction safety requirements of OSHA, State, and other regulatory agencies.

C. Sanitary Facilities.

1. The Contractor shall provide sanitary facilities for his employees, subcontractor's employees, and other site visitors.
2. The facilities shall conform to code requirements, be acceptable to sanitation authorities, and be maintained in a sanitary condition at all times.
3. Upon completion of the work, the sanitary facilities shall be removed and the area restored to its original condition.

1.2 TEMPORARY CONTROLS

A. Noise Control.

1. Equip construction machinery and vehicles with practical sound and muffling devices and operate in a manner to minimize noise consistent with efficient performance of the Work.

B. Dust Control.

1. Take reasonable measures to prevent unnecessary dust so as not to create a nuisance.
2. Moisten dirt and gravel roads used for transportation with water or apply a chemical dust suppressant to control dust.
3. Cover dusty material in transit to prevent blowing.

C. Pollution Control.

1. Prevent the pollution of drains and water courses by sanitary wastes, sediment, debris, and other substances resulting from construction activities.
2. Retain all spent oils, hydraulic fluids, and other petroleum fluids in containers for disposal at approved locations off the site.
3. Do not perform equipment maintenance or fueling within fifty feet (50') of any water course.

D. Erosion Control.

1. Contractor to develop an Erosion Control Plan and submit it to the City Engineer for review prior to construction.
2. Reference to Specification 02370 (Erosion and Sediment Control)
3. Take such measures as are necessary to prevent erosion of soil, on the site and adjacent properties that might result from construction activities.
4. Provide temporary materials such as hay bales, sand bags, plastic sheets, inlet protection devices, fabric, rip-rap, or culverts to prevent the erosion of banks or excavations where runoff may be increased or concentrated due to construction activities.

1.3 TRAFFIC REGULATION

A Contractor shall develop a Traffic Control Plan and submit to the Public Works Department or City Engineer for review prior to construction.

B. Keep traffic areas free of excavated material, construction equipment, pipe, and other materials and equipment unless otherwise stipulated; and conduct operations in a manner to avoid unnecessary interference with the public and roads.

C. Furnish properly-equipped flagmen where necessary to provide for public safety or where required by jurisdictional authorities.

D. Warning Signs and Lights.

1. Provide barricades and warning signs for open excavations, parked equipment, and soil stockpiles.

2. Illuminate by means of warning lights all barricades and obstructions from sunset to sunrise.
3. Comply with the "Manual on Uniform Traffic Control Devices", U.S. Dept. of Transportation, or applicable statutory requirements of the State Highway Department.

E. Provide suitable parking areas for the use of all construction workers and others performing work in furnishing services in connection with the Project so as to avoid interference with construction activities.

1.4 SUBMITTALS.

A. Erosion Control Plan.

1. Contractor is required to submit an erosion control plan to the City Engineer for review and approval.

B. Traffic Control Plan.

1. Contractor is required to submit a traffic control plan to the City Engineer for review and approval.

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

1. GENERAL
   - A. Conformance: Manual of Uniform Traffic Control Devices (U.S. Dept. of Transportation), or applicable statutory requirements of authority having jurisdiction. Local requirements of regulatory agencies take precedence over Manual of Uniform Traffic Control Devices.
   - B. Operations on or about traffic areas and provisions for regulating traffic will be subject to the regulation of governmental agencies having jurisdiction over the affected areas.
   - C. Keep traffic areas free of excavated material, construction equipment, pipe, and other materials and equipment.
   - D. Keep fire hydrants and utility control devices free from obstruction and available for use at all times.
   - E. Conduct operations in a manner to avoid unnecessary interference with public and private roads and drives.
     1. Provide and maintain temporary approaches or crossings at streets, businesses, residences.
   - F. Keep road open and in acceptable condition. Restoration to be at or better than pre-project condition.
     1. May reroute or detour traffic if acceptable with each authority having jurisdiction.

2. TRAFFIC CONTROL PLAN
   - A. Submit to City Engineer for review and acceptance a detailed traffic control plan and schedule for each phase of the project. Plan must be accepted a minimum of 7 days prior to work commencing at the site. Maintain the accepted plan and schedule throughout all phases of construction. Plan to be prepared by a Certified Traffic Control Supervisor.

3. FLAGMEN
   - A. Required where necessary to provide for public safety, or the regulation of traffic, or by jurisdictional authorities.
   - B. Shall be properly equipped and licensed.

4. WARNING SIGNS AND LIGHTS

A. Provide suitable barricades and warning signs for:
   1. Open trenches and other excavations.
   2. Obstructions, such as material piles, equipment, piled embankment.

B. Illuminate by means of warning lights all barricades and obstructions from sunset to sunrise.

C. Protect roads and driveways by effective barricades on which are placed acceptable warning signs.

D. Review and amend damaged or misplaced devices (including lights) twice daily by a Certified Traffic Control Supervisor.

5. PARKING

A. Provide suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Project so as to avoid interference with private property, public traffic, City of Federal Heights' operations, or construction activities.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT (CITY CONTRACTS ONLY)

1.1 CLOSEOUT PROCEDURES: The following project closeout procedure defines the responsibilities of the Contractor and City in closing the project:

Step 1: Contractor advises the City in writing that he has reached "Substantial Completion" and provides a list of items to be completed or corrected. Closeout may be conducted by areas or portions of the work if requested by the City.

Step 2: City inspects the work to determine if it is substantially complete, and issues a Certificate of Substantial Completion plus a "Punch List" of items to be completed or corrected. Corrective work must start within 10 days of notification of deficiencies

Step 3: Contractor completes and/or corrects all punch list items and notifies the City in writing that his work is ready for final inspection. At this time, a final application for payment is submitted and the City will issue an initial acceptance

Step 4: City makes final inspection. When the work is found to be acceptable under the Contract Documents, and the Contract fully performed, the City will advertise the date of final payment on two separate days. The City issue a final Payment ten (10) days after the final advertisement is published.

Step 5: At the end of the warranty period (2 years) the City will make an inspection. The City will issue final acceptance if no corrective action is required. If corrective work is required the corrective work will be completed and the warranty period will be extended an additional year.

1.2 FINAL PAPERWORK: Prior to release of final payment, the Contractor shall deliver the following items to the City:

All Guarantees, Warranties and Submittals, as specified.
Receipts for Extra Materials Delivered to the City.
Final Application for Payment.
Consent of Surety to Final Payment.
Contractor's Affidavit of Release of Liens.
Project Record Documents.
Red-lined as-built drawings.
Electronic as-built AutoCad file

END OF SECTION

SECTION 01710

CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Execute cleaning, during progress of the Work, and at completion of the Work.

B. Adequate periodic cleaning will be a condition for recommendation of progress payments.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 – EXECUTION

3.1 DURING CONSTRUCTION

A. Promptly remove splattered concrete, asphalt, oil, paint corrosive liquids and cleaning solutions from surfaces to prevent marring or other damage.

3.2 FINAL CLEANING

A. Workmen shall be knowledgeable in the area of cleaning to which assigned.

B. Remove grease, mastic, adhesives, dust, dirt, stains, labels, and other foreign materials from visible exposed interior and exterior surfaces, including piping, manholes, riprap, inlets and concrete surfaces.

END OF SECTION

SECTION 01711

SITE CLEANUP

PART 1 – GENERAL

1.1 GENERAL

A. Execute cleanup, during progress of the Work, and at completion of the Work.

B. Adequate cleanup will be a condition for recommendation of progress payments for all City Contracts.

1.2 DESCRIPTION

A. Provide on-site covered containers for the collection of waste materials, debris and rubbish.

B. Neatly store construction materials, such as concrete forms, when not in use.

C. Broom clean exterior paved surfaces and rake other exterior surfaces.

1.3 DISPOSAL

A. Wastes shall not be buried or burned on the site or disposed of into storm drains, sanitary sewers, streams or waterways.

B. Remove waste materials, clearing materials, demolition materials, unsuitable excavated materials, debris and rubbish from the site daily and dispose of at disposal areas furnished by Contractor away from the site.

C. For all City Contracts, do not dispose of items noted to be salvaged. Provide these items to City as directed by City Engineer.

END OF SECTION

SECTION 01720

RECORD DRAWINGS

PART 1: GENERAL

1-1 SCOPE: The Contractor shall provide the City one neatly and legibly marked set of drawings showing the final location of all improvements. For any City Contract the City will furnish the Contractor one set of drawings for the express purpose of making the Record Drawings. Also, provide the City with an as-built electronic AutoCad drawings file.

1-2 REQUIREMENTS: Marking of the drawings shall be with colored ink at the time the materials are installed and shall be kept current. The drawings shall be available for review and comment by the Engineer during the progress of the Work of the Contract.

Indicate all changes and revisions to the original design that affect the permanent facilities and will exist in the completed work. Reference the location of underground utilities.

1-3 SUBMITTAL REQUIREMENTS: The Contractor shall provide an electronic as-built AutoCad file and one set of full-size record drawings to the City prior to requesting final inspection of the project.

END SECTION

SECTION 02110

SITE DEMOLITION, CLEARING, AND GRUBBING

PART 1: GENERAL

1.1 DESCRIPTION

The work of this section consists of the clearing of trees and vegetation where required; removal of pavements, curb and gutter, pipelines, inlets, structures, manholes, fencing, wire bales, stumps, roots, debris and other materials as described herein; disposal of unutilized materials; and related incidentals required to prepare the site for the contract work for the entire project.

1.2 JOB CONDITIONS

A. Work Limits: Specific areas to be cleared, stripped and grubbed will be all areas to be excavated or to receive embankment. The extent of site clearing is shown on the Drawings.

B. This Section includes but is not limited to the protection of existing trees, removal of trees and other vegetation, clearing and grubbing, topsoil stripping, removing above-grade improvements, and removing below-grade improvements within the boundaries shown on the Drawings or as staked on site.

C. Landscape Preservation: Protect from injury all vegetation indicated to remain. To minimize damage to such vegetation, fell trees to center of area to be cleared. Secure approval before cutting any trees. Paint damaged trees with an approved asphalt base paint.

1.3 RELATED WORK SPECIFIED ELSEWHERE

Excavation, Trenching, and Site Earthwork - Section 02200
Rock Riprap - Section 02262
Cast-in-Place Concrete - Section 03300
Contract Construction Drawings

1.4 SUBMITTALS

A. Permits for Disposal Debris

1. Arrange for disposal of debris resulting from clearing and grubbing to locations outside the Owner's Property at a legal disposal area.

1.5 PROJECT CONDITIONS

A. TRAFFIC

1. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.

B. PROTECTION OF EXISTING IMPROVEMENTS

Provide protection necessary to prevent damage to existing improvements indicated to remain in place.

1. Protect improvements on adjoining properties and on Owner's property.

2. Restore damaged improvements to their original condition, as acceptable to property owners.

C. PROTECTION OF EXISTING TREES AND VEGETATION

Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, compaction of root zone, smothering of trees by stockpiling construction materials or excavated materials within the drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fencing and guards to protect trees and vegetation to be left standing. All trees within contract limit line that may be saved within the proposed improvements shall be reviewed by the Owner. No trees designated to remain shall be removed without the approval of the Owner.

1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.

2. Provide protection for roots over 1-1/2" diameter that are cut during construction operations. Hand prune roots and coat cut faces with an acceptable coating formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.

3. Replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to Owner at no additional cost to Owner. Employ a licensed arborist to repair damages to trees and shrubs.

D. TOPSOIL, STRIPPING, AND STOCKPILING

1. Topsoil in areas indicated for clearing and grubbing shall be stripped to a 4” depth or as directed by Owner.

2. Stripped topsoil shall be immediately placed, or stockpiled on site, in an area approved by the Owner. The stockpile shall remain undisturbed until topsoil spreading operations begin. Storage time within the stockpile shall be as short as possible.

E. DEMOLITION

Partially or completely raze, remove, and dispose of curb and gutter, pavements, inlets, pipelines, manholes, fencing, structures, and other obstructions as indicated on the Drawings or directed by the Owner. Fill cavities left by removal to level of surrounding ground and thoroughly compact, as directed. Directions for execution of the work will be changed and supplemented by the Owner as necessary.

F. CLEARING AND STRIPPING

Clear site of trees, roots, and other vegetation, except for those indicated to be left standing.

1. Confine clearing to within the limits shown on Drawings.

2. Fell trees in a manner that will avoid damage to trees, shrubs, and other installations which are to be retained.

3. Completely remove stumps, roots, and other debris protruding through ground surface. Grind stumps to 12” below proposed grade.

4 Use only hand methods for grubbing inside drip line of trees indicated to remain.

5. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

   a. Place fill material in horizontal layers not exceeding 8 inches loose depth and thoroughly compact to a density equal to adjacent original ground.

G. REMOVAL OF IMPROVEMENTS

Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate construction and other work indicated.

1. Abandonment or removal of certain underground pipe or conduits may be indicated on the Drawings. Removal of abandoned underground piping or conduit interfering with construction is included under this section.

2. Remove only those trees which have been indicated on the Drawings, or directed by the City, to be removed. Remove fallen trees and brush and high weeds from areas to be cleared. Strip all short grasses and topsoil to a 6-inch minimum depth, or in the absence of topsoil, strip the top 4 to 6 inches of surface material and store separately from other excavated materials.

3. Remove drainage structures, concrete, walls, old foundations, fences, signs, slabs, and structures that encroach upon or obstruct the work as directed by the City.

4. Trim, as directed, low hanging and unsound or unsightly branches on trees and shrubs designated to remain.

H. GRUBBING

When the height of the embankment is less than 3 feet from finish subgrade, remove all stumps, roots, and debris a minimum of 12 inches below the original ground. When the height of the embankment is 3 feet or more from finish subgrade, stumps may be cut flush and left in place. In embankment areas, backfill stump and root holes with approved materials and compact before placing embankment material. In all excavation areas, remove stumps, roots, and debris a minimum of 12 inches below finish grade.

I. SALVAGE AND DISPOSAL

1. All trees, logs, branches, stumps, and other debris materials arising from the demolition, clearing and grubbing operation, except topsoil, shall become the property of the Contractor and shall be legally disposed of. Rock boulders shall be stockpiled for reuse in boulder walls and future landscape work.

2. Do not deposit or bury on the site debris resulting from the clearing and grubbing work.

3. Debris may not be burned on-site.

4. Remove waste and excess materials from Owner’s property and disposed off-site in a legal manner.

J. RESTORATION

After completion of construction activities restore project site to existing or better condition.

END OF SECTION

SECTION 02130

DEMOLITION & OBSTRUCTION REMOVAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Removal and satisfactory disposal of pipelines, manholes, inlets, vaults, concrete curb, gutter and sidewalks, asphalt and concrete paving and other obstructions not designated or permitted to remain.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 Specifications sections, apply to this section.

B. Additional information concerning obstruction removal may be found on the drawings. In case of conflict between the drawings and the information specified herein, the more stringent requirements shall govern.

1.3 JOB CONDITIONS

Protection: Protect all vegetation, utilities, structures, and other facilities to remain, from damage in manner acceptable to Engineer. Maintain designated temporary roadways, walkways, and detours.

1.4 REFERENCES

A. State of Colorado, Department of Transportation (CDOT): State Department of Highways Standard Construction Specifications for Road and Bridge Construction, Latest Edition.

B. City of Federal Heights Standards and Specifications, Latest Edition.

C. Project Special Provisions

PART 2 – PRODUCTS – Not Used

PART 3 - EXECUTION

3.1 FLATWORK

A. Remove concrete and asphalt not designated to remain. Where existing construction is to be partially removed, saw edges to remain in place on straight line with vertical face.

3.2 STRUCTURES

Remove structures within project limits or as shown on drawings. Protect portions to remain from damage. Damage to structures shall be repaired at Contractor's expense.

3.3 UTILITIES

Remove designated utility lines within project limits, properly capping or plugging existing lines to remain. Replace utilities to remain that are disturbed.

3.4 DEMOLITION:

Partially or completely raze, remove, and dispose of curb and gutter, pavements, manholes, pipelines, and other obstructions as indicated on the Drawings. Concrete and asphalt to be removed shall be saw cut or as otherwise required. Fill cavities left by removal to level of surrounding ground and thoroughly compact, as directed. Materials removed become the property of the Contractor unless otherwise noted herein. The Contractor shall remove such materials from the site of the Work.

3.5 DISPOSAL

Materials removed become the property of the Contractor unless otherwise noted. Depose all removed material at a legal disposal site.

3.6 RESTORATION

After completion of construction activities restore project site to existing or better condition.

END OF SECTION

SECTION 02222

PIPELINE EXCAVATING, TRENCHING & BACKFILLING

PART 1: GENERAL

1.1 SCOPE OF WORK: The work to be performed under this Specification shall include all labor, materials, equipment, and services as are necessary for the excavating and backfilling of the trenches for buried pipelines and manholes, etc.

The work shall include the excavation of whatever substances are encountered to the depths shown on the Drawings, as modified in the field by the City Engineer, and installation of compacted bedding, backfill and surface restoration as described herein.

1.2 QUALITY ASSURANCE: Reference in this Specification of a Standard, such as ASTM, AWWA or ACI, is to be interpreted to be the latest revision of that Standard.

A. References:
American Association of State Highway and Transportation Officials (AASHTO)
American Society for Testing and Materials (ASTM)
Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction
City of Federal Heights STANDARDS AND SPECIFICATIONS
Denver Water Board Standards

B. For all City contracts the City shall provide a qualified Soils Engineer to perform quality assurance for the City for testing of backfill as required in Part 3 of this section for all city contracts.

1.3 GENERAL REQUIREMENTS: It is the general intent that the Contractor leaves the work area in an equal or better condition than it was preceding the Contract work.

The Contractor must conform to the amended Rules and Regulations, Construction Standards for Excavations, CFR 29 Part 1926, subpart P, Title 29, of the Occupational Safety and Health Administration, Department of Labor, including revisions and Appendices thereto.

Except as shown otherwise on the Drawings, all excavation shall be made by open cut. Permission may be granted to tunnel.

The work is to conform to the Details shown on the Drawings.

The length of trench permitted to be open at any one time will be limited to 150 feet or such limitation as necessary for protection of the work or the convenience of the public, in the opinion of the City Engineer.

It is the general intent that the Contractor leaves the work area in a similar and equal

condition as it was preceding the work.

1.4 JOB CONDITIONS

A. If unauthorized over-excavation occurs, the Contractor shall be responsible for the repair of the area by backfilling with approved material and compacting to 95 percent maximum density (ASTM D 698) or to 98 percent maximum density for structures unless specified elsewhere.

B. The Contractor will assume full responsibility for alleviation or prevention of dust as a result of the work.

1.5 SITE PREPARATION

Fences, walls, curbs, sidewalks, structures, etc. shown on the Drawings to be removed, or if not so shown on the Drawings and authorized in writing by the City Engineer or Owner to be removed, shall be so removed and shall later be replaced in a manner acceptable to the Owner or City Engineer. All materials removed and not reused shall be hauled from the site and disposed of by the Contractor.

1.6 DEFINITIONS

A. Compaction Density: Unless accurate results cannot be obtained, the compaction requirements shall conform to maximum dry density according to ASTM D698, Moisture-Density Relations of Soils (Standard Proctor). When the ASTM D698 test is not applicable, the percentage compaction requirements shall conform to ASTM D2049, Test for Relative Density of Cohesionless Soils, unless otherwise noted. The moisture content of all backfill material shall be within 2% of optimum unless otherwise noted.

B. Trench Zones: For the purpose of this Specification, the terms “Bedding Zone,” “Pipe Zone” and “Backfill Zone”.

1. Bedding Zone Material: Bedding zone material shall consist of all material placed below the pipe invert or, when permitted, the native materials graded and prepared for direct placement of the pipe.

2. Pipe Zone Material: Pipe zone material shall consist of all material placed above the pipe invert to an elevation 12 inches above top of pipe.

3. Backfill Zone Material: Backfill Zone material shall consist of all material above the Pipe Zone.

C. Trench Excavation: All material encountered along trench will be considered common excavation.

1.7 PROTECTION OF EXISTING FACILITIES:

A. General: Existing power lines, telephone lines, fences, water mains, cables, conduits, ditches, embankments and other structures in the vicinity of the work not authorized to be removed shall be supported and protected from injury by the Contractor during the construction and until completion of the work affecting them. The Contractor shall be liable for all damages done to such existing facilities and structures, as herein provided and he shall protect the City from any liability or expense for injuries, damages, or repairs to such facilities.

B. Underground Facilities: The type, size, location and number of all known underground facilities have been shown on the Drawings; however, no guarantee is made as to the true type, size, location, or number of such facilities. It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities along the route of the work. The omission from, or the inclusion of, utility locations on the Drawings is not to be considered as the nonexistence of, or a definite location of, existing underground utilities. When working in areas of known pipes where the depth of pipe is not known, potholing shall be completed before any trenching shall begin. All utilities within the trenching limits of the pipe shall be potholed to verify their location and elevation before trenching begins.

C. The Contractor shall notify the owner or owners of the existing utilities, whether aboveground or underground, 48 hours prior to proceeding with excavation whenever such operations are within ten feet of the possible location of any existing utility. The notification shall also include a request for field staking any such underground facility that may be in the area of influence by the construction.

D. Should any such utility be damaged in the excavation operations, the Contractor shall immediately notify the Owner of such utility and, unless authorized in writing by the Owner of the utility, the Contractor shall not attempt to make repairs except to prevent further damage to property. Written authorization shall be so worded as to save the City from any responsibility whatsoever relative to the sufficiency of the repairs.

E. If a conflict that is not shown on the Drawings develops between an existing utility and the work required by this Contract, the Contractor shall notify the Owner of the utility and the City Representative immediately in writing. The City Representative may consider such conflict to be a change in the work.

F. If during construction any underground utility conduit, including sewers, water mains, gas mains and drainage structures, or any aboveground utility facilities are required to be relocated, the Contractor shall notify the utility Owner well in advance of his approach to such utility so that arrangements with the Owner or Owners of the affected utility can be completed without delay to the work.

G. Utility companies include, but are not limited to, the following: The City of Federal Heights, the City of Thornton, Xcel Energy, and Qwest.

H. Monuments, property pins, survey reference points, and benchmarks shall not be disturbed without specific written permission from the City. Any such markers disturbed without written permission shall be replaced at the Contractor's expense by a licensed land surveyor.

1.8 SUBMITTALS (City Contracts Only)

A. The Contractor shall submit certified laboratory reports and gradation test data for all imported materials to the City Representative.

B. Soil Tests: The City will contract with an independent testing consultant to perform standard and /or modified proctor soil compaction test, as determined by the ASTM D-698 and D-1557 test respectively for City's quality assurance. The contractor may hire his own testing agency to perform his quality control at no additional cost to the Owner.

PART 2: MATERIALS

2.1 GENERAL: All bedding and backfill material shall have the approval of the City. Approved material from project excavations shall be used for backfill. All bedding and backfill material shall be free of frozen material, organic material and debris. The materials to be used in each trench zone are indicated on the Details shown on the Drawings and these materials are described below. All materials may be subject to gradation tests and compaction tests prior to approval of the use of that material. The test results shall be submitted to the City for approval and verified as to their accuracy if such tests are requested.

The amount of water used in compaction shall be optimum to obtain the percent relative compaction required. The amount of water required shall be controlled by the Contractor to meet conditions brought about by storms, drought, or other causes.

A. Granular Bedding or Granular Backfill Material: This material shall be imported crushed rock or angular surfaced gravel and meet the following gradation (ASTM D448, No. 67):

Sieve Size Passing by Weight	Total Percent
1 inch	100
¾ inch	90-100
⅜ inch	20-55
# 8	0-10
# 200	0-5

B. Squeegee bedding material or squeegee backfill material. Squeegee material shall be a clean granular material meeting the following gradation:

Sieve Size or Designation	Percent by Weight Passing
3/8-inch	100
No. 200	0 – 5

C. Select Material: Select material shall not be permitted unless authorized by the City Engineer. This material shall consist of suitable material screened from the excavated earth having no rocks or stones greater in size than 2-inch.

When specified and acceptable select material (suitable for placement within 12 inches of the pipe barrel) is not available at any particular location, the Contractor shall screen out rocks and stones larger than permitted or shall provide acceptable screened material from excavations at other locations of the work under this Contract.

D. Trench stabilization material: This material shall be Class 5 Aggregate Base Course as specified by the Colorado Department of Transportation, and shall meet the following gradation:

Sieve Size	Total Percent Passing by Weight
1 ½ -inch	100
1 - inch	95-100
#4	30-70
#200	3-15

E. Common Backfill material: Common backfill material shall consist of suitable

material from the excavated earth, meeting all the requirements of this Specification. The material shall have a moisture content not exceeding 2% of optimum.

No boulders over 3-inches in any dimension shall be allowed in the top 12 inches of the trench or within 12 inches of the top of pipe. All boulders shall be carefully placed so that no damage will be done to the pipeline.

F. Imported Common Backfill Material: The Contractor may request use of an imported common backfill material from the City Engineer. The Contractor's request shall include a report describing the material, listing its properties, and recommending installation procedures. The report shall be prepared and signed by an engineer licensed to practice in the State of Colorado. For City Contracts, the Contractor will use such material at his cost, subject to approval of the City Engineer, unless geotechnical engineer determines that excavated material is unsatisfactory, then the cost will be negotiated with the City.

Imported common backfill material shall not be used where flowfill is utilized.

G. Flow fill: Refer to Specification "Flowable Concrete Backfill", section 03315.

H. Roadbase backfill material. This material shall be Class 6 aggregate base course as specified by the Colorado Department of Transportation; and shall meet the following gradation:

Sieve Size	Total Percent Passing by Weight
¾-inch	100
# 4	30 - 65
# 8	25 - 55
# 200	3 – 12

I. Pipeline insulation. When required, this material shall be closed cell polystyrene foam of the minimum compressive strength specified herein. Water absorption shall be no more than 0.1% of volume when tested according to ASTM C272. Aged (design) value of thermal conductivity shall be 0.18 Btu in./hr. sf °F when measured at a mean temperature of 25°F in accordance ASTM C177 and/or with ASTM C518. Insulation compressive strength shall be determined by testing in accordance with ASTM D1621.

Insulation shall be provided in 4-ft x 8-ft sheets and shall not be factory scored. Minimum thickness shall be 4-inches.

Insulation shall have a minimum compressive strength of 40 psi, shall be DOW STYROFOAM HL40 or approved equal.

J. Underground Utility Marking Tape. Tape shall be a minimum thickness of 5 mil and width of 2 inches. Tape shall be Blue for water and marked “Caution – Water Line” and Green for sewers and marked Caution - Sewer Line.

PART 3: EXECUTION

3.1 PAVEMENT REMOVAL AND REPLACEMENT

A. Score existing surface to create clean break line. Existing asphalt or concrete road may be thicker than required minimum patch thickness. Remove and dispose of existing surface and aggregate base course. Leave 2 feet undisturbed subgrade lip on each side of trench. Replace pavement in accordance with permit requirements or minimum thickness in these Specifications. Compact asphalt to minimum 95% ASTM D1559; consolidate concrete with vibrators.

3.2 TRENCH EXCAVATION

A. General: All excavation is considered common excavation.

B. Excavate trenches to lines, grades, and elevations indicated on the Drawings. Fine grade the trench bottom throughout and excavate to accommodate joints and connections so the barrel of the pipe will receive bearing pressure throughout its entire length.

C. Exploratory Excavation: It shall be the Contractor's responsibility to excavate and locate all existing utilities which may affect construction of the water facilities. All exploratory excavations shall occur far enough in advance to permit any necessary relocation to be made with minimum delay and to verify existing vertical and horizontal location to determine alignment for the proposed water line. All costs incurred by the Contractor in making exploratory excavations shall be considered to be included in the unit price bid for constructing each section of water line or the associate structures.

D. Trench Depth: The trenches shall be excavated to such depths that the pipeline can be laid at the elevation of the grade lines shown on the Drawings, or at the depths or covers specified on the Drawings or as specified in the Sections for specific pipeline installations. The pipe trench shall be excavated to at least a depth of 4 inches below the bottom of the pipe, backfilled with the specified bedding material, and compacted per these specifications. Length of trench permitted to be open at any one time may be limited if, in the opinion of the Engineer, such limitations are necessary for the safety and convenience of the public; however, in no case shall the length of open trench exceed 150 feet.

E. Existing Asphalt Pavement: The excavation in areas with asphalt paving must be confined to a minimum width as required to maintain a safe trench condition. The pavement shall be cut vertical and on a straight line.

F. Trench Preparation: The trench wall shall be so braced that the workmen may work safely and efficiently. All trenches shall be drained so that pipe laying may take place in un-watered conditions.

Trenches above a point 12 inches above the top of the pipe shall be of such extra width, when required, as will permit the convenient placing of approved shoring materials or equipment.

Bell holes in trench bottom shall be provided at each joint to permit the jointing to be made properly and to prevent the pipe from bearing on the bells.

After excavation, the trench bottom shall be uniformly graded and hand-shaped so that the pipe barrel will have uniform and continuous bearing on firm, undisturbed trench bottom (when permitted), or compacted, specified granular bedding throughout the length of the pipe. The trench grade shall permit the pipe spigot to be accurately centered in the preceding-laid pipe joint, without lifting the pipe above the grade and without exceeding the permissible joint deflection. If it is necessary to raise the pipe subgrade, approved, compacted granular bedding material shall be used.

If unstable foundation is encountered, the Contractor shall excavate a minimum of 6 inches and a maximum of 24 inches of the unstable material and backfill the over-excavation with stabilization material.

G. Shoring: As needed, all trench sidewalls shall be properly sheeted and braced to meet Federal, State and local laws in regard to safe working conditions. The shoring shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

If the City is of the opinion that at any point the trench walls are not properly supported to protect the work, he may order the placement of additional supports by the Contractor. Compliance with such order shall not relieve or release the Contractor from his responsibilities for the safety of the work.

H. Blasting: Blasting is not permitted.

I. Removal of Water: The Contractor shall provide and maintain at all times ample means and devices with which to remove promptly and to properly dispose of all water entering the trench excavation.

Water shall be disposed of in a suitable manner without damage to adjacent

property and in compliance with discharge permit requirements. The Contractor shall be responsible for obtaining necessary permits. No water shall be discharged into City systems.

Dewatering shall be accomplished by well points, sumping, or any other acceptable method which will insure an un-watered trench to a sufficient depth below trench bottom, so that the Contractor's operations will not disturb the trench bottom. Any dewatering method shall be subject to the approval of the City and State.

J. Trench Width: The minimum clear trench width measured at the top of the pipe barrel shall be not less than the outside pipe diameter, plus 12 inches. For all pipe, the maximum clear trench width measured at a point 12 inches above the top of the pipe barrel shall be not greater than the trench width shown on the following table:

MAXIMUM TRENCH WIDTH TABLE

Pipe Diameter Inches	Maximum Trench Inches	Pipe Diameter Inches	Maximum Trench Inches
4	24	20	42
6	26	21	44
8	28	24	48
10	30	27	52
12	33	30	56
14	35	33	60
15	36	36	68
16	37	42	75
18	40	48	82

If the above-stated maximum trench widths are exceeded, either through accident or otherwise, and if the City determines that the combined dead and live loads will exceed the design loadings on the pipe, the Contractor shall either cradle the pipe in concrete or use a pipe of a stronger class as required by the City.

K. Trench Walls: All the trench sidewalls shall be considered to be vertical from the bottom to the top of the excavation.

The Contractor may slope or bench the trench sidewalls when necessary due to soils conditions to maintain a safe trench condition and conform to OSHA requirements. Such sloping or benching shall terminate at a depth not lower than one foot above the top of the pipe barrel, and from that point down, the trench wall shall be vertical. The trenching operation, including the spoil bank and sloping of the trench sidewalls shall be confined to the width of the permanent and temporary rights-of-way, if any. The Contractor shall provide a design for

sloping or benching by a registered professional engineer for trenches over 20 feet in depth.

A clear area shall be maintained a sufficient distance (2 ft. min.) back from the top edge of the excavation to avoid overloading that may cause slides or caving of the trench walls. The excavated material shall be kept trimmed in such a manner as to be of as little inconvenience as possible to the public and adjoining property owners. Unless otherwise authorized by the City, all public thoroughfares and crossroads shall be kept open to traffic. When authorized by the City at street crossings, sidewalks and other points considered necessary, the trenches shall be bridged in a safe manner so as to prevent serious interruption of travel and to provide access to fire hydrants and public and private premises.

3.3 TRENCH BACKFILL

A. One Foot Over Pipe: Excavate pipe cover material from material within work limits which contains no stones larger than 2" in diameter. If sufficient acceptable backfill material is not available, segregate or screen out large stones or provide acceptable material from other excavations in work under this Contract or provide acceptable imported material to obtain minimum compaction at no cost to City. Cover material shall be clean soil, free from organic materials, chunks of soil, frozen material, debris or other unsuitable materials. Place and hand tamp bedding to one-foot above top of pipe. Place backfill in lifts and compact to a density of 95%, ASTM D698, at a point 1’ above top of pipe (top of bedding).

B. Remainder of Trench: Backfill with same materials excavated from work limits unless unsuitable. No boulders over 3" in diameter in remainder of trench. No backfill material with rock larger than 6" in diameter. Mound excess material 12” over trenches which are not under pavement. No noticeable settlement in trench at end of warranty period. For asphalted areas, the top 1-foot (under asphalt) shall be imported aggregate base course or crushed recycled concrete.

C. Flow Fill Backfill: To be used for all services and main line connections/fire hydrant service lines crossing the street perpendicular. Flow fill shall be from 24” above top of pipe to bottom of proposed asphalt depth.

D. Bedding zone installation
Bedding material shall be placed to the required elevation of the pipe invert. Tamping equipment shall be used to thoroughly tamp the bedding material to a minimum of 95 percent maximum dry density or to 75 percent relative density. The moisture content of the material shall be within 2 percent of optimum.

E. Pipe zone installation

1. Without pipeline insulation. After bedding material has been placed and approved and after the pipe has been installed and approved, the pipe zone backfill shall be installed to the elevation shown on the details on the Drawings. The backfill material shall be placed and compacted in distinct, separate lifts not to exceed 12 inches of loose depth; except that the first loose lift shall not be higher than the pipe centerline (springline). Tee bars, or other acceptable equipment, shall be used to compact the backfill material under the haunches on both sides of the pipe and throughout its complete length. If select backfill materials are permitted in this zone but acceptable select backfill material (suitable for placement within 12 inches of the pipe barrel) is not available at any particular location, the Contractor shall use imported granular backfill material. Compaction shall meet the requirements of "Bedding Zone Installation," utilizing Tee-bars or mechanical tamping equipment.

2. With flat panel pipeline insulation: When required, after bedding material has been placed and approved and after the pipe has been installed and approved, the vertical insulation panels (if required) and pipe zone backfill material shall be installed.

   The backfill material shall be placed and compacted in distinct, separate lifts not to exceed 6 inches of loose depth; except that the first loose lift shall not be higher than the pipe centerline (springline). Compaction shall meet the requirements of "Bedding Zone Installation," utilizing Tee-bars or mechanical tamping equipment.

   Insulation shall be scored with a cutting tool and straight edge for cutting. Panel cuts shall be straight and at right angles to the plane of the board surface. Vertical panels of the insulation shall be set on the bedding material as directed by the City Representative. Spacers shall be used to hold the panels in place. Individual panels shall be butted together with a maximum clearance of ⅛-inch spacing. Joints shall be staggered, and shall be covered with a 12-inch lap piece of insulation. Backfill between the panels shall be installed to slightly above the top of the panels to provide support for the horizontal panels without void space.

   Horizontal panels of insulation shall be placed on the top of the vertical panels and shall be fully supported by the backfill material between the panels.

F. Backfill zone installation

1. Backfill zone beneath all traveled ways: Backfill material in roads, streets, and parking areas, highway shoulders, and within 15 feet of pavement in State Highway Department rights-of-way, shall be carefully placed and compacted up to the limit of base course material or to gravel.

Compaction shall be by mechanical tamping in 8-inch maximum loose lifts using mechanical or hand tampers, weighing not less than 20 pounds, or 12-inch maximum loose depth using vibratory rollers. All other means must be approved in writing by the City Representative. All backfill shall be compacted to a minimum of 95% of maximum laboratory dry density or 70 percent relative density. The material shall be within 2.0 percent of optimum moisture content.

The Contractor may request approval of alternate means of compaction. Such request must be submitted to the City Engineer in writing. Approval of the compaction method will be made by the City Engineer only in writing. Use of specified or approved compaction methods does not relieve the Contractor from providing a completed project meeting the intent of this Specification.

2. Flow fill substitute. The Contractor may substitute Flow Fill for Common Backfill material in the backfill zone. For City contracts, contractor selection of Flow Fill shall be at no additional cost to the City.

G. Maintenance of Backfill

All backfill shall be maintained in a satisfactory condition and all places showing signs of settlement shall be filled and maintained during the project and for a period of two year following the date of final acceptance of all work performed. When the Contractor discovers or is notified by the City Engineer that any backfill is not in compliance with the provisions of these Standards and Specifications, the Contractor shall correct such condition at once. Any utilities and road surfacing damaged by such settlement shall be repaired by the Contractor to the City's satisfaction. In addition, the Contractor shall be responsible for the cost to the City of all claims for damages filed with the Court and actions brought against the City for, and because of, such damage.

H. Underground Utility Marking Tape

Tape shall be installed above all PVC water and sewer mains. Install tape approximately 2 feet above top of pipe.

3.4 COMPACTION

A. Demonstrate method of compaction. For all City Contracts, the City's contracted testing agency will test compacted demonstration section for uniform density throughout depth of each 6" lift except where flow fill is placed. For work completed for a non-City Contract, the contractor shall be responsible for demonstrating adequate compaction to the satisfaction of the City Engineer. Construction methods may be required to be altered until acceptable to City Engineer. Continue same procedure until significant change in soils occurs, or compaction is not being achieved, then demonstrate new method. Soil which cannot meet compaction requirements will be replaced with a suitable material which will compact, at no cost to the City.

B. Compaction requirements for all trenches within limits of pavement, shoulders, or back of curbs:

1. Predominantly cohesive soils where AASHTO T99 procedures are applicable: Compact uniformly throughout each lift to 95%, AASHTO T99.
2. Level and smooth each layer to distribute soils and finer fragments of earth. Wet each loose layer as necessary to facilitate compaction prior to placing additional lifts.
3. Trenches outside pavement: Compact to 95% AASHTO T99.

C. Unless accurate results cannot be obtained, the compaction requirements shall conform to maximum dry density according to ASTM D698, Moisture-Density Relations of Soils (Standard Proctor). When the ASTM D698 test is not applicable, the percentage compaction requirements shall conform to ASTM D2049, Test for Relative Density of Cohesionless Soils.

When required by the City, the Contractor shall excavate backfilled trenches for the purpose of performing compaction tests at locations and depths required by the City Engineer. The Contractor shall backfill and compact the excavations at no additional cost to the City.

3.5 SOILS TESTING

All soil testing is to be performed by material testing firm acceptable to the City Engineer according to the criteria outlined in this section. For City Contracts, soil testing will be contracted by City for quality assurance.

A. General

1. Perform field density tests in accordance with ASTM D1556, ASTM D2167 or ASTM D2922.
2. Perform field moisture tests in accordance with ASTM D3017.
3. Moisture and Density Analysis: Prepare not less than one (1) optimum moisture and maximum density curve for each type of existing or imported soil

proposed for use in filling or backfilling, including structural fill and base courses for paving.

4. All reports shall include elevation or depth below finish grade at which test was taken. Results shall report densities (maximum dry and relative) to nearest 0.1 lb/ft^3, moisture content (optimum and in-place) to nearest 0.1%, and compaction (relative and required) to nearest 0.1%.
5. Pavements
   (a) Subgrade: One (1) test for every 2000 sf of compacted subgrade or major fraction thereof, but in no case less than three (3) tests for each day's work.
   (b) Compacted Base Course and Fill: One (1) test for every 2000 sf of each compacted fill layer or lift, or major fraction thereof, but in no case less than three (3) tests per layer or lift for each day's work.
6. Trenching
   (a) Perform one (1) field density and moisture test for every 100 lf or major fraction thereof, of trench backfill, taken at the trench bottom and at two (2) feet vertical intervals in the compacted fill depth. In no case will less than eight (8) tests be made.
7. Failings

   If, based on the independent testing and inspection agency's reports and inspections, compacted subgrade or fills are found to be below specified density, provide additional compaction and testing.

3.6 UNSUITABLE MATERIALS

A. At locations where unstable or undesirable conditions are encountered and as designated by the City Engineer, the Contractor shall excavate and dispose of excavated materials. This material shall be replaced with suitable materials from other project earthwork that will be placed and compacted according to the requirements of the item of work involved.

3.7 SURFACE RESTORATION

A. General: Where pavement, curb and gutter, sidewalks, landscaping, or other improved surfaces have been removed or damaged during the course of the work, such items shall be restored to a condition equal to that prior to removal, to the same elevation and alignment. The subgrade for all restored surfaces shall be thoroughly compacted by mechanical or hand tampers, weighing not less than 20 pounds, or vibratory rollers, or by other proposed means of compaction acceptable to the City.

   Sod defined as densely grassed turf, which is removed shall be replaced with sod (if drought conditions allow) of the same quality, or the sod removed may be put back if it has been properly stored and remains in a healthy condition. Contractor will be responsible for watering for one growing season.

B. Street Improvements: Paving, curb and gutter, sidewalks or other street

improvement removed or damaged during construction shall be replaced with the same type and dimensions of items removed or damaged and shall be equal to, and consistent with, the undisturbed portions of the improvements existing prior to the trench excavation, unless specified otherwise. All concrete used in the restoration work shall be equal to the requirements of the City.

After the backfill has been approved by the City, the paving shall be replaced using hot-mix asphaltic material approved by the City. The thickness of the paving shall not be less than 6 inches thick, or match the existing asphalt thickness if more than 6 inches thick. Preparation for paving shall include cutting the pavement with a vertical face 2 feet beyond the trench wall or limit of damaged pavement, cleaning, prime and tack coats. After placing the material, the pavement shall be compacted with a smooth roller. All methods shall meet the requirements of the City. The final paved surface shall be uniform so that if tested with a 10-foot straight edge, the variation shall not exceed one-quarter inch. Areas not complying with these tolerances will be reworked to obtain conformity.

3.8 CLEANUP

A. The Contractor shall final grade the structural and trench backfill to a smooth grade to effect a neat and workmanlike appearance.

B. Excess excavated material, rubbish, and construction debris if any, shall be hauled away to a licensed dumpsite location. Alternately, the Contractor may haul this material to private property upon approval of the owner of that property and the City Representative.

C. The Contractor shall remove all tools, equipment of the work, barricades and temporary structures from the site. The construction site shall be left clean, to the satisfaction of the City Representative.

END OF SECTION

SECTION 02262

ROCK RIPRAP

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of installation of water control measures, excavation and backfill as required, subgrade preparation materials and installation of bedding, rock riprap and grout as indicated herein and on the Drawings.

1-2 RELATED WORK SPECIFIED ELSEWHERE:

Excavation, Trenching and Site Earthwork - Section 02200
Cast-In-Place Concrete - Section 03300

Note: Grout shall be subject to the same requirements as cast-in-place concrete, as specified in Section 03300 (see Part 2-3 of Section 02262 for grout material requirements).

1-3 SUBMITTALS AND TESTING: In accordance with Section 01300, for each type of rock, including: riprap, granular bedding and weep drain filter material, submit certificate stating the source of rock and that the rock will meet the requirements of this section. Include test results for specific gravity, abrasion, gradation and freeze thaw on samples of rock to be supplied on this project. Submit design mix for grout.

Rock shall be visually checked by the Contractor at the quarry or at the work site as required for size, elongation, cracks, deterioration and other defects visible on the entire surface area of the stone. If cracks are observed, the Contractor shall notify the City to make a determination as to acceptability of rock. Stone with cracks or defects that are detrimental to a long lasting product shall not be shipped to the work site.

PART 2: MATERIALS

2-1 RIPRAP:

A. GENERAL: Rock fragments of the quality and gradations specified herein shall be furnished by the Contractor for use in riprap and bedding materials to be placed in accordance with these Specifications. Asphalt, broken concrete, concrete slabs or other materials not classified as rock will not be allowed for use as riprap material.

All individual rock fragments shall be dense, sound and resistant to abrasion, and shall be free from cracks, seams and other defects that would tend to unduly increase their destruction by water and frost actions. No shale and/or organic materials shall be allowed. No rock shall have a dimension more than 3 times its least dimension of the rock. The rock fragments shall be block-shaped and shall have sharp, clean edges at the intersections of relatively flat faces and shall conform to the following test requirements of the American Society for Testing Materials Standards:

Test	**Designation**	**Requirement**
Specific gravity, (saturated dry basis)	ASTM method C-127	Not less than 2.50
Absorption	ASTM method C-127	Not more than 2%
Freeze-thaw	AASHTO Test 103	Not more the 10% loss by weight after 12 cycles
Abrasion (using LA machine)(grading A)	ASTM 535	Less than 40% loss of weight after 500 revolutions

All rock to be used on the project must be approved by the City. Once approved, the rock shall be kept consistent through the project. No change may be made to the rock source unless specifically approved by the City.

B. GRADATION: Only rock meeting the requirements of these specifications shall be used for riprap. The gradation requirements for ordinary riprap shall be as follows (approximate weight assumes spherical shape which more closely approximates the weight of the individual stone):

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	Approximate* Min. Rock Weight (Pounds)	d_{50} ** (Inches)
Type VL	70-100	12	85	
	50-70	9	36	
	35-50	6	11	6***
	2-10	2	0.4	
Type L	70-100	15	166	
	50-70	12	85	
	35-50	9	36	9***
	2-10	3	1.3	
Type M	70-100	21	455	
	50-70	18	287	
	35-50	12	85	12
	2-10	4	3	
Type H	100	30	1,327	
	50-70	24	680	
	35-50	18	287	18
	2-10	6	11	
Type VH	100	42	3,642	
	50-70	33	1,767	
	35-50	24	680	24
	2-10	9	36	

*Based on Specific Gravity = 2.60; **d_{50} = Mean particle size; *** Bury types VL and L with 6 inches top soil and revegetate to protect from vandalism (other types of riprap may be buried if noted on the plans).

Unless otherwise noted on the Drawings, riprap shall be placed in the following minimum thicknesses (not including bedding thickness):

Riprap Designation	Riprap Layer Thickness (inches)
Type VL	12
Type L	16
Type M	21
Type H	30
Type VH	42

C. QUALITY CONTROL: The Contractor shall manage the delivery and stockpiling of rock at the site to assure that adequate supply of rock meeting the specification is available for installation when required. Stockpile locations shall

be arranged to avoid interference with other project operations. Rock which does not meet specifications or is not installed shall be removed from the site.

2-2 BEDDING: Use free-draining material consisting of sand, gravel, crushed stone or other approved free-draining material. Imported materials shall be used if no on-site materials are available. All materials shall meet the following gradation requirements:

1.GRANULAR BEDDING GRADATION

U.S. Standard Sieve Size	Percent by Weight Passing Square Mesh Sieves	
	Type I	**Type II**
3-inch	-	100
1 1/2-inch	-	-
3/4-inch	-	20-90
3/8-inch	100	-
M 4	95-100	0-20
M 16	45-80	-
M 50	10-30	-
M 100	2-10	-
M 200	0-2	0-3

2-3 GROUT:

A. Concrete for grout shall be an approved batch meeting the following requirements. All concrete shall develop 4,000 psi compressive strength within 28 days, the cement shall be Type II modified or Type V, the stone aggregate shall have a maximum diameter of ½-inch and the slump shall be within the range of 3" to 6". Use stiff mix or other measures as approved for steeper slope applications. The water cement ratio shall not exceed 0.48.

2-4 CURING COMPOUND: Curing compound for grout shall be an approved compound (Master Builders Acryseal or equivalent acceptable to City). The curing compound shall be in accordance with ASTM C 309, shall be non-toxic, and must not cause discoloration of the grout and boulders.

PART 3: EXECUTION

3-1 SUBGRADE PREPARATION:

A. WATER CONTROL: Prior to commencing work on rock placement, install water control measures as required to perform work in dry conditions. Water control measures shall include, but are not limited to, diversions, sumps with pumps or other means necessary to maintain the level of groundwater below subgrade elevation and to divert surface water away from the work area. The Contractor is responsible for investigating and familiarizing himself with respect to all site conditions that may affect the work, including surface water, level of groundwater and time of year the work is to be done. For all City Contracts, by submitting a bid

the Contractor acknowledges that such investigations have been made and consideration of such conditions are a part of his bid.

B. SUBGRADE PREPARATION FOR RIPRAP AND BEDDING MATERIAL: Excavate for placement of rock as indicated, providing a firm smooth uniform surface at the proper grade. The subgrade shall be compacted to 95% maximum density (ASTM D698) or to 70 percent of its maximum relative density (ASTM D2049). In fill areas, after removal of topsoil and any soft yielding material, place approved on-site material and compact as specified herein to the designated subgrade elevation. Subgrade elevation and compaction shall be verified by the City prior to placement of riprap or boulders. Refer to Section 02200 for removal and replacement of unsuitable material.

3-2 TYPE I AND TYPE II BEDDING PLACEMENT: For in-situ fine grained soils a layer of Type II bedding shall be placed on top of a layer of Type I bedding. For in-situ coarse grained soils only a layer of Type II bedding is required. Bedding thicknesses shall be as follows:

	Minimum Bedding Thickness (Inches)						
Riprap	Fine Grained Soils					Coarse Grained Soils*	
Type	Type I		Type II		Total	Type II	
VL, L, M	4	+	4	=	8	6	
H,VH	4	+	6	=	10	8	

* 50% or more by weight retained on the #40 sieve.

At the Contractor's option a 12-inch layer of Type II bedding may be substituted for the combination layer of Type I and Type II bedding over in-situ fine-grained soils. The Contractor shall handle and place the bedding in a manner which will prevent segregation. The bedding need not be compacted but shall be placed in such a manner as will result in uniform layers of the specified thickness.

3-3 RIPRAP: Prepare subgrade and place bedding where required as specified herein. Machine place stones into position following details indicated. Arrange as necessary by machine or by hand to interlock without damaging bedding. The finished riprap shall be well graded and free from objectionable pockets of small stones and clusters of larger stones. Dumping and/or backhoe placement alone is not sufficient to ensure proper interlocked placement. The basic procedure shall result in larger materials flush to the top surface with faces and shapes arranged to minimize voids, and smaller material below and between larger material. Surface grades will be a plane or as indicated, but projections above or depressions under the finished design grade more then 10 % of the rock layer thickness will not be allowed. Smaller rock shall be securely locked between the larger stone. It is essential that the material between the larger stones not be loose, or easily displaced by flow or by vandalism. The stone will be consolidated by the bucket of the backhoe or other means that will cause interlocking of the material. All rock is to be placed in a dewatered condition beginning at the toe of the slope or other lowest point. Placing riprap in layers will not be permitted.

END OF SECTION

SECTION 02370

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This work shall consist of temporary measures needed to control erosion and water pollution. These temporary measures shall include, but not be limited to, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the project, and as directed by the City Representative, and as shown on the Drawings.

B. The Erosion Control Plan presented in the Drawings were reviewed and approved by the City of Federal Heights and serves as a minimum for the requirements of erosion control during construction. The CONTRACTOR has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the project. Therefore, if the provided plan is not working sufficiently to protect the project areas, then the CONTRACTOR shall provide additional measures as required to obtain the required protection. The CONTRACTOR shall include in his bid price for erosion control a minimum of all items shown on the Erosion Control Plan and any additional items that may be needed to control erosion and water pollution.

1.2 SUBMITTALS

A. Construction schedule for Erosion Control per subsection 3.01

B. Sequencing Plan per subsection 3.12

PART 2 PRODUCTS

2.1 MATERIALS

A. Materials may include straw bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel and other suitable materials, and shall be reasonably clean, free of deleterious materials, and certified weed free. All materials shall be submitted for approval prior to installation.

B. Temporary grass cover (if required) shall be a quick growing species suitable to the area, which will provide temporary cover and will not later compete with the grasses sown for permanent cover. All grass seed shall be approved by the City Representative prior to installation.

C. Fertilizer and soil conditioners shall be approved by the City Representative prior to installation.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. For City Contracts, when so indicated in the Contract Documents, or when directed by the City Representative, the CONTRACTOR shall prepare construction schedules for accomplishing temporary erosion control work. These schedules shall be applicable to clearing and grubbing, grading, structural work, construction, etc. CONTRACTOR shall also submit for acceptance his proposed method of erosion control on haul roads and borrow pits and his plan for disposal of waste material. Work shall not be started until the erosion control schedules and methods of operations have been accepted.

B. For City Contracts, the CONTRACTOR will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in CONTRACTOR's accepted schedule. Temporary erosion control measures will then be used to correct conditions that develop during construction.

C. The erosion control features installed by the CONTRACTOR shall be adequately maintained by CONTRACTOR until the project is accepted.

D. In the event of conflict between these requirements and erosion and pollution control laws, rules, or regulations of other Federal, State or local agencies, the more restrictive laws, rules, or regulations shall apply.

3.2 STABILIZATION OF DISTURBED AREAS

A. Temporary sediment control measures shall be established within 5 days from time of exposure/disturbance. Permanent erosion protection measures shall be established within 5 days after final grading of areas.

3.3 DUST ABATEMENT

A. During the performance of the work required by these Specifications or of any operation appurtenant thereto, the Contractor shall furnish all the labor, equipment, materials and means required, and shall carry out proper and efficient measures whenever and as often as necessary to reduce the dust nuisance and to prevent dust which has originated from his operations from damaging dwellings or causing a nuisance to persons. The Contractor shall be liable for any damage resulting from dust originating from his operations. The cost of sprinkling or of other methods for dust control shall be included in the cost for erosion and sediment control.

3.4 PROTECTION OF ADJACENT PROPERTIES

A. Properties adjacent to the site of a land disturbance shall be protected from sediment deposition. In addition to the erosion control measures required on the Drawings, perimeter controls may be required if damage to adjacent properties is likely. Perimeter controls include, but are not limited to, a vegetated buffer strip around the lower perimeter of the land disturbance, sediment barriers such as straw bales and silt fences; sediment basins; or a combination of such measures. Vegetated buffer strips may be used only where runoff in sheet flow is expected and should be at least 20 feet in width.

3.5 TIMING AND STABILIZATION OF SEDMENT AND EROSION CONTROL MEASURES

A. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas must be constructed as a first step in grading and be made functional before land disturbance takes place. Earthen structures such as dams, dikes, and diversions must be stabilized within 5 days of installation. Stormwater outlets must also be stabilized prior to any upstream land disturbing activities.

3.6 STABILIZATION OF WATERWAYS AND OUTLETS

A. All on-site stormwater conveyance channels used by the CONTRACTOR for temporary erosion control purposes shall be designed and constructed with adequate capacity and protection to prevent erosion during storm and runoff events. Stabilization adequate to prevent erosion shall also be provided at the outlets of all pipes and channels.

3.7 STORM SEWER INLET PROTECTION

A. All storm sewer inlets which are made operable during construction or which drain stormwater runoff from a construction site shall be protected from sediment deposition by the use of filters.

3.8 WORKING IN OR CROSSING WATERCOURSES AND WETLANDS

A. Construction vehicles should be kept out of watercourses to the extent possible. Where in-channel work is necessary, precautions must be taken to stabilize the work area during construction to minimize erosion. The channel (including bed and banks) must always be restabilized immediately after in-channel work is completed.

B. Where a live (wet) watercourse must be crossed by construction vehicles during construction, a Temporary Stream Crossing must be provided for this purpose. No more than 4 crossing per work day will be allowed.

3.9 CONSTRUCTION ACCESS ROUTES

A. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment controlled disposal area. Street washing shall be allowed only after sediment is removed in this manner.

3.10 DISPOSITION OF TEMPORARY MEASURES

A. All temporary erosion and sediment control measures shall be disposed of within 30 days after final site stabilization is achieved or after the temporary measures

are no longer needed as determined by the City Representative. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.

3.11 MAINTENANCE

A. All temporary and permanent erosion and sediment control practices must be maintained and repaired as needed to assure continued performance of their intended function.

3.12 SEQUENCING

A. The CONTRACTOR shall submit a sequencing plan for approval for erosion control in conformance with his overall Construction Plan for approval by the City Representative. Changes to the Erosion Control Sequencing Plan may be considered by the City Representative only if presented in writing by the CONTRACTOR.

3.13 SUBSTANTIAL COMPLETION OF EROSION CONTROL MEASURES

A. At the time specified in the Contract Documents, and subject to compliance with specified materials and installation requirements, the CONTRACTOR will receive a Substantial Completion Certificate for temporary erosion control measures.

3.14 INSPECTION OF EROSION AND SEDIMENT CONTROL MEASURES

A. At a minimum all erosion and sediment controls will be inspected every 14 days

B. All erosion and sediment control measures will be inspected immediately after a significant storm event. If necessary, Erosion and Sediment control measures will be repaired or replaced immediately.

3.15 MODIFICATION OF EROSION AND SEDIMENT CONTROL MEASURES

A. All modifications to the Erosion and Sediment Control Plan must be approved by the City of Federal Heights.

B. All approved modifications to the Erosion and Sediment Control Plan must be recorded in the Erosion and Sediment Control Plan and Illustrated on Site Plan.

3.16 MAINTENANCE OF EROSION CONTROL MEASURES AFTER SUBSTANTIAL COMPLETION

A. The CONTRACTOR will be responsible for maintaining temporary erosion control measures as specified in the Drawings and/or Contract Documents until such time as the disturbed drainage area has stabilized as determined by the City Representative.

3.17 FINAL COMPLETION AND ACCEPTANCE OF EROSION CONTROL MEASURES

A. After the City Representative has determined that the drainage area has stabilized, the CONTRACTOR shall remove all remaining temporary erosion control measures. Any damage to the site shall be repaired to the satisfaction of and at no cost to the City Representative.

END OF SECTION

SECTION 02500

PORTLAND CEMENT CONCRETE PAVEMENT AND FLATWORK

PART 1 - GENERAL

1-1 SUMMARY:

A. WORK INCLUDED: Provide all exterior concrete flatwork, including Portland cement concrete paving, walks, patios, terraces, steps, ramps, curbs, gutters, and driveway approaches, as shown on the Drawings or specified herein and including excavating, backfilling, furnishing, forming, jointing, placing, finishing and curing of concrete, or as required to complete the Work.

B. RELATED WORK:

2. Excavation, Trenching, and Site Earthwork are specified in Section 02200

3. Hot Mix Asphalt Pavement is specified in Section 02510.

4. Structural concrete, including interior slabs-on-grade, is specified in Section 03300.

C. RELATED DOCUMENTS:

1. Related Documents: Drawings and, for all City Contracts, general provisions of the Contract, including General and Special Conditions apply to work of this section. Structural concrete for footings shall be as indicated on the Drawings.

2. Additional information concerning concrete flatwork and paving may be found on the Civil Drawings. In case of conflict between the Drawings and the information specified herein, the more stringent requirements shall govern.

1-2 REFERENCES:

A. REFERENCE STANDARDS: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents applicable to any City Contract.

1-3 SUBMITTALS (City Contracts Only):

A. SUBMITTAL PROCEDURES: Refer to Section 01300.

B. PRODUCT DATA: Submit to City not less than 14 days prior to scheduled delivery of materials.

1. Manufacturer's data for joint material, rebar, dowels, curing compounds, additives, admixtures and sealants.

C. CONCRETE DESIGN MIXES: Submit to City not less than 14 days prior to installation of materials.

1. Concrete: Including proportions of fine and course aggregate, water cement, air content and admixtures. Mix design shall be made by testing laboratory. Concrete design mixes in accordance with the requirements of Section 03300.

D. BATCH TICKETS: The Contractor shall collect delivery or batch tickets from the ready-mix driver for all concrete used on the project and turn them over to the City. Batch tickets shall provide weights of fine and coarse aggregates: weights (or gallons) of water; including surface water on the aggregates; sack mix content; quantity (cubic yards) of batch; slump; times of batching and discharging of concrete; name of batch plant; name of Contractor; type, name and amount of admixture; date and truck number.

1-4 QUALITY ASSURANCE:

A. CONTRACTOR QUALIFICATIONS: Install work using skilled persons, proficient in the trades required in a neat, orderly and responsible manner with recognized standards of workmanship. For all City Contracts, Contractor shall have not less than 5 years successful experience with installation of similar work.

B. Comply with City of Federal Heights and City of Thornton Standards and Specifications Section 602 for sidewalks, curbs, gutters, and driveway approaches or aprons, including standard dimensions, profiles, thicknesses, reinforcing, and compressive strength. In the event of conflict between the construction documents and the City standards, the more stringent requirements will apply.

C. Comply with applicable requirements of ADA Handbook, ANSI A117.1, and local and State codes and ordinances regarding walks, steps, ramps, and curb ramps.

D. STANDARDS: Conform to applicable AASHTO, ASTM, ACI, CDOT and PCA standards including:

1. ACI 301 – Specification for Structural Concrete for Buildings
2. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
3. ACI 305 – Hot Weather Concreting
4. ACI 306 – Cold Weather Concreting
5. ASTM C-94 Specifications for Ready-Mixed Concrete
6. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction
7. Metropolitan Government Pavement Engineering Council (MGPEC) Pavement Design Standards and Construction Specifications

1-5 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Furnish ready-mixed concrete mixed and delivered per ASTM C-94. When concrete is mixed in truck mixer, do not load over NRMCA rated capacity, mix at speed for not less than 70, nor more than 100 revolutions of drum or blades.

B. Deliver concrete to job and discharge entire contents within 1 hour after introduction of mixing water. In hot weather or under conditions contributing to quick set of concrete, shorter times may be required.

C. REINFORCEMENT: Deliver reinforcement to the project site bundled, tagged and marked. Use tags indicating bar size, lengths, and other information corresponding to the Drawings. Store concrete reinforcement materials at the site in a manner to prevent damage and accumulation of direct or excessive rust.

1-6 CONSTRUCTION PERMITS AND COORDINATION

A. The Contractor shall obtain all documentation from concerned agencies such as construction permits, clearances and verification of any underground cabling or piping and ground structures and coordinate with these agencies their relocation or removal as required.

1-7 PROJECT/SITE CONDITIONS:

A. FIELD MEASUREMENTS: Verify dimensions and existing conditions shown on the Drawings by taking field measurements. Report discrepancies to the Architect for clarification, and make minor adjustments in layout as required by field conditions and as approved by the Architect, at no additional cost to the Owner.

B. ENVIRONMENTAL REQUIREMENTS: Perform work only under suitable weather conditions. Comply with the environmental requirements of Section 03300 for concrete placement.

1. Cold Weather: When concrete is placed with the ambient temperatures below 40 degrees F., the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. The aggregates, or water, or both, shall be heated in order to place the concrete at temperatures between 50 degrees F. and 100 degrees F. Placing of concrete may be started in the morning if the Contractor desires, but shall be discontinued at 3:00 p.m. of the same day if freezing weather threatens. The concrete or aggregates shall be protected during transit, mixing, and before and after placing, as directed by the City to retain all heat possible in the concrete mix. After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, canvas, framework, heating apparatus, etc. to enclose and protect the contents and maintain the temperature of the concrete at not less than 50 degrees

F. until at least sixty percent (60%) of the design strength has been attained. Except as provided above, cold weather concreting shall be in accordance with ACI – 306. If, in the opinion of the City, the protection is not adequate, concreting shall cease until conditions or procedures are satisfactory to the City.

2. Hot Weather: When air temperature in shade exceeds 90 degrees F., concrete mix at delivery shall not exceed 80 degrees F. The placement of concrete in hot weather shall comply with ACI – 305.

C. TRAFFIC CONTROL: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1-8 GUARANTEE: Contractor shall guarantee all work, materials and workmanship for the period stated in the Performance Bond. Repairs made during the guarantee period shall be done in a mutually agreed upon manner acceptable to the City.

PART 2 - PRODUCTS

2-1 MATERIALS:

A. REINFORCING: Reinforcing bars shall be billet steel conforming to ASTM A615 Grade 40 for #5 and smaller and ASTM A615 Grade 60 for #6 and larger. Use of heat in bending bars is not permitted. Splices where permitted, shall be as specified in ACI-318.

B. FIBROUS REINFORCING: Refer to City of Thornton Standards and Specifications Section 602. Fibrous Reinforcing is required in concrete for curb, gutter and sidewalks.

C. ANCHOR AND EXPANSION BOLTS: Anchor bolts shall meet the requirements of ASTM A449, ASTM A307, or ASTM F1554. High strength bolts shall meet the requirements of ASTM A325. Expansion bolts shall be “Thrubolt Wedge Anchor” by ITW RAMSET/Redhead.

D. EXPANSION JOINT FILLER:

1. Sealed Joints: Preformed, compressible fiber or cork filler material complying with ASTM D1751 or D1752, Type II, guaranteed compatible with expansion joint sealant materials, 1/2’ thick unless otherwise indicated. Provide high-impact polystyrene removable “void cap” to create 1/2” deep reveal for installation of sealant.

2. Self-Sealing Joints: Preformed, compressible asphalt fiber joint filler complying with ASTM D994, 1/2” thick unless otherwise indicated. Do not use asphalt fiber filler in joints to receive elastomeric joint sealants

2-2 MIXES:

A. CONCRETE MIX: Comply with applicable provisions of Section 03300 for use intended.

PART 3 - EXECUTION

3-1 PROTECTION:

A. VERIFICATION OF CONDITIONS: Examine areas and conditions under which the work of this Section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

B. The Contractor is to exercise caution when working adjacent to existing structures, underground services and the like. Any damage to or displacement of any structure or service caused by the Contractor's negligence shall be repaired to its original condition at the Contractor's expense. Contractor is responsible for protecting concrete from vandalism.

3-2 PREPARATION:

A. SUBGRADE PREPARATION:

1. The Contractor shall perform all earthwork to produce a compacted subgrade conforming to ASTM D-698. Where fill material is required, it shall be composed of inorganic soils, have 100% finer than 6" size, 25% minimum of minus 200 sizes, capable of being compacted to 95% standard proctor density. Do fine hand grading as required to assure minimum thickness of concrete as indicated. Be sure any required gravel subgrade, or drainage system is in place. Be sure any required gravel base course is in place and compacted to 95% standard proctor density. Proof-roll prepared sub-base surface to check for unstable areas and need for additional compaction. Do not begin work until such conditions have been corrected and are ready to receive paving.

2. Moisture condition and compact subgrade to 95% standard proctor density.

3. Perform work only under suitable weather conditions. Do not work frozen materials

B. UTILITY TRENCHES: Do not proceed with concrete flatwork and paving installation until all utility trenches within or crossing areas to be paved, and any subsequent filling in the areas, have been properly compacted and tested.

C. FORM WORK:

1. Design, erect, support, brace, and maintain form work so that it will safely support vertical and lateral loads that might be applied, until such loads

can be supported by the concrete structure.

2. Design formwork to be readily removable without impact, shock or damage to concrete surfaces and adjacent materials. Provide form work sufficiently tight to reduce leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to reduce leakage and fins.

3. Use steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with a nonstaining form release agent that will not discolor or deface surface of concrete.

D. FORM CONSTRUCTION:

1. Construct forms complying with ACI-347, to the exact sizes and shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plum work in finished concrete work.

2. Provide for openings, offsets, sinkages, recesses, chamfers, blocking, screeds, anchorages, and inserts and other features required.

3. Provide openings in forms to accommodate other work, including mechanical and electrical work.

E. FORM COATINGS: Coat form contact surfaces with form-coating compound before reinforcement is placed.

F. CLEANING AND TIGHTENING: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt and other debris just before concrete is to be placed. Retighten forms immediately after concrete placement as required to reduce mortar leaks.

G. RE-USE OF FORMS: Clean and repair surface of forms to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new form work.

H. REINFORCING: Install as indicated on the Drawings. Reinforcing bars shall have a minimum of 2” clear cover unless otherwise noted on the Drawings. Lap splices for reinforcing shall be a minimum of 30 bar diameters. Provide bent corner bars to match and lap horizontal reinforcing at corners and intersections in concrete footings and walls.

I. PREPARATION FOR CONCRETE PLACEMENT:

1. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

2. Remove snow, ice, or frost from subbase surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.

3. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

4. Remove loose material from compacted subgrade surface immediately before placing concrete.

3-3 INSTALLATION:

A. GENERAL: Comply with applicable requirements of Section 03300 regarding concrete placement, consolidation, preparation for finishing, and curing of concrete installed under this Section.

B. WALKS: Minimum 4" thick, with expansion joints at intervals of approximately 100 ft. and tooled control joints at intervals equal to width of walks, existing joints, or minimum of 5 ft. o.c. Tool edges to rounded profile and finish as noted herein or shown on the Drawings. Pitch walks 1/4" per ft. for drainage unless otherwise indicated.

C. CURBS AND GUTTERS: Construct to profiles indicated or required by applicable public works standards. Provide wheelchair ramps at street intersections and driveway approaches, in accordance with ADA Handbook, ANSI 117.1, and local and State code requirements or ordinances. Provide expansion joints at 90 ft. o.c. maximum.

D. Notify the City not less than 8 working hours in advance of any pour and as soon as form work and reinforcing are substantially complete.

E. See Drawings regarding items to be embedded in concrete, including but not restricted to the miscellaneous steel, expansion joints, anchor bolts, etc.

F. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.

G. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

H. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete.

I. Remove rejected concrete from the project site and dispose of in an acceptable location.

J. Isolate flatwork from building elements, walls, columns with expansion joints unless otherwise indicated.

K. Saw cutting of divider joints may be used providing cutting occurs as soon as it can be done without dislodging coarse aggregate and before initial shrinkage stresses have occurred.

L. Consolidate concrete placed in forms by vibrating, hand-spading, or rodding. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Vibration of forms and reinforcing will not be permitted. Bring slab surfaces to the correct level; smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

M. Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of concrete bonding agent, and clean surfaces of coatings loose particles and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and to not leave loose particles or aggregate, or damaged concrete at the surface.

3-4 JOINTS:

A. General: Construct expansion, control, and cold pour joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

B. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

C. CONTROL JOINTS: Provide control joints, sectioning concrete into areas as shown on Drawings. Concrete curbing shall have a control joint a minimum of 10 feet on center.

1. Tooled Joints: Form joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

2. Sawed Joints: Form joints with powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surfaces will not be torn, abraded, or otherwise damaged by cutting action.

D. COLD POUR JOINTS: Place construction joints at end of placements and at locations where placement operations are stopped for more than ½ hour, except where such placements terminate at expansion joints.

1. Construct joints as shown or if not shown, use standard metal keyway-section forms.

E. EXPANSION JOINTS: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, and other fixed objects as indicated on the Drawings.

F. Extend joint fillers full width and depth of joint, not less than 0.5-inch or more than 1-inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.

G. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or slip joint filler sections together.

H. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

I. FILLERS AND SEALANTS: Comply with requirements of manufacturer's specifications.

3-5 FINISHING:

A. Exposed horizontal and vertical surfaces shall be finished as indicated on the Drawings.

B. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture.

C. For flatwork areas, after floating, test surface for trueness with a 10 foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

D. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to ½-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

E. After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface as follows:

1. Broom finish as indicated on the Drawings. Repeat operation if required to provide a texture acceptable to the City.

2. On inclined slab surfaces, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.

F. VERTICAL EXPOSED FACES: After form removal, clean ends of joints and repair any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by the City.

3-6 PROTECTION:

A. GENERAL: Protect freshly placed concrete from premature drying and excessive cold and hot temperature, and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of the cement and proper hardening of the concrete. Provide barricades or other suitable barriers to prevent pedestrian or vehicular traffic until concrete has sufficiently hardened.

Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.

Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

Protection from vandalism and traffic is the responsibility of the Contractor.

B. CURING METHODS: Apply specified curing compound at full strength with coverage rate not to exceed 200 square feet per gallon.

If rainy weather is imminent, steps shall be taken to properly protect the concrete from washing or addition of excess water until such time as it has sufficiently hardened, (minimum 7 day strength). Use canvas or tarp coverings to resist scouring from rain water.

3-7 TESTING: The City reserves the right to test materials and subgrade required in this section. See Section 01410-Testing.

3-8 REPAIRS:

A. Repair or replace broken or defective concrete, as directed by the City using methods meeting the City's approval.

B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 7 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

C. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just before final inspection.

END OF SECTION

SECTION 02510

HOT BITUMINOUS PAVEMENT (HBP)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnishing, laying, and compacting hot-mixed asphaltic concrete pavement and patching in conformance with lines, grades, and typical cross-sections shown on the drawings.

B. Related Work:

1. Water System: Section 02713
2. Sanitary Sewer System: Section 02550
3. Storm Sewer System: Section 02527

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of any City Contract, including general and supplementary conditions and Division 1 specification sections, apply to this section.

B. Additional information concerning Hot Bituminous Paving may be found on the civil drawings. In case of conflict between the drawings and the information specified herein, the more stringent requirements shall govern.

1.3 QUALITY ASSURANCE

A. Source: City Engineer or City Representative shall have access to batching plant at all times work is in progress.

B. Testing Agency:

1. All testing and inspections required for City quality assurance will be performed by an independent testing and inspection agency. For City Contracts, a testing and inspection agency shall be contracted by the City.
2. Notify the testing and inspection agency not less than 48 hours in advance of all work requiring testing or inspection services.

C. Record of Work: Contractor shall keep record of time and date of placement, temperature, and weather conditions. Retain until completion and furnish copy to City Engineer/City Representative. Batch tickets from hot mix plant shall be sent

out with each load produced that day, and shall note, at a minimum, the following items: Mix identification, time batched, mass in load, cumulative mass produced that day. If batching for multiple mix designs, a record is to be produced at day's end noting quantities of each mix produced, projects they were shipped to, and any notations on waste between mixes to indicate cleaning out the plant.

1.4 REFERENCES

A. MGPEC – 2008 version.

B. State of Colorado, Department of Transportation (CDOT): State Department of Highways Standard Construction Specifications for Road and Bridge Construction, Latest Edition.

C. Reference Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.

1.5 SUBMITTALS

A. Samples: Provide samples of proposed materials. Following acceptance of a job mix design by the City, submit representative samples of each material in each mix design to the independent testing agency contracted by the City so that a laboratory mix can be prepared for machine calibrations.

B. Test Reports: Furnish copies of certified test results for each material used in the mix design as follows:

1. Aggregate - AASHTO T96
2. Performance Graded Asphalt Binder – AASHTO MP-1, CDOT table 702-1
3 Liquid Asphalt - AASHTO M81, M82; ASTM D2026
4. Emulsified Asphalt - AASHTO M140
5. Compaction - AASHTO T230
6. Stability and Flow - AASHTO T245
7. Hydrated Lime – ASTM C207, Type N
8. Mineral Fillers – AASHTO M17

C. Job Mix Formula: Job mix designs for the project shall be within Master Range, as defined by the Asphalt Institute's Superpave Services No. 2 Manual. The aggregate shall be grading 'SX' for top lift and "S" for bottom lifts and oil shall be Performance Graded (PG) 64-22. Minimum 4" to 6" full depth asphalt is required. Match existing pavement depth or provide 6" depth for patching, whichever is greater as approved by the City. The mix design shall be submitted along with complete test results from a certified, independent laboratory. Test Results will include the following, and reference CDOT testing Procedures:
   (1) Asphalt Content – CP-L 5120
   (2) Gradation – CP-31A, 31B

(3) Fractured Faces and Void Content of Fine Aggregate – CP-45
(4) Maximum Theoretical specific Gravity (Rice) – CP-51
(5) Air Voids – CP-L 5115
(6) Voids in Mineral Aggregate – CP-48
(7) Lottman Stability – CPL-5109
(8) Superpave Gyratory, N_{DESIGN}

D. A Superpave Gyratory, N_{DESIGN} with aggregate meeting the 'SX' grading, containing PG 64-22 oil, and providing the testing called out above shall be acceptable provided all other criteria of this section are met. A new mix design shall be submitted with any change in source, type, or proportion of any of the materials in the mix design.

1.6 DELIVERY, STORAGE, AND HANDLING

Transport mixtures from mixing plant in trucks having tight, clean, non-sticking compartments. When transporting, provide covers to protect from weather and prevent loss of heat. During temperatures below 50º F on long distance deliveries, provide insulation around entire truck bed surfaces.

1.7 JOB CONDITIONS

A. Environmental Requirements: Do not place asphaltic concrete on wet surfaces, or when temperature is below 40 º F for lower lifts and 50º F for top lift, unless agreed to by City Engineer.

B. Protection: After final rolling, do not permit vehicular traffic on asphaltic concrete pavement until cooled and hardened. Provide barricades, flagmen, and warning devices as required to protect pavement. Maintain pedestrian and vehicular traffic as required. Cover openings of structures in paving until permanent coverings are placed.

PART 2 - PRODUCTS

2.1 AGGREGATE

Clean, hard, durable particles of crushed stone, crushed gravel, natural gravel, or crushed slag with not more than 45% of wear, AASHTO T96.

Sieve Size	Percentage by Weight Passing Square Mesh Sieves	
	Grading S	Grading SX
1"	100	-
3/4"	90-100	100
1/2"	*	90-100
3/8"	*	*
#4	*	*
#8	23-49	28-58
#30	*	*
#200	2-7	2-8

2.2 HYDRATED LIME ADDITIVE

Lime shall be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount passing the No. 200 sieve. Hydrated lime for aggregate pretreatment shall conform to ASTM C207, Type N. The residue retained on a 200 sieve shall not exceed 10% in accordance with ASTM C 110.

2.3 ASPHALTIC CEMENT

Asphaltic cement binder shall meet the requirements of Superpave performance grade binder for PG 64-22.

2.4 RAP (Reclaimed Asphalt Pavement)

Rap shall be of uniform quality and gradation with a maximum size no greater than the nominal aggregate size of the mix. Mix shall not contain more than 25 percent RAP in lower lifts and 20% in upper lift. (MGPEC Item 9 – 9.2.5)

2.5 TACK COAT

One of the following, grade and type:

A. Emulsified asphalt, AASHTO M208 (CSS-1h)

B. Cationic emulsified asphalt, AASHTO M140 (SS-1h)

2.6 MIX DESIGN

A. Furnish mix design as required by City of Federal Heights /MGPEC. The design shall be determined using CDOT CP-L5115 for Superpave method of mixture design – guidance provided in Superpave Level – 1 mix design SP-2 published by A.C.

Mixture properties per MGPEC Table 9.3.1a.

B. Furnish aggregate gradation.

C. Accepted design mix shall meet compaction requirements of these specifications.

2.7 MIXING

A. General: Comply with ASTM D995 for material storage, control, mixing, and plant equipment and operation.

B. Aggregates: Keep each component of various-sized combined aggregates in separate stockpiles. Maintain so separate aggregate sizes will not be intermixed and to prevent segregation. Heat-dry aggregates to reduce moisture content to not more than 2%. Deliver dry aggregate to mixer at recommended temperature to suit penetration, grade, and viscosity characteristics of asphaltic cement, ambient temperature, and workability of mixture.

C. Asphaltic Cement: Heat bitumen to viscosity at which it can be uniformly distributed throughout mixture. Select temperature range of 275 º F to 325 º F to suit temperature - viscosity characteristics of asphalt. Do not exceed 325º F.

D. Mixing: Accurately weigh or measure dry aggregates and weigh or meter asphaltic cement to comply with job-mix formula requirements. Mix aggregate and asphaltic cement to achieve 95% coated particles for mixtures when tested in accordance with AASHTO T195.

PART 3 - EXECUTION

3.1 PREPARATION OF SURFACES

A. Base Course: Blade, shape, and smooth base to uniform section. Remove loose materials. If time lapse from final shaping to placement is longer than 24-

hours, reshape, wet and compact surface.

B. Existing Surfaces: Clean off all foreign materials. Fill holes and low places with leveling courses and compact prior to surface placement. Tack coat existing surfacing at 0.1 gallon per square yard of diluted mixture. Apply only to areas on which surfacing is to be placed immediately. Do not extend more than 2000' ahead of paving equipment. Prevent traffic from traveling on tack coat.

3.2 FRAME ADJUSTMENTS

Set frames of structures to final grade. After adjusting, surround frames with bed of concrete. Place compacted asphaltic concrete to top of frame. If permanent covers are not in place, provide temporary covers over openings until compaction is complete. Where frames and covers are paved over, mark so crews can find on emergency basis until cut out and adjusted to final surfacing.

3.3 PLACEMENT

A. Minimum air temperature for lower lifts shall be 40º F and 50º F for top lift. Placement air temperature shall be increased by 5º F for each 10 miles pr hour wind velocity to a maximum of 70º degrees F. Mix temperature at placement shall not be less than 245º F.

B. Mechanical, self-powered pavers shall be capable of spreading mix within specified tolerances, true to line, grade, and crown as indicated on drawings. Pavers shall be equipped with quick and efficient steering devices, and shall be capable of traveling forward and reverse. Pavers shall be equipped with hoppers and distribution screws which place mix evenly in front of adjustable screeds. Screed shall be adjustable for height and crown, equipped with controlled heating device for use as required. Screed shall strike off mix without tearing, shaving or gouging surface, to depth and cross-section specified, without aid of manual adjustment during operation. Paver shall be capable of placing courses in thicknesses from 1/2" to 4" and from widths of 8' to 15'. Extensions and cut-off shall permit changes in widths by increments of 6".

C. Strike finish surface smooth; true to cross section; uniform in density and texture; free from hollows, transverse corrugations, and other irregularities. Paint contact surfaces between gutters, manhole rings and other similar structures with thin, uniform coating of tack coat. Final surface shall be 1/4" above all structures and gutters sloping away from paving, flush with gutters sloping towards paving.

D. Hand Placement: Where certain areas, because of irregularity, inaccessibility, or unavoidable obstacles, do not lend themselves to machine placement, City Engineer may agree to hand placement. Spread and compact to same finish and compaction tolerances of these specifications.

E. Joints: Make joints between old and new pavement, or between successive

day's work, to insure thorough bond between old and new surfaces. Clean surfaces free of sand, dirt, dust, or other materials, and apply tack coat. Construction joints must have same texture, density, and smoothness tolerances as other surfacing

1. Construct transverse joints to existing material by cutting material back to expose full depth edge. Paint thin uniform tack coat on joint and place new asphaltic concrete.

2. Prepare longitudinal joints by overlapping screed 1" on existing surface. Deposit sufficient material to complete joint. Push excess by hand rake 1/2" on new mat leaving vertical uncompacted face approximately 1" high. Compact against joint by rolling equipment. No depression allowed exceeding 1/8" for a width of 6", after final compaction.

3. Longitudinal joints shall offset joint in layer immediately below by a minimum of 6”.

4. Joints in top layer of pavement shall be located:

    a. For 2-lane roadways, offset 6 to 12 inches from the center of pavement and from the outside edge of travel lanes.
    b. For roadways of more than 2 lanes, offset t 6 to 12 inches from lane lines and from outside edge of travel lanes.

F. Finish Tolerance: Place leveling courses within 1/4" of design grade. Finished surfaces will be tested with 10' straight edge, parallel to center line at location of wheel paths for each lane. Straight edge will be advanced 5' and space under straight edge shall not exceed 1/4". Correct areas deficient in smoothness by completely removing surface material and replacing. Overlay corrections may be made only if approved by City.

3.4 SEGREGATION

All segregated areas shall be removed immediately and replaced with specification material before the initial rolling. If more that 50 square feet of segregated pavement is removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source has been determined and corrected.

3.5 COMPACTION

A. General: Provide minimum one pneumatic-tired and one steel-wheel roller to obtain required density, surface texture, and rideability. Begin rolling operations immediately following placement of asphaltic concrete. Do not permit heavy equipment, rollers, etc. to stand on finished surface where deformation may occur. End each pass of roller in different place. All compaction shall be in accordance with CDOT Standard Specifications for Road and Bridge Construction Section 401.17.

B. Rollers:

1. Steel-wheel rollers self-propelled, developing contact pressure under compression wheels of 250 to 350 psi per inch of width of roller wheel. Rollers equipped with adjustable scrapers and means for keeping wheel wet to prevent mix from sticking.
2. Pneumatic-tired rollers self-propelled, developing contact pressure under each tire of 85 to 110 psi. Wheels so spaced that one pass will accomplish one complete coverage equal to rolling width of machine. Wheels oscillate but not wobble. Remove and replace immediately any tires picking up fines.

C. Compaction Procedures:

1. Compact longitudinal joints and edges first, starting at outside edge and gradually progress towards center of pavement. Begin super elevated curves rolling on low side on previously transversely compacted material. Successive passes should overlap by one half width of roller. Mat temperature must not be below 185º F.
2. Immediately follow rolling of longitudinal joint and edges with breakdown rolling. Place drive wheel nearest paver and pull roller towards paver. Return roller to existing surface and make gradual shift to overlap previous pass by half roller width. Operate pneumatic-tired rollers as close to paver as necessary to obtain density required. Make enough passes for reasonably smooth surface.
3. Final rolling by a combination of steel and pneumatic rollers to obtain density, surface texture, and surface tolerances required.
4. Contractor is responsible to ensure that all compaction meets specified range.

D. Compact between 92-96% of maximum Theoretical Specific Gravity (Rice). Re-compact asphaltic concrete not conforming to density standards to these specifications. Contractor as required shall cut test plugs, fill, and repair test holes at his expense. Sections not meeting the compaction criteria will be removed and replaced.

3.6 FIELD QUALITY ASSURANCE

A. Aggregate – At City's discretion samples of the aggregate used in the hot mix asphalt shall be obtained for every 1000 tons of HBP produced, or a minimum of one sample per day of at least 200 tons of production. Samples may be obtained by the City's contracted testing laboratory from the belt at the hot mix plant, following the addition of lime or any mineral fillers, and prior to the addition of bituminous materials. This sample shall be tested for gradation in accordance with CP-31A and 31B, and observed for fractured faces and aggregate quality.

B. Hot Bituminous Pavement- A sample of the Hot Bituminous Pavement may be obtained from behind the paving laydown machine prior to any roller passes. One sample shall be obtained by the City's contracted testing laboratory for every 500 tons produced, or a minimum of one sample per day of at least 200 tons production. For all City Contracts, these samples shall be tested by the City's contracted testing laboratory for asphalt content, following CP-85. One sample per project shall be submitted to the City's contracted testing laboratory for Maximum Theoretical Specific Gravity (Rice) testing and asphalt content testing using the burn off oven method. The aggregate material following burn off shall then be tested by the independent laboratory for graduation in accordance with CP- 31A and CP-31 B. For non-City Contracted work, the contractor will be responsible for demonstrating compliance with these criteria.

C. Compaction Testing- For all City Contracts, the City's contracted testing laboratory will perform quality assurance testing of compaction at a minimum rate of one test per 250 tons produced, or a minimum of one test per day of a least 100 tons produced. The testing will be performed using a calibrated nuclear moisture-density gauge, corrected with cores in accordance with CP-44 and CP-81. Two (2) cores will be taken, at the City's discretion, by the City's contracted testing laboratory from each lift (mat) of asphalt pavement produced. For non-City Contracted work, the contractor will be responsible for demonstrating compliance with these criteria.

3.7 PATCHING

Cut out and fill with fresh, hot asphaltic concrete. Remove deficient areas for full depth of surface and base course. Cut sides perpendicular and parallel, and perpendicular to direction of traffic to extent of failure. Apply tack coat to exposed surfaces before placing new pavement. Compact and finish to specification. Patch shall extend minimum of two-feet beyond the trench excavation in each direction.

3.8 TEMPORARY PATCHING

Whenever permanent pavement patching is not constructed immediately following utility cut backfilling operations, temporary pavement patching consisting of minimum of 3 inches of hot or cold mix asphalt may be utilized. Temporary pavement patching may be left in place for a maximum of 14 calendar days, unless otherwise required by the City

representative, following completion of backfilling operations. Temporary patches must be inspected daily by the contractor and maintained by the contractor to the following tolerances at all times. Deteriorated temporary patches exhibiting ruts, humps, or depressions in excess of ¾ inch shall be repaired or replaced immediately.

3.9 CLEAN UP

A. General cleanup of the area shall be performed on a daily basis to the satisfaction of the City Engineer and City Representative. Proper safety provisions, including ropes, fence, barricades, construction signs, and warning signs, shall be maintained until completion of work.

B. After completing operations, clean surfaces, pick up excess paving materials, and clean work area.

END OF SECTION

SECTION 02516

STORM SEWER MANHOLES AND INLETS

PART 1: GENERAL

1.1 DESCRIPTION: The work of this section consists of furnishing and installing pre-cast and cast-in-place bases, pre-cast concrete risers, frames, covers, and installation materials, and appurtenances.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

Pipeline Excavation, Trenching and Backfilling – Section 02222
Storm Sewer System – Section 02527
Site Concrete work – Section 02800

1.3 QUALITY ASSURANCE: American Society for Testing and Materials (ASTM)

1.4 SUBMITTALS: Furnish manufacturer's literature on manholes, joint material, frame and cover, and steps.

PART 2: MATERIAL

2.1 MANHOLES

Manholes shall be constructed of pre-cast reinforced concrete components in accordance with the details shown on the Drawings. The base can be either cast-in-place or pre-cast. The top section required for change of diameter shall be eccentric cone, or, if permitted by the City Representative flat slab. All pre-cast components, including the base, riser sections, grade rings, tops, appurtenances, and base sections shall conform to ASTM C478.

To bring the manhole cover to the correct elevation, the adjustment section of each manhole shall be constructed of pre-cast concrete grade adjustment rings or rubber adjustment riser. These rings shall be not less than 6-inches wide and furnished in heights to allow for 1-inch adjustment. Total adjustment height, with grade rings shall not exceed 12-inches.

2.2 JOINTS: Joints between manhole sections and between grade rings shall be sealed. The sealant shall be a flexible butyl resin sealant that has an in service temperature range from -30º F (or lower) to +200º F, and shall be Rubr-Nek or approved equal.

2.3 FRAME AND COVER: Frames and covers for manholes shall have a combined weight of 400 pounds, machine fit securely without rocking, hot dipped in asphalt, 24 inch size cast iron frame and cover and be as manufactured by East Jordan Iron Works, or City Representative approved equal. The cover shall have the word "STORM SEWER" clearly cast on its surface.

2.4 MANHOLE STEPS: Manhole steps shall be steel reinforced copolymer polypropylene conforming to ASTM C-478 as manufactured by M.A. Industries firmly secured into preformed tapered holes.

2.5 GROUT: No-shrink, non-metallic grout shall be: U.S. Grout “5-Star” or approved equal.

2.6 CONCRETE: Concrete for cast-in-place manhole bases shall have a 28-day compressive strength of not less than 4,000 psi. All reinforcement shall be standard deformed reinforcement conforming to the requirements set forth in ASTM, A615, Grade 60.

2.7 CONCRETE INLETS AND CATCH BASINS

A. Inlets and catch basins to be pre-cast or cast-in-place, at Contractor’s option. Use concrete which will attain a 28-day compressive strength of not less than 4,000 psi with a cement content of not less than 6 sacks per cubic yard.

B. Inlets to be Type R per the Standard Details within the Contract Drawings. Access manhole frames and covers shall be furnished by the City and picked up by contractor at East Jordan Iron works 8150 Pontiac Street, Commerce City, Colorado 80022.

PART 3: EXECUTION

3.1 CONSTRUCTION: Concrete construction shall conform to the requirements for reinforced concrete.

A. Manholes shall be constructed to conform to the details shown on the drawings. Channel inverts shall be smooth and U-shaped, conforming to the inside diameter of the existing incoming and outgoing pipelines. Changes in direction of flow shall be made with a channel of a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. Where differences in existing pipeline invert elevations exist, sloped flow channels shall be formed so the fluid does not undergo a vertical drop. The floor of the manhole outside of the channel shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot.

B. Pipe sections shall be flush on the inside of the structural wall (except as noted below) and project outside sufficiently for proper connection with the next pipe section. All pipelines into a manhole or inlet shall have a joint located no more than 12-inches from the exterior wall. Where incoming pipes enter a storm drain manhole at an elevation 3-feet or greater above the base, the incoming pipe shall project approximately 2-inches inside the manhole. Grout all annular spaces around pipe openings.

The invert channels of manholes shall be smooth and semi-circular in shape, conforming to the inside of the incoming and outgoing sewer pipelines. Changes

in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. Where differences of 24-inches or less in invert elevations are called for, sloped flow channels shall be formed so the water does not undergo a vertical drop. The invert channels may be formed directly in the concrete of the manhole base. The floor of the manhole outside of the channel shall be smooth and shall slope toward the channels not less than 1-inch per foot nor more than 2-inches per foot. The manhole covers shall be set with their tops at the grade line, as set forth on the drawings. To bring the manhole cover to the correct elevation, the top section of each manhole shall be constructed of pre-cast concrete, steel, or rubber grade adjustment rings. These rings shall be not less than 6-inches wide and furnished in heights to allow for one-inch adjustment. When a manhole is located in the pavement area it shall not be constructed to final grade until the pavement has been completed unless directed otherwise by the City.

C. Grout all joints of storm sewer manholes inside and outside after manhole is complete.

D. Stubs shall be provided at manholes when so shown on the drawings. Such stubs shall be sealed with a removable plug. Plugs shall be specifically manufactured for the pipelines in which they are to be installed. The plug shall be constructed of a material approved by the City and shall provide a permanent water-tight installation.

E. Cast-in-place manhole base. The invert channels may be formed directly in the concrete of the manhole base. Do not set pre-cast manhole sections on manhole base for a minimum of 48 hours after base placement.

F. Pre-cast manhole base. The Contractor will install a pre-cast manhole base subject to the approval of the City Representative. If the Contractor elects to use a pre-cast base, any revisions required to accommodate actual field locations will be at no additional cost to the City.

The area beneath the manhole shall be over-excavated 3 to 4 inches beneath the bottom elevation of the manhole. Squeegee backfill material, free of fines, shall be compacted in place for foundational support of the manhole. Screed boards shall be set level at the right elevation and the compacted material screeded to form a uniformly graded foundation. The surface grade of the newly compacted backfill shall be checked and surveyed to ensure a uniform surface elevation beneath the entire manhole base, such that the invert elevations of the channel within the manhole are as shown on the Contract drawings.

The precast base shall be carefully set so as not to disturb the screeded granular base.

G. Manhole barrel. Each joint of the precast manhole barrel shall have a minimum of one continuous gasket placed on the lower ledge before the barrel immediately above is lowered into place.

Any opening between manhole walls and pipe made by the Contractor, or as designated elsewhere, shall be closed water tight with grout. The grout shall extend no less than the full thickness of the manhole barrel.

Channels that have been formed into existing concrete bases shall be smoothed to the specified contour with grout.

H. The manhole cover shall be set with its top at the grade line as set forth on the Drawings. When a manhole top is above the ground line, compacted backfill shall be placed around the exposed section as shown on the Drawings. Manhole cover in pavement shall be set ¼" to ½" below surface elevation.

3.2 CONNECTION TO EXISTING MANHOLES/INLETS: Pipe connections to existing manholes/inlets shall conform to the following requirements:

A. Connecting new pipe in the same location of the old pipe, jackhammering/chipping of the around the existing connection to allow spaced for the new connection. A flexible rubber gasket shall be installed around the pipe at the connection and the void around the pipe shall be grouted with non-shrink grout.

B. Connecting new pipe in new location shall require core drilling to. Jackhammering /chipping will not be permitted. A flexible rubber gasket shall be installed around the pipe at the connection and the void around the pipe shall be grouted with non-shrink grout.

3.3 TESTING MANHOLES: During the construction of the manholes, the Contractor shall, in accordance with good practice, insure that no earth, sand, rocks or other foreign material exists on the joint surfaces during assembly of the sections. The City Representative shall check each manhole to determine whether the manhole fulfills the requirements of the Drawings and Specifications. Visual examination is required.

A. Visual Examination: The City Representative shall visually check each manhole, both exterior and interior, for flaws, cracks, holes, or other inadequacies that might affect the operation or watertight integrity of the manhole. Should any inadequacies be found, the Contractor shall make any repairs deemed necessary by the City Representative.

3.4 INLETS, OUTLETS, AND CATCH BASINS:

A. Cast-in-place in accordance with the Contract Drawings and applicable public works standards. Comply with applicable requirements of Section 03300.

B. Construct inverts of pipes or concrete smoothed inverts sane size as pipe up to centerline of pipe. Form perimeter bench as indicated

C. Embed steel angles or other accessories as indicated or required to anchor and support frames, grates, and covers.

D. Install frames, grates, and covers accurately to the placement dimensions shown on the Contract Drawings. Anchor castings in place and set in adjustment mortar to assure a firm foundation.

3.5 ADJUSTING MANHOLE TOPS: When grade adjustment of an existing structure is specified, remove frames and covers and reconstruct as required. Reset cleaned frames at the indicated elevation. Prior to final acceptance, clean structures of accumulations of silt, debris, or foreign matter.

END OF SECTION

SECTION 02520

CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnishing, forming, jointing, placing and curing of curbs and gutters, sidewalks, cross-pans, equipment pads in conformance with regulations of authority having jurisdiction. Removal and replacement of the above items will be included under piping bid item.

B. Related Work:

1. Pipeline Excavation, Trenching & Backfilling: Section 02222.
2. Water System: Section 02713.
3. Sanitary Sewer System Section 02550

1.2 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 cement concrete pavement may be found on the civil drawings. In case of conflict between the drawings and information specified herein, the more stringent requirements shall govern.

1.3 REFERENCES

A. State of Colorado, Department of Transportation (CDOT): State Department of Highways Standard Construction Specifications for Road and Bridge Construction, 1999.

B. MGPEC

C. Reference Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.5 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete pavement mix, include proportions of fine and coarse aggregate, water, cement, air content and admixtures. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with requirements indicated, based on comprehensive testing of current materials.

D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials and aggregates.
2. Fiber reinforcement.
3. Admixtures.
4. Curing compounds.
5. Bonding agent or adhesive.
6. Joint fillers.

E. Shop Drawings: Reinforcement, precast sections.

F. Placement: Method proposed, if requested.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

D. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.

E. Record of Work: Contractor shall keep record of time and date of placement, temperature, and weather conditions. Retain until completion and furnish copy to City Engineer and City Representative.

F. Concrete Testing Service:
   1. For all City Contracts, the City will engage a qualified independent testing agency to perform material testing. For non-City contracted work the contractor shall be responsible for demonstrating compliance with the criteria of this section.
   2. Notify the testing and inspection agency not less than 48 hours in advance of all work requiring testing or inspection services for any City Contracted work.

G. Regulatory Requirements:

   1. Comply with City standards for sidewalks, curbs, ramps, gutters, and driveway approaches or aprons, including standard dimensions, profiles, thicknesses, reinforcing, and compressive strength. In the event of conflict between the Contract Documents and the standards, the more stringent requirements will apply.
   2. Comply with applicable requirements of ADA Handbook, ANSI A117.1, and local and State codes and ordinances regarding walks, ramps and curb ramps.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Field Measurements: Verify dimensions and existing conditions shown on the drawings by taking field measurements. Report discrepancies to the City Engineer and City Representative for clarification and make minor adjustments in layout as required by field conditions and as approved by the City Engineer, at no additional cost to the City.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

   1. Use flexible or curved forms for curves of a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

D. Supports for Reinforcement: Chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 EXPANSION JOINT FILLER

A. Sealed Joints: Preformed, compressible fiber or cork filler material complying with ASTM D1751 or D1752, Type II, guaranteed compatible with expansion joint sealant materials, ½" thick unless otherwise indicated. Provide high-impact polystyrene removable "void cap" to create ½" deep reveal for installation of sealant.

B. Self-Sealing Joints: Preformed, compressible asphalt fiber joint filler complying with ASTM D994, ½" thick unless otherwise indicated. Do not use asphalt fiber filler in joints to receive elastomeric joint sealants.

2.4 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type II.

1. Fly Ash: ASTM C 618, Class C or F.

C. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:

1. Maximum Aggregate Size: ¾ inches.
2. Do not use fine or coarse aggregates containing substances that cause spalling.

D. Water: Potable.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Calcium Chloride will not be permitted

C. Air-Entraining Admixture: ASTM C 260.

2.6 FIBER REINFORCEMENT – Not Used

2.7 CURING MATERIALS

A. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. White burlap-polyethylene sheet.

B. Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type I or II, Class B.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.

2.8 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

1. For City Contracts, do not use City's contracted field quality-control testing agency as the independent testing agency.

C. Proportion mixes to provide concrete with the following properties:

1. Minimum Compressive Strength (28 Days): 4000 psi.
2. Slump Limit: Maximum 4 inches.
3. Maximum water-cement ratio at point of placement: 0.48.
4. Minimum 564 lb. Cement per cubic yard.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 5.0 to 8.0 percent.

F. Synthetic Fiber: Not Used

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms are capable of remaining in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
3. Provide tie bars at sides of pavement strips where indicated.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet minimum to 100 feet maximum unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface for joint sealant.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
   a. Radius: 1/4 inch.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Plastic joint strip where applicable for control joints on sidewalks only.

F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: 1/4 inch.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete by mechanical vibrating equipment. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

G. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified with expansion joints at intervals of approximately 50 feet minimum to 100 feet maximum and tooled control joints at 10' o.c. Provide expansion joints at connections to existing concrete. If results are not approved, remove and replace with formed concrete.

H. Walks: Minimum 4" thick, with expansion joints at intervals of approximately 50 feet minimum to 100 feet maximum and tooled control joints at intervals equal to width of walks or maximum 5 feet o.c. Tool edges to rounded profile and finish as noted herein or shown on the drawings. Pitch walks ¼" per foot for drainage unless otherwise indicated.

I. Approaches: Minimum 10" thick, with #4 rebar spaced 12" o.c.b.w. unless otherwise indicated or required by City. Construct to radius of flare indicated, and taper or warp into alignment with adjacent curbs, gutters, and walks. Place approaches over compacted subgrade.

J. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. General: No dusting or topping of the surface, or sprinkiling with water, to facilitate finishing shall be permitted.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends

lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: For all City Contracts, the City will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. For non-City contracted work, Contractor is responsible for demonstrating compliance with all criteria of this section. Sampling and testing for quality control may include the following:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.
5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 50 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.

7. When total quantity of a given class of concrete is less than 50 cu. yd., City Engineer may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
9. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.

B. Test results shall be reported in writing to the City Engineer and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by City Engineer but will not be used as the sole basis for approval or rejection.

D. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by City Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

3.11 CLEANUP AND RESTORATION

A. General cleanup of the area shall be performed on a daily basis to the satisfaction of the City Engineer and City Representative. Proper safety provisions, including ropes, fence, barricades, construction signs and warning signs shall be maintained until completion of work.

B. After completing concrete operations, clean surfaces, pick up excess materials and clean work area.

END OF SECTION

SECTION 02527

STORM SEWER SYSTEM

PART 1: GENERAL

1.1 DESCRIPTION:

The work of this section consists of the construction of reinforced concrete pipe for storm sewers and drain pipe, in accordance with the lines and grades indicated or established.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

Excavation, Trenching and Backfilling - Section 02200
Storm Manholes and Inlets - Section 02516
Sanitary Sewer Systems – Section 02550
Site Concrete Work - Section 02800

1.3 QUALITY ASSURANCE:

Standards, American Association of State Highway and Transportation Officials (AASHTO) American Society for Testing and Materials (ASTM).

1.4 SUBMITTALS:

Submit product data on all pipeline materials used and test results on pipe material by manufacturer. Submit shop drawings for all pipe and fittings.

PART 2: MATERIALS

2.1 POLYVINYL CHLORIDE PIPE & FITTINGS (PVC):

A. Approval of City Engineer Required

B. PVC gravity sewer pipe and fittings shall conform to ASTM D3034 for diameters from 4” to 15” and ASTM F679 for 18”-24”, with integral –bell gasket joints. Rubber gaskets shall be factory installed and conform to ASTM F 477. Pipe joints shall conform to ASTM D 3212. Pipe shall be made of PVC plastic compound conforming to ASTM D 1784 and shall have a SDR of 26 and minimum pipe stiffness of 115 PSI.

C. Refer to Sanitary Sewer System - Section 02550 for material specification.

2.2 REINFORCED CONCRETE PIPE (RCP):

A. The reinforced concrete pipe shall comply with the requirements of ASTM Specification, Designation C76. The pipe shall be Class III unless noted otherwise on the drawings. The cement for the pipe shall conform to the requirements set forth in ASTM Specification, Designation C150 and shall be Type I/II and shall have a minimum compressive strength of 4,000 psi. All wall thicknesses shall be those established in "Wall B" in Table 5, of said C76 specification, and the reinforcement shall be as shown in the same "Wall B".

B. No lifting holes will be permitted without the approval by the City. The Contractor shall grout all lifting holes for the full depth of the hole prior to backfilling the pipe. Contractor must submit details of the grouting materials and procedures to be followed to the City for approval prior to grouting.

C. The following shall be clearly marked on the interior surface of the pipe:

ASTM Specification
Class and size
Date of manufacture
Name or trademark of manufacturer

D. Flared end sections, prefabricated plugs, bends and tees shall comply with the requirements of ASTM C76 and shall be the same class and shall have the same joint design as the pipe described above.

E. The joints for all pipes shall have rubber gasket joints suitable for a watertight application. Joints shall be in accordance with ASTM C443, "Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets" and AASHTO M198.

F. The joint design shall be similar and equal to tongue and groove or bell and spigot. The joint sealants for the pipe shall be butyl rubber based materials equal to Rub-R-Nek by K.T. Snyder Co. Sealant shall be provided in continuous coils.

J. If grout for joints is required as shown on the drawings, grout for joints shall be a non-shrink grout, Master Builders Master-flo 713 grout, or approved equal. Flared end sections, prefabricated plugs, bends and tees shall comply with the requirements of ASTM C76 and shall be the same class and shall have the same joint design as the pipe described above.

K. The pipe will be tested by the manufacturer based on the 3-edge bearing test as set forth in ASTM Specification, Designation C76. At the Contractor's own cost, which cost shall include the pipe, testing, and report to the City, the pipe shall be tested at the manufacturer's plant. Not more than 1 percent of the number of pipe lengths, but no fewer than 2 pipes for each size of pipe will be tested.

L. The City may select the pieces to be tested. In addition, visual testing will be made at the job site, and pipe will be rejected on account of any deficiencies covered by ASTM Specification Designation C76 and on account of the following:

- Porous spots, inside or outside, having a greater area than 10 square inches and a depth of more than 3-inch.
- Patched or repair of porous spots, or other defects that are not approved by the City.
- Exposure of reinforcement which indicates the reinforcement is misplaced.
- Broken or chipped ends that prevent satisfactory joints.

PART 3: EXECUTION

3.1 LAYING CONDUIT:

A. Provide proper facilities for lowering pipe sections into place. Dropping pipe will not be permitted. Place each section true to line and gradient in close and true contract with adjacent sections.

B. Lower segment shall be in contact with shaped bedding its full length. Bedding and backfill shall conform to details in drawings. Place bell or groove ends of conduits facing upstream.

3.2 JOINING CONDUIT:

A. The pipe bell and spigot end shall be thoroughly cleaned with a wire brush to remove any dirt or concrete. Both ends of the joint shall be inspected for uneven surface or projection that would affect the joint. Repair damage if necessary.

B. Install continuous sealant material on spigot end. If necessary, the joint material may be installed on the top and sides of the spigot end and the bottom of the bell end. Care shall be taken to assure there is no gap in the sealant.

C. A lubricating solution which is not injurious to the gasket or concrete such as flax soap shall be liberally applied to the gasket groove and to the entire surface of bell ring. Following this operation, a thin film of lubricant shall be applied to the gasket which shall then be snapped into place in the groove.

D. The pipe being jointed shall be carefully moved into position, line and grade checked and, as the spigot end is started into the bell of the section previously laid, the sealant position shall be checked to insure uniform entry into the bell at all points. The equipment used to force the joints together must be adequate to overcome the pressure involved and the joining is uniform and straight.

E. When indicated on the Drawings that alignment changes are required, the deflection shall be accomplished by the use of fabricated bends, beveled end sections or deflecting joints depending on the change required. Maximum opening shall be no more than 2-inch greater than the opposite side of the joint. Openings greater than 1-inch shall be grouted.

F. The Contractor shall inspect the interior surface of each pipe joint and sealant location after it has been shoved home. All cracks, chips, and other defects noted in the lining shall be repaired by the Contractor with materials furnished by the pipe manufacturer. The interior joints of pipe on flat grade or where designated shall be coated and sealed with non-shrink grout materials.

G. In the event any foreign material becomes embedded in the lubricant, or the lubricant becomes contaminated by water or other substances before the joint is started, the area affected shall be re-cleaned and new lubricant applied.

H. The pipe jointing shall be slowly and carefully completed without displacement or damage to the gasket. Examine the completed joint to assure that contact is complete and uniform for the full circumference. Check alignment and grade.

I. All cast-in-place concrete structures shall be installed in accordance with the requirements of the Specification, Cast-In-Place Concrete, Section 03300. Pre-cast concrete manhole and/or inlet installation shall be completed in accordance with the requirements of the Specification, Storm Manholes and Inlets, Section 02516.

3.3 POLYVINYL CHLORIDE PIPE (PVC)

A. Refer to Sanitary Sewer System - Section 02550 for installation specification.

3.4 INSULATION BOARD

A. Provide 6” thick insulation board where there is less than 18 inches clearance between water main and storm sewer or as shown on the drawings. Extend insulation board 2 feet to either side of the edge of water main crossing.

3.5 SEWER CROSSING

A. Normal conditions: Whenever possible lay storm sewer over sanitary sewers to provide vertical separation of at least 18" between invert of water main/sanitary sewer and crown of storm sewer.

B. Unusual Conditions: If above separation cannot be met, use following

1. Storm sewer passing over sanitary sewers:
   a. Where the storm sewer crosses over the sanitary sewer with less than 1.5 feet of clear distance between the pipes, the sanitary sewer shall be encased with a minimum of 6 inches of concrete from springline to 6 inches above the top of sanitary sewer. The encasement shall extend along the centerline of the sewer a minimum of one foot beyond the OD of the water main at each end of the encasement or
   b. One continuous length of sanitary sewer pressure water pipe (C-900), minimum 18'' long centered on water main. Joints between different pipes encased in concrete 6" thick and extending 6" either side of joint:

2. Storm Sewer passing under sanitary sewer:
   a. Provide a concrete cradle for the sanitary sewer joints 6 inches either side of the joint, from 6 inches below the sewer OD to sewer springline. In addition the bedding material shall be replaced around the sewer to the greater of a point at one foot above the top of the sanitary sewer or to the sewer springline and thoroughly compacted and consolidated to support the sewer.

   b. One continuous length of sanitary sewer pressure water pipe (C-900), minimum 18'' long centered on storm sewer. Joints between different pipes encased in concrete 6" thick and extending 6" either side of joint:

3. Storm Sewer passing under water main:
   a. Provide a concrete cradle for the storm sewer joints 6 inches either side of the joint, from 6 inches below the sewer OD to sewer springline. In addition the bedding material shall be replaced around the sewer to the greater of a point at one foot above the top of the sewer or to the sewer springline and thoroughly compacted and consolidated to support the sewer.

3.6 INSPECTION

A. Video Inspection. The Contractor shall inspect the installed sewer line using video inspection in the presence of a City Representative. The contractor shall provide the City a copy of the video in DVD format. (DVD disk, -R format, speed not to exceed 2hrs per disk, on screen graphics shall be readable, audio narrative is required)

3.7 CLEANUP AND RESTORATION

A. Restore all pavements, curbs, gutters, utilities, fences, irrigation ditches, yards, lawns, and other structures or surfaces to condition equal to or better than before work began, and to satisfaction of City Engineer. Deposit all waste material in designated waste areas. Grade and shape disposal site. Complete topsoil and reseeding of site, if required. Where disposal sites are not designated, remove and dispose of all waste material off site.

B. General cleanup of the area shall be performed on a daily basis to the satisfaction of the City Representative. Proper safety provisions, including ropes, fence, barricades, construction signs, and warning signs, shall be maintained until completion of work.

END OF SECTION

SANITARY SEWER SYSTEM

SECTION 02550

PART 1: GENERAL

1.1 DESCRIPTION: The work to be performed in accordance with this Specification includes furnishing all materials, equipment, supplies and accessories and of performing all operations needed in connection with installation of buried pipelines.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

Excavation, Trenching and Backfilling - Section 02200
Sanitary Sewer Manholes - Section 02560
Site Concrete Work - Section 02800

1.3 QUALITY ASSURANCE:

The American Society for Testing and Materials (ASTM)
American National Standards Institute (ANSI)
Federal Specifications (FS)
Manufacturers' printed recommendations

1.4 SUBMITTALS:

Submit shop drawings in accordance with Section 01300, complete with material, grade and class on all pipe, fittings, and couplings and on all joints, coatings, and appurtenances. Submit detailed catalog and engineering data sheets for all components. Submit a proposed schedule for delivering and installing the pipe.

PART 2: MATERIALS

2.1 GENERAL:

All pipe, fittings, couplings, and appurtenant items shall be new, designed for the intended service, and free from defects or contamination. They shall be furnished in pressure or thickness classes as specified or shown. All pipes shall have joints as called for in the specifications or indicated on the Drawings.

Provision shall be made for the contraction and expansion of each joint with an integral rubber ring and integral thickened bell as part of each joint. Pipe shall be supplied in laying lengths of 20 feet. All pipe and fittings shall be assembled with a non-toxic lubricant. All gaskets shall be suitable for gravity sanitary sewer service.

Each special fitting shall be a completely manufactured unit with either bells or spigots on each connection that are an exact duplication of the bells and spigots on the pipeline. Fittings with any other type of connections will not be accepted.

2.2 PIPE:

A. Small diameter PVC sanitary sewer pipe. Small diameter sanitary sewer pipe (4-inch to 15-inch diameter) and fittings shall conform to the requirements of ASTM D-3034. The pipe shall be of type PSM polyvinyl chloride pipe (PVC). The pipe material shall be made of PVC plastic having a cell classification of 12454-B or 12364-C or 12454-C or 13364-B (with a minimum tensile module of 500,000 psi) as defined in ASTM D1784. All PVC pipe and fittings shall meet or exceed all of the material requirements of ASTM D3034 and thickness requirements of SDR-35 (4-inch to 15-inch diameter). Gaskets shall conform to ASTM F477.

Each length of pipe shall have marked on the exterior the following:

(1) Manufacturer's Name or Trademark and code
(2) Nominal Pipe Size
(3) PVC Cell Classification (e.g. 12454-B)
(4) Legend - Type PSM SDR-35 Sewer Pipe
(5) Specification ASTM-D3034

Each fitting shall have marked on the exterior the following:

(1) Manufacturer's Name or Trademark and code
(2) Nominal Size
(3) PVC
(4) PSM
(5) Specification ASTM-D3034

2.3 MISCELLANEOUS

A. Miscellaneous Concrete. Concrete for encasing the sewer pipeline, manhole bases, securing clean-out access castings, and other similar items shall have a 28-day compressive strength of not less than 4,000 psi. All reinforcement required shall be standard deformed reinforcement conforming to the requirements set forth in ASTM A615, Grade 40.

B. Couplings: Couplings shall be used only where shown on the drawings, or where approved in writing by the City Representative. The Contractor shall provide a description of and exact location of any coupling used.

Couplings shall conform to ASTM C425, C443, C564, D5926 as applicable.

No-hub or hubless couplings shall consist of an elastomeric PVC boot and 300 series stainless steel tightening bands. The coupling shall be Fernco or equal.

Protect flexible coupler by using Shear Guard as manufactured by Onset Pipe Products, Inc.

C. Grout: Grout shall be a non-shrink type with aluminum filings; grouts with iron filings are not acceptable. Grout shall be “Five Star Grout”, “Embeco Grout” or equal. The Contractor may substitute a 2 component, 100% solids epoxy resin (Sikadur Hi-Mod LV) for the specified grout.

D. Sealants: Sealants shall be a one component polyurethane base, elastomeric sealant. When required due to moisture or immersion, provide a primer for application onto the substrate according to manufacturer’s recommendation. Sealants shall be SIKAFLEX-la, and primer shall be SIKAFLEX 429 or equal.

PART 3: EXECUTION

3.1 GENERAL: In the absence of specific wording to the contrary, the Contractor shall follow normal good construction practice in accordance with materials manufacturer's printed instructions. Pipelines shall be installed in trenches described in Section 02222, Pipeline Excavation, Trenching and Backfill. The depth of bury is shown on the Drawings.

Pipe, fittings, and all other accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage to them. Under no circumstances shall any materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. Skidding which damages protective coatings will not be permitted.

All pipe and fittings shall be so handled that the pipe will not be damaged. If, however, any part of the pipe is damaged, the repair shall be by the Contractor at his expense in a manner satisfactory to the City Representative. Any fittings and damaged area of pipe that cannot be repaired to the satisfaction of the City Representative shall be removed from the site.

3.2 INSTALLATION OF POLYVINYL CHLORIDE PIPE:

A. General Installation Requirements: Each pipe length and fitting interior, interior surface of bells, and exterior surface of spigots shall be cleaned of all foreign material before placing it in the trench and shall be kept clean all times thereafter. Each item must also be examined for cracks and other defects before installation.

Pipe shall be cut, only whenever necessary, to conform to location of manholes or connections. All cuts shall be straight, true, and at right

angles to the axis of the pipe unless otherwise noted or directed by the City Representative. The cutting process shall leave a smooth end without damaging the pipe. All burrs shall be removed from the ends of cut pipe, and the end lightly rasped or filed. All tools used in cutting pipe shall be subject to the City Representative's approval.

Pipe laying shall proceed upgrade with the spigot ends of pipe pointing in the direction of the flow, unless otherwise approved by the City Representative. Each pipe length shall be laid true to line and grade in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets to the flow line. Pipe shall be laid in an un-watered trench and shall not be used for draining water from the trench. Whenever the pipe is left unattended or pipe laying is not in progress, temporary plugs shall be installed at all openings. Temporary plugs shall be watertight and of such design as to prevent debris and animals from entering the pipe. All temporary plugs shall be subject to approval of the City Representative.

The Contractor shall obtain from each pipe manufacturer complete installation instructions. The Contractor shall provide the City Representative with 2 copies of those instructions and shall have additional copies at the site of the work. The Contractor shall install the materials in accordance with the manufacturer's recommendations. If there is a conflict between the Contract Documents and the manufacturer's instructions, the Contractor shall obtain resolution from the City Representative before proceeding with the work.

B. Installation of PVC Pipe: No deflection in the joints of PVC pipe conforming to ASTM D-3034 shall be allowed. All pipe shall be fully supported by the full length of pipe barrel without support by the bell or by mounding.

C. Jointing the Pipe: The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into the bell. Position the completed joint so that the mark on the pipe end is in line with the end of the bell.

D. Connection of PVC Pipe to Concrete Manhole Base: The PVC pipe shall be encased in the concrete for the manhole base as detailed on the Drawings and special provisions shall be made for watertightness of the connection.

The exterior circumference of the PVC pipe where encased in concrete for watertightness shall be uniformly roughened or scarified by sanding with coarse sandpaper or emery cloth for the encased length.

Additionally, a gasket shall be stretched onto the PVC pipe to form a weep ring where encased in concrete.

Any alternative to the above-specified methods for PVC pipe connection to concrete shall be submitted to the City Representative for his approval.

E. Manhole Reconnection: For reconnection to existing manhole, make connections to existing manholes, in similar manner as new manhole. Core drill opening in existing manhole as necessary to insert new pipe and attain watertight seal. Chip existing concrete bench inside manhole to provide enough thickness for mortar bed to make smooth continuous invert. Place expandable warterstop around portion of sewer pipe inserted into existing manhole. Use expandable grout to completely fill hole in manhole to create watertight repair.

3.3 UTILITY CROSSING

A. Normal conditions: Whenever possible lay sanitary sewer over water mains and storm sewer to provide vertical separation of at least 18" between invert of water main and crown of sewer.

B. Unusual Conditions: IF above separation cannot be met, use following:

1. Sanitary sewer passing over or less than 18" under water main.
   a. One continuous length of sanitary sewer pressure pipe (C-900), minimum 18'' long centered on water main. Joints between different pipes encased in concrete 6" thick and extending 6" either side of joint: or
   b. Sewer pipe encased in 6" concrete around pipe, and extend 10' either side of water main.

2. Water mains passing over sanitary sewers:
   a. The sewer shall be encased with a minimum of 6 inches of concrete from springline to 6 inches above the top of sewer. The encasement shall extend along the centerline of the sewer a minimum of one foot beyond the OD of the water main at each end of the encasement or
   b. One continuous length of sanitary sewer pressure pipe (C-900), minimum 18'' long centered on water main. Joints between different pipes encased in concrete 6" thick and extending 6" either side of joint:

3. Storm Sewer passing over sanitary sewer:
   a. The sanitary sewer shall be encased with a minimum of 6 inches of concrete from springline to 6 inches above the top of sewer. The encasement shall extend along the centerline of the sewer a minimum of one foot beyond the OD of the water main at each end of the encasement or

   b. One continuous length of sanitary sewer pressure water pipe (C-900), minimum 18'' long centered on water main.

Joints between different pipes encased in concrete 6" thick and extending 6" either side of joint:

3.4 FLUSHING AND TESTING SEWER PIPELINES:

A. Pipeline Flushing. The Contractor shall flush the pipelines, as the work progresses, by means that are in accordance with good practice, to insure that earth, sand, rocks or other foreign materials are removed from the interior of the pipeline. The Contractor and City's Representative shall determine whether any displacement of the pipe has occurred after the trench has been bedded to an elevation 12 inches above the pipe and tamped as specified. The test will be as follows:

B. Alignment and Grade. A light will be flashed between manholes, or if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipeline shows poor alignment, displaced pipe, earth, or other debris in the pipe, or any other kinds of defects, the defects, determined by the City Representative, shall be remedied by the Contractor at his own expense. The test will be repeated following completion of backfilling and any poor alignment, displaced pipe, or other defects, determined by the City Representative, shall be corrected at the Contractor's expense.

C. Video Inspection. The Contractor shall inspect the installed sewer line using video inspection in the presence of a City Representative. The contractor shall provide the City a copy of the video in DVD format. (DVD disk, -R format, speed not to exceed 2hrs per disk, on screen graphics shall be readable, audio narrative is required)

D. Deflection. All PVC sewer pipelines may, at the City's option and at no additional expense to the City, be tested for deformation after placement and compaction of backfill. Method of testing shall be by deflecto-meter of the rigid GO/No-GO type device. An alternative method will be permitted only by written permission of the City Representative or as defined in the Special Construction Provisions of these Specifications. Maximum allowable deflection shall be five (5) per cent of the pipe diameter. Any and all pipe with vertical deflection greater than the allowable shall be excavated, removed from the pipeline, replaced, backfilled and compacted as specified, and retested at the Contractor's expense.

END OF SECTION

SECTION 02560

SANITARY SEWER MANHOLE

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE:

Pipeline Excavation, Trenching and Backfilling – Section 02222
Sanitary Sewer System – Section 02550
Site Concrete Work – Section 02800

1.2 QUALITY ASSURANCE: American Society for Testing and Materials (ASTM)

1.3 SUBMITTALS: Furnish manufacturer's literature on manholes, joint material, frame and cover, and steps.

PART 2: MATERIAL

2.1 MANHOLES

Manholes shall be constructed of pre-cast reinforced concrete components in accordance with the details shown on the Drawings. The base can be either cast-in-place or pre-cast. The top section required for change of diameter shall be eccentric cone, or, if permitted by the City Representative flat slab. All pre-cast components, including the base, riser sections, grade rings, tops, appurtenances, and base sections shall conform to ASTM C478.

To bring the manhole cover to the correct elevation, the adjustment section of each manhole shall be constructed of pre-cast concrete grade adjustment rings or rubber adjustment riser. These rings shall be not less than 6-inches wide and furnished in heights to allow for 1-inch adjustment. Total adjustment height, with grade rings shall not exceed 12-inches.

Gaskets for connecting PVC pipe to manhole sections shall be specifically manufactured for that purpose. There shall be cast into the barrel and/or base section for each pipe penetration, a neoprene or poly-vinyl chloride boot of conical shape with a shoulder of proper diameter to allow passage of the pipeline. The boot shall be secured to the pipeline with clamps of stainless steel.

2.2 JOINTS: Joints between manhole sections and between grade rings shall be sealed. The sealant shall be a flexible butyl resin sealant that has an in service temperature range from -30º F (or lower) to +200º F, and shall be Rubr-Nek or approved equal.

2.3 FRAME AND COVER: Frames and covers for manholes shall have a combined weight of 400 pounds, machine fit securely without rocking, hot dipped in asphalt, 24 inch size cast iron frame and cover and be as manufactured by East Jordan Iron Works, or City Representative approved equal. The cover shall have the word "SEWER" clearly cast on its surface.

2.4 MANHOLE STEPS: Manhole steps shall be steel reinforced copolymer polypropylene conforming to ASTM C-478 as manufactured by M.A. Industries firmly secured into preformed tapered holes.

2.5 GROUT: No-shrink, non-metallic grout shall be: U.S. Grout “5-Star” or approved equal.

2.6 CONCRETE: Concrete for cast-in-place manhole bases shall have a 28-day compressive strength of not less than 4,000 psi. All reinforcement shall be standard deformed reinforcement conforming to the requirements set forth in ASTM, A615, Grade 60.

PART 3: EXECUTION

3.1 INSTALLATION OF MANHOLES

A. General. Manholes shall be constructed to conform to the details shown on the drawings. Channel inverts shall be smooth and U-shaped, conforming to the inside diameter of the existing incoming and outgoing pipelines. Changes in direction of flow shall be made with a channel of a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. Where differences in existing pipeline invert elevations exist, sloped flow channels shall be formed so the fluid does not undergo a vertical drop. The floor of the manhole outside of the channel shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot.

B. The manhole cover shall be set with its top at the grade line as set forth on the Drawings. When a manhole top is above the ground line, compacted backfill shall be placed around the exposed section as shown on the Drawings. Manhole cover in pavement shall be set ¼” to ½” below surface elevation.

C. Grout all joints of storm sewer manholes inside and outside after manhole is complete.

D. Stubs shall be provided at manholes when so shown on the drawings. Such stubs shall be sealed with a removable plug. Plugs shall be specifically manufactured for the pipelines in which they are to be installed. The plug shall be constructed of a material approved by the City and shall provide a permanent water-tight installation.

E. Outside each manhole where the pipe enters/exits, and within 12-inches

of the manhole pre-cast wall, the Contractor shall install a bell section of pipe, or a flexible joint.

F. Cast-in-place manhole base. The invert channels may be formed directly in the concrete of the manhole base. Do not set pre-cast manhole sections on manhole base for a minimum of 48 hours after base placement.

G. Pre-cast manhole base. The Contractor will install a pre-cast manhole base subject to the approval of the City Representative. If the Contractor elects to use a pre-cast base, any revisions required to accommodate actual field locations will be at no additional cost to the City.

The area beneath the manhole shall be over-excavated 3 to 4 inches beneath the bottom elevation of the manhole. Squeegee backfill material, free of fines, shall be compacted in place for foundational support of the manhole. Screed boards shall be set level at the right elevation and the compacted material screeded to form a uniformly graded foundation. The surface grade of the newly compacted backfill shall be checked and surveyed to ensure a uniform surface elevation beneath the entire manhole base, such that the invert elevations of the channel within the manhole are as shown on the Contract drawings.

The precast base shall be carefully set so as not to disturb the screeded granular base.

H. Manhole barrel. Each joint of the precast manhole barrel shall have a minimum of one continuous gasket placed on the lower ledge before the barrel immediately above is lowered into place.

Any opening between manhole walls and pipe made by the Contractor, or as designated elsewhere, shall be closed water tight with grout. The opening shall be of sufficient size to accommodate the pipe, “O”-rings, and grout. The grout shall extend no less than the full thickness of the manhole barrel.

Channels that have been formed into existing concrete bases shall be smoothed to the specified contour with grout.

3.2 TESTING MANHOLES: During the construction of the manholes, the Contractor shall, in accordance with good practice, insure that no earth, sand, rocks or other foreign material exists on the joint surfaces during assembly of the sections. The City Representative shall check each manhole to determine whether the manhole fulfills the requirements of the Drawings and Specifications. Visual examination is required.

A. Visual Examination: The City Representative shall visually check each manhole, both exterior and interior, for flaws, cracks, holes, or other inadequacies that might affect the operation or watertight integrity of the

manhole. Should any inadequacies be found, the Contractor shall make any repairs deemed necessary by the City Representative.

END OF SECTION

SECTION 02713

WATER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Excavation, exploratory excavation (pothole-backhoe or vacuum), backfill, bedding, soil stabilization, ground water removal, connection to existing mains, and installation of main piping and services, valves, fittings, valve boxes, and all necessary appurtenances. Also includes removal and replacement of existing paving or concrete where required, haul and import of adequate backfill material to meet compaction requirements and removal of existing thrust blocks where necessary. Includes abandonment/removal of existing gate valve risers and existing water mains.

B. Related work:

1. Obstruction Removal: Section 02130
2. Pipeline, Excavating, Trenching and Backfilling: Section 02222
3. Site Concrete Work: Section 02800

1.2 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 water system may be found on the construction drawings. In case of conflict between the drawings and the information specified herein, the more stringent requirements shall govern.

1.3 SUBMITTALS

A. Submit shop drawings or product data showing specific dimensions and construction materials for:

1. Valves and Valve Boxes
2. Fittings
2. Piping
4. Fire Hydrants
5. Meter Vaults and Meter Yokes
6. Service Line Appurtenances

B. Test Reports: Submit two (2) copies of laboratory gradation tests for bedding and trench stabilization materials and compaction tests.

C. Permits: Submit copies of all permits issued for project. Contractor is responsible for obtaining all applicable City, County, and State Permits for the project. City fees are waived for City projects.

D. Certificates: Submit two (2) copies of water sample acceptance from Health Department prior to placing water system in service.

E. Locates: Contractor is solely responsible for utility locates prior to construction. Notify City's Representative of conflicts prior to construction.

1.4 REFERENCES

A. State of Colorado, Department of Transportation (CDOT): State Department of Highways Standard Construction Specifications for Road and Bridge Construction, 1999.

B. Denver Water Board Engineering Standards

C. American Water Works Association (AWWA)
American Society of Testing and Materials (ASTM)
American National Standards Institute (ANSI)

D. Reference Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.

1.5 JOB CONDITIONS

A. Coordination and use of electric power is the Contractor's responsibility.

B. Immediately pump or bail out water found in excavations, whether rain or seepage. Excavations must be kept free from water at all times.

C. It shall be the responsibility of the Contractor to take all measures and furnish all equipment and labor necessary to control the flow, drainage and accumulation of water as required to permit completion of the work under this section to avoid damage to all work at no additional cost to the City.

D. It shall be the responsibility of the Contractor to take all measures and furnish all material, equipment and labor necessary to provide adequate backfill material as specified herein.

E. Water Service shall remain operational at all times until service change over is completed. Provide residences with water as needed during

outages.

1.6 PROJECT RECORD DOCUMENTS

A. Refer to specification “Record Drawings”, Section 01720.

1.7 PROTECTION

A. Barricades and Safety Provisions: Place and maintain until completion of work adequate barricades, construction signs, warning lights and guards to avoid property damage and protect persons from injury. Flares with open flames will not be permitted. Protect all materials, equipment, pipe and earth piles that may serve as hazards to vehicular or pedestrian traffic by barricades or guards and warning lights.

B. Shoring: Provide and maintain all sheeting, shoring and bracing required to safely retain earth banks. Protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury; all in accordance with applicable codes and governing authorities.

C. Do not remove any sheeting unless the pipe strength is sufficient to support the trench loads based on trench width measured to the back of sheeting. Remove sheeting and shoring gradually as excavation backfilling progresses to protect the construction or other structures, utilities or property. Do not attempt removal of sheeting in one operation after backfilling is complete.

D. All work must comply with latest OSHA requirements.

E. Utilities: Protect from damage existing utility lines shown on drawings or locations of which are made known to contractor prior to work and utility lines constructed during construction operations of the project. Hand excavate within 18 inches of known piping or objects to prevent damage from equipment. Before commencing work, obtain information concerning location, type, and extent of concealed existing utilities on the site and adjacent properties. Repair damage to utilities at no cost to the City.

F. Granular Fill: Protect existing granular fill adjacent to existing structures from dirt that would impede free drainage. Remove and replace any portions of granular fill that become contaminated with dirt.

G. Drainage: Maintain the excavations and site free from water throughout the work. Remove any water encountered in the trench to provide firm

subgrade, to permit joints to be made dry at the final grade, and to prevent entrance of water into the pipeline. Accomplish the foregoing by the use of sumps and gravel blankets, well points, or drain lines.

H. Rock, gravel, and other appurtenances used to keep trenches free from water or used to add support to installed piping is considered incidental to construction and all costs shall be the responsibility of the Contractor.

I. Survey Control Range Boxes: Protect existing survey control monuments from damage. Contractor will be responsible for replacement or repair of any monument damaged or destroyed. Replacement of monuments must be performed by a qualified land surveyor.

1.8 QUALITY ASSURANCE

A. Testing Agency:

1. All City quality assurance testing required herein will be performed by an independent testing agency employed by the City.

2. Notify the testing agency not less than 48 hours in advance of all work requiring testing services.

PART 2 - PRODUCTS

2.1 PIPE

A. Pipe:

1. Ductile Iron Pipe: Use for fire hydrant line only. AWWA C151, thickness class 52, with cement-mortar lining, AWWA C104. Outside coating shall be bituminous, one mil thick. Pipe joints, push-on type utilizing rubber ring gasket, AWWA C111.

2. Polyvinyl Chloride (PVC): Sizes up to 12-inches shall conform to AWWA C900 pressure pipe. Thickness Class shall be DR-14 with a minimum working pressure of 200 psi. Joint type shall be made using an integral bell with an elastometric gasket push-on type joint. Solvent cement type joints are prohibited. Length shall be 20-feet.

3. Mechanical Joint:
   a. Ductile Iron Pipe: AWWA C110, pressure rating 250 psi mechanical joint only, AWWA C111. Glands and galvanized bolts shall be vulcanized natural rubber gaskets, AWWA C111. Outside coating shall be bituminous, one mil thick.
   b. PVC: Sizes up to 12-inches shall conform to AWWA C900 pressure pipe. Thickness Class DR-14 for a minimum working pressure of 200 psi.

4. Service Lines: ASTM B88, Type K, seamless tubing, soft annealed temper with flared or compression connections.

5. Interior Pipe (Within structure):
   a. All interior pipe and fittings shall be flanged unless otherwise noted on the drawings.
   b. All flanged ductile-iron pipe shall conform to ANSI Specification A21.15 & B16.1and, unless otherwise shown on the plans, be faced and drilled to a 150-pound template.
   c. Joints in flanged pipe shall have inserted therein red rubber ring gaskets, full face width and not less than 1/8-inch thickness. All thread studs shall be used on all valve flange connections and shall be in accordance with ASTM A-307 Grade B with heavy hex nuts.
   d. All ductile-iron pipes shall be Class 52. Pipe shall have cement lining.

2.2 FITTINGS, RESTRAINTS & ACCESSORIES

A. Fittings:

1. Fittings: - all connections mechanical joints only.
2. Ductile Iron: AWWA C110 or AWWA C153, pressure rating 250 psi mechanical joint only, AWWA C111. All fittings cement-mortar lined, AWWA C104.

B. Restraints

1. Mechanical joint restraint can be accomplished by the use of a Megalug restraining system, Uniflange joint restraints or approved equal.

2. Ductile Iron Pipe: Pipe joint restraint shall have a working pressure of 200 psi with a minimum safety factor of 2:1. Acceptable manufacture shall be EBAA iron megalug 1100 series or approved equal.

3. PVC: Mechanical joint restraint shall have a working pressure of 200 psi with a minimum safety factor of 2:1. Acceptable manufacture shall be EBAA Iron Megalug 2000 PV series or approved equal.

4. Ductile Iron Pipe: Pipe Bell Restraint Harness with a minimum safety factor of 2:1. Acceptable manufacture shall be EBAA Iron Megalug 1700 series or approved equal.

5. PVC: Pipe Bell Restraint Harness with a minimum safety factor of 3:1. Acceptable manufacture shall be EBAA Iron Megalug 1500 series or approved equal.

6. Hardness Rod: Shall be mild steel, ASTM A-36. Hex not shall be ASTM

A-307, Grade A or B, hexagon heavy series. Rods shall have a bituminous coating for corrosion protection.

7. Mega Flange: Restrained Flange Adapter for adapting and restraining plain end DIP, PVC & Steel pipe. Acceptable manufacture shall be EBAA MegaFlange series 2100.

8. Foster Adapter: is an ultra-compact, bolt through MJ restrain for valves and fittings. Ductile iron conforming to ANSI/AWWA A21.53/C153. Minimum working pressure of 350 psi and asphaltic coated.

C. Accessories:

1. Tracer Wire: Essex 1998 ground wire AWG-12 UL insulated or equal shall be attached to all pipes, for the purpose of future location, as detailed. For splicing trace wire use 3M Direct Bury Splice Kit as mfg by Farwest Corrison Control or Bundy KS17 (14 to 6 AWG) copper split connectors, or approved equal.

2. Test Station: Test stations shall be CP Test Services, Glenn Series Glenn-4 with locking lid, 3 ½"x4", or approved equal. Cover shall be heavy duty. City will verify for continuity of tracer wire. If Test Station is located within the roadway place station within a valve box.

3. Underground Plastic Marking Tape: Manufacturer's standard permanent, continuous printed plastic tape with metallic core, intended for direct burial service; not less that 6" wide x 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW".

4. Polyethylene Encasement: All ductile iron pipe and fittings shall be encased in polyethylene film with a minimum thickness of 8 mils in accordance with AWWA C105/ANSI A21.5 and ASTM D1250.

2.3 VALVES

A. Gate Valves: Cast iron body with pressure rating 200 psi, bronze-mounted, AWWA C500. Resilient seated, non-rising stems. If the resilient seats are bonded to the gates, the gates shall be totally encapsulated in the material with the exception of guide tabs or slots. Valves pipe connection shall be mechanical joint only. Valves with ring stem seal, 2" square operating nut, open counter-clockwise. Mueller Resilient Wedge or Waterous Resilient Wedge or approved equal.

B. Valve Boxes: Cast iron, adjustable screw type, with minimum 5" diameter shaft provided with cover marked "water". Tyler series 6850, 6860 with #160 base or East Jordan Iron Works 8560 with #160 base or approved equal.

C. Check Valve: Flanged joint, 150 pound class with a bronze horizontal swing check integral disc and hinge.

2.4 FIRE HYDRANTS

A. MUELLER Centurion Model A423: Conforming to AWWA Standard C502. Working pressure of 200 psi. 6" mechanical joint inlet, minimum 5-1/4" compression-type main valve which closes with pressure, two 2-1/2" hose nozzles and 4-1/2" streamer shall have National Standard threads, or a specified by City of Federal Heights Fire Department. Nozzle threads ANSI B26. Nozzles easily replaced in field with standard tools. Operating and cap nuts 1-1/2" No. 17 National Standard pentagon main valve opening counter-clockwise. Direction of opening indicated by arrow cast on top of hydrant. Hydrant shall have a breakable section which permits clean break at or near ground level. Working parts removable for maintenance or repair without excavation. Operating mechanism non-wetting, oil reservoir lubricated, with O-ring seals. Barrel drain bronze mounted with at least two outlets, and operate automatically with main valve.

2.5 WATER SERVICE

A. Tapping Saddle: Saddle shall be dual straps for ductile iron pipe and single wide strap for PVC water mains. Saddle material shall be either a bronze or brass body with bronze or stainless steel straps.
1. Outlet threads on tapping saddles shall be "cc" type.
2. Acceptable manufacturers of tapping saddles are:
    a. Mueller/Ford
    b. Approved equal

B. Corporation Stop: All corporation stops shall conform to AWWA C800
1. All corporation stops shall be constructed of brass.
2. Corporation stop inlet threads for tapping saddles shall be "cc" type.
3. All corporation stop outlets shall use a compression connection.
4. All corporation stops shall be ball type valves only.
5. Corporation stops shall be used for all taps which are 2-inches and smaller.
6. Corporation stops shall have uniform size on inlet and outlet.
7. Acceptable corporation stops are:
    a. Mueller – 300 series – B-25008
    b. or approved equal

C. Curb Stop (3/4” to 2”):
1. All curb stops shall have compression connections at both ends.
2. Curb stops shall be used for services which are 2-inches and smaller.
3. Curb stops shall be ball type valves only.

4. Acceptable curb stops are:
    a. Mueller 300 series – B-25209
    b. or approved equal

D. Curb Box: Tyler 6500 Series or approved equal. Lid shall have a brass pentagon head plug and marked water.

E. Meter Yoke (¾", 5/8"x3/4" & 1"):
1. Mueller B-2489-2A flared copper both ends with dual angle check valves on customer side
2. Mueller B-2474-2A compression copper both ends with dual angle check valves on customer side

F. Meter Yoke 1 1/2" & 2"):
1. B-2423 w/downstream check valve

G. Meter - Residential (¾", 5/8"x3/4" & 1"): Neptune T-10 Direct Read Register

H. Meter - Residential (1 ½", 2,): Neptune T-10 Pro-Read Register

I. Meter - Commercial (3", 4", 6"): Neptune Tru Flo meter with by-pass, test plug and Pro-Read Register

J. Meter: Special fire flow condition: Neptune HP Turbine or Neptune Protectus with test plug and Pro-Read Register

K. Meter Pit – Residential: For meter 1" & smaller 24" dia. Concrete Meter Pit with 12 inch sections rings; meter pit ring & cover shall be constructed of cast iron, cover with locking screw forged pentagon bolt, furnished with frost cover. Within landscape area used bonnets (Casting # M70-CI-20 (M-70 style – cast iron – 20" base) – supplier HD Waterworks. Within Driveway use COMCO bonnets

L. Meter Vault – Commercial: For 1" & 2" meters 60 inch dia. Concrete meter pit; meter vault ring & cover shall be standard 24 inch manhole ring & cover

2.6 COUPLINGS

A. All couplings shall use a compression connection

B. Acceptable couplings are:
1. Mueller/Ford
2. Approved equal.

2.7 TAPPING SLEEV E

A. Mueller H615, JCM 412 or approved equal

2.8 BACK FLOW PREVENTOR

A. Double Check Assembly for low hazard areas. Reduced Pressure Assembly for high hazard areas
B. Manufacture Febco or approved equal
C. Assembly must be enclosed either above grade or in a below grade vault. Below grade vault must have a means of draining

2.9 PRESSURE REDUCING VALVE

A. PRV shall be Roll-Seal w/basket strainer Mfg by Hydrosol

2.10 BLOW-OFF VALVE

A. Per detail drawing

2.11 BEDDING

A. Refer to Pipeline Excavating, Trenching & Backfilling Section 02222.

PART 3 - EXECUTION

3.1 UNDERGROUND INTERFERENCE

A. A reasonable attempt has been made to locate and identify the underground interferences to be encountered. However, it shall be the responsibility of the Contractor to verify the locations shown on the Drawings. It shall also be the responsibility of the Contractor to locate any interference not shown on the Drawings. The Contractor shall exercise care when working in order to protect all underground interference and shall be fully responsible for any and all damage caused by his operations.

3.2 TRENCHING

A. Trench Excavation: Refer to Pipeline Excavating, Trenching & Backfilling, Section 02222.

B. Verification of Conditions: Examine areas and conditions under which the work of this Section is to be performed. Do not proceed with work until unsatisfactory

conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.2 UNSTABLE TRENCH BOTTOM

A. Refer to Pipeline Excavating, Trenching & Backfilling, Section 02222

3.3 BEDDING

A. Refer to Pipeline Excavating, Trenching & Backfilling, Section 02222

B. Install in conformance with drawings. Place from minimum of 6" below bottom of pipe to 12-inches top of pipe. May taper to edge of trench.

3.4 PIPE INSTALLATION

A. General: Deliver, handle, store, and install in accordance with the pipe manufacturer's recommendations and the applicable paragraphs of AWWA C600, AWWA C603, and ASTM D2321.

Carefully examine all pipe and fittings for cracks and other defects. Groove in bells of ductile iron pipe to be full and continuous or be rejected. Remove all foreign matter from interior and ends of pipe and appurtenances before lowering into trench. Carefully lower all pipe, fittings, valves, and hydrants into trench piece by piece to prevent damage to pipe materials, protective coatings, and linings. Do not dump into trench. If pipe cannot be lowered into trench and into place without getting earth into it, place heavy, tightly woven canvas bag over each end and leave in place until joints are made. During pipe laying, place no debris, tools, clothing or other materials in pipe.

Keep trenches free from water during pipe laying and jointing. Dewatering of trench considered as incidental to construction and all costs included in contract prices. When pipe laying is not in progress, close open ends of pipe by watertight plug, or other means approved by City Engineer.

Dewatering shall be accomplished by the use of well points, sump pumps, rock or gravel drains placed below subgrade foundations or subsurface pipe drains. All water shall be disposed of in a suitable manner without being a menace to public health or causing public inconvenience. No water shall be drained into other work being completed or under construction. Contractor is responsible for obtaining all permits necessary for dewatering.

The dewatering operation shall continue until such time as it is safe to allow the water table to rise in the excavations. Pipe trenches shall contain enough backfill to prevent pipe floatation.

Water shall not be allowed to rise until the concrete has set a minimum of twenty-four (24) hours, and the forms have been removed. Water shall not be allowed to rise unequally against unsupported structural walls.

B. Deflection of Pipe: Do not exceed deflection limits for each type of pipe as recommended by pipe manufacturer. Typical values are:

1. Ductile Iron: Length = 18 Ft.

Maximum Deflections in Feet

Pipe Size in Inches	3	4	6	8	10	12
Mechanical Joint	2.60		2.23	1.68		

2. PVC C900 20-foot Length Pressure Pipe: Do not exceed deflection limits for each type of pipe as recommended by pipe manufacturer.

C. Pipe Jointing:

1. General: Cut pipe for inserting valves, fittings, or closure pieces in neat and workmanlike manner with no damage to pipe or lining. Leave smooth end at right angles to axis of pipe.
2. Mechanical Joints: Thoroughly clean last 8" of spigot and inside bell to remove oil, grit, tar, and other foreign matter. Coat spigot and gasket with solution furnished by pipe manufacturer. Slip cast-iron gland on spigot end of pipe with lip extension of gland toward spigot end. Coat gasket with joint lubricant and place on spigot end of pipe to be laid, with thick edge toward gland.
   Push entire section forward to seat spigot in bell of pipe in place. Press gasket into place within bell, even around entire joint. Move ductile-iron gland along pipe into position for bolting all nuts with suitable torque wrench. Alternately tighten nuts 180 degrees apart to produce equal pressure on all parts of gland.

Pipe Size Inches	Bolt Size Inches	Range of Torque Ft.-Lb.
3"	5/8	45 - 60
4"-24"	3/4	75 - 90

3. Push-on Joints: Thoroughly clean exterior 4" of pipe spigot and inside of adjoining bell to remove all oil, grit, tar, and other matter. Place gasket in bell with large round side of gasket pointing inside pipe bell. Apply thin film joint lubricant over gasket's entire exposed surface. Wipe spigot end of pipe clean and insert into bell to contact gasket. Force pipe into bell to

manufacturer's jointing mark.

D. Flanged Joint

1. Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessary stressing of the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence using torque wrenches at settings recommended by the manufacturer (75 lb. min.). Only compressed asbestos sheet gaskets with a rubber compound binder shall be used. Where steel flanges are connected to ductile iron flanges, an insulating connection shall be provided.

E. Cutting and Fitting

1. The Contractor shall make all pipe cuts required to conform to location, line and grade. All cuts on ductile iron pipe shall be made by the use of pipe cutters or pipe saws. All cuts shall be straight and true.

F. Valve/Tee Cut-In

1. Existing water main pipe shall be cut with minimum gap separating the cut-in assembly and the existing pipe.

2. Preferred assembly would consist of one fitting bolted to another via a foster adapter without the use of a section of pipe between fittings and the end fitting meg-a-lugged to the existing pipe.

3. An alternate method is to use a 3 foot section of pipe between fittings and meg-a-lug each fitting to the existing pipe.

G. Polyethylene Wrap:

1. Provide polyethylene wrap as shown on the drawings for all ductile iron pipe and fittings.
2. Twenty four inch (24”) flat width tubing shall be used with six inch (6”), and eight inch (8”) diameter pipe.
3. The entire joint shall be covered by a cigarette-wrap of forty eight inch (48”) wide polyethylene sheet material over each set of lugs. Irregular shaped valves and fittings shall be covered with flat forty eight inch (48”) wide polyethylene sheet material.
4. Insulators: Insulators are installed at the outlet end of the corporation stop. Insulators shall be Ford Service Insulators or an approved equal for service lines.
5. Tape: The polyethylene seams and overlaps will be wrapped and held in place by means of two inch (2”) wide plastic backed adhesive tape. The tape will be Polyken #900 (polyethylene), Scotchrap #50 (polyvinyl) or equal. The tape will be such that the adhesive will bond securely to both metal surfaces and polyethylene film.

H. Thrust Restraint: Refer to construction drawings. Removal of existing thrust blocks and rodding is the sole responsibility of the Contractor. The City shall not be responsible for any damage caused by the Contractor involving the removal of thrust blocks, regardless of size, or rodding

I. Service Lines: Construct service lines from the water main tap to the curb stop in a straight horizontal alignment that is perpendicular to the main from which it is tapped with one continuous length of tubing ("no splices") to meter. All service line taps shall be ¾" saddle wet tap unless otherwise indicated on approved plans.

1. All service lines shall be a minimum of 54 inches and a maximum of 66 inches below the final grade.

2. When backfilling the service trench, sand/squeege shall be used under and 6-inches above the goose neck at the service connection.

   a. For gradation refer to specification "Pipeline, Excavating, Trenching and Backfilling – Section 02222".

3. Water Service Replacement: Contractor shall make tap to reconnect water service to main. Contractor shall install insulator, corporation stop, meter yokes, type K copper tubing from new main to existing meter or curb stop or as specified, saddle tap, excavation, backfill, asphalt replacement, concrete replacement, (including curb & gutter & sidewalk), landscape restoration, and all necessary fittings needed to accommodate proper water service reconnection per City of Federal Heights standards (typ.). Contractor shall not trench through or under existing curb and gutter or sidewalk but shall bore, jack, or push water service pipe under such items. All taps and services to be inspected by the City of Federal Heights.

J. Corporation Stops

1. Taps shall not be made within two feet of any joint or fitting.
2. Taps shall be separated by a minimum of two feet (measured along the pipe length), even when taps are made on opposite sides of pipe.
3. Taps which are made on the same side of the pipe and within 10 feet of each other (measured along the pipe length), shall be staggered fifteen degrees.
4. Taps made shall be made in accordance with the manufacturer's recommendations.
   a. Use tapping saddles only.
   b. Use shell cutters to make opening in pipe.

K. Curb Stops

1. The Contractor shall adjust the curb stop box to ½-inch above final grade prior to final inspection.

2. Curb stop box shall be ABOVE the curb stop.
3. Curb stop box shall be plumb, so that a shut-off key can be placed on the curb stop.

L. Exterior Meter Settings

1. Exterior meter settings shall be installed by the Contractor according to the manufacturer's recommendations, and in accordance with Typical Detail Drawings.

M. Service and Tap Inspection

1. The Contractor shall insure that the curb stop, corporation stop, and any couplings remain exposed until after the inspection and the approval for backfill is given by the City.
2. All tap and service inspections shall be scheduled.

N. Meter Inspections

1. All water meter inspections shall be scheduled.

O. Tracer Wire:

1. Tracer wire shall be attached to all PVC pipe, for the purpose of future location, as detailed. Use copper split connectors per tracer wire detail.
2. Tracer wire shall be installed along each fire hydrant assembly by providing a single strand of copper wire from each hydrant valve to back of hydrant to be attached to Test Station.

P. Test Station:

1. Underground pipeline tracer wire termination boxes will be installed at the locations as shown on the accepted plans.

Q. Plugging Dead Ends:

1. Install standard plugs or caps and concrete kickblocks at dead ends of all fittings and pipe in accordance with drawings. If dead end is not to be extended, place water service line as near to dead end as practical.

R. Underground Type Plastic Line Marker:

1. During backfilling of underground water piping, install continuous underground plastic line marker 2 feet above the pipe.

3.5 VALVES AND HYDRANTS

A. Carefully inspect valve and hydrant before installation. Clean interior. Operate

valve and hydrant to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and securely brace into place. Set hydrant with bury line at finish grade, with hose nozzles parallel to and pumper nozzle facing pavement, at least 6" behind curb or sidewalk and 18" from property line or as shown on drawings. Provide drainage pit having 9 square feet of surface area and 2' of depth below seep hole. Backfill pits with 1-1/2" washed rock to 6" above barrel drain hole. Provide thrust blocking at bowl of each hydrant as shown on drawings. Do not obstruct barrel drain hole. Hydrants and valves backfilled by installing 1-1/2" aggregate road base to subgrade. Valve boxes centered and plumb over the operating nut. Valve boxes, valves and fire hydrants shall be supported by bricks, concrete or other means to prevent any shock or stress transferring to pipe. Set valve box covers to just below subgrade level to prevent damage during construction of surfacing if applicable. Adjust to grade of final surfacing.

B. Construct a concrete block around fire hydrant from a point 2” below the safety flange to a minimum depth of 6 inches below grade. The block shall extend a minimum of 6 inches beyond hydrant in all directions.

3.6 BLOW-OFF VALVE

A. Provide Hydrant blow-off valve as detailed on the drawings.

3.7 SEWER CROSSING

A. Normal conditions: Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18" between invert of water main and crown of sewer.

B. Unusual Conditions: If above separation cannot be met, use following:

1. Sanitary sewer passing over or less than 24" under water main.
   a. One continuous length of pressure sanitary sewer pipe (C-900), minimum 18'' long centered on water main. Joints between different pipes encased in concrete 6" thick and extending 6" either side of joint: or
   b. Sewer pipe encased in 6" concrete around pipe, and extend 10' either side of water main.

2. Water mains passing over sanitary sewers:
   a. Where the water main or associated piping crosses over the sewer with less than 2 foot of clear distance between the pipes, the sewer shall be encased with a minimum of 6 inches of concrete from springline to 6 inches above the top of sewer. The encasement shall extend along the centerline of the sewer a minimum of one foot beyond the OD of the water main at each end of the encasement or

b. One continuous length of sanitary sewer pressure pipe (C-900), minimum 18'' long centered on water main. Joints between different pipes encased in concrete 6" thick and extending 6" either side of joint:

3. Water Main passing under storm sewer:
   a. Provide a concrete cradle for the storm sewer joints 6 inches either side of the joint, from 6 inches below the sewer OD to sewer springline. In addition the bedding material shall be replaced around the sewer to the greater of a point at one foot above the top of the sewer or to the sewer springline and thoroughly compacted and consolidated to support the sewer.

4. Storm crossing separation that is 18” or less, insulation board shall be installed between pipes. Refer to Section 02527.

3.8 BACKFILL

A. Refer to Pipeline Excavating, Trenching & Backfilling, Section 02222.

3.9 COMPACTION

A. Refer to Pipeline Excavating, Trenching & Backfilling, Section 02222.

3.10 TRAFFIC REGULATION

A. Refer to Traffic Regulation Specification Section 01570.

B. Roadway Usage Between Operations: At all times when work is not actually in progress, Contractor shall make open, passable, and maintain to traffic such portions thereof as may be agreed upon between Contractor and City and all other authorities or parties having jurisdiction over properties involved.

3.11 UTILITIES ENCOUNTERED

A. Protection of all existing gas, water, sewer services, drains, cable, telephone lines and electric lines encountered during construction is the Contractor's responsibility. If utilities are disturbed, they shall be maintained and/or restored to original condition at the Contractor's expense. Backfill around utilities shall be adequately compacted to assure permanent stability. Provide any necessary bracing for exposed utilities during construction.

3.12 FIELD QUALITY CONTROL

A. Notify City Engineer and City Representative at least 24 hours in advance of pipe being laid in any trench. Cover no pipes until observed by City Engineer. Notify

City Engineer and City Representative at least 48 hours before pipe is to be tested. All water mains are to be disinfected, flushed, and hydrostatically tested per City of Federal Heights Regulations.

B. Hydrostatic Testing:

1. General: Make pressure and leakage tests on all newly laid pipe. Test two or more valved sections not to exceed 1000 feet. Test first section of pipe laid to verify if watertight. Lay no additional pipe until first test section has passed tests. Hydrant valves connected to water mains being tested shall be opened.

   Furnish following equipment and materials for tests, unless otherwise directed by City Engineer:

   2 Graduated containers
   2 Pressure gauges
   1 Suitable hose and suction pipe as required

2. Testing Procedure: Test each 1000 feet maximum of line installed while trench is partially backfilled and joints are left exposed for examination for leaks. Do not conduct pressure tests until 48 hours after placement of concrete thrust blocks. After pipe has been partially backfilled, slowly let water into line. Vent to allow air in line to be released. Flush line as necessary for cleaning. Leave water in line for 24 hours prior to pressure test. Test at 1-1/2 times working pressure, calculated for low point of test section, or 150 psi, whichever is greater. Valve off pump and hold pressure in line for test. Test for two hours or as agreed to by City Engineer. At end of test, operate pump until test pressure is again attained. Calibrate container of water for pump suction to determine amount of water to replace leakage.

3. Leakage Allowance: Leakage is quantity of water necessary to refill line at end of test period. No installation will be accepted until leakage is less than: Formula – $L=ND\sqrt{P}\div 7400$

   When testing against existing closed valves, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size may be allowed at the discretion of the City.

ALLOWABLE LEAKAGE PER 1000' OF PIPE IN GPH

Avg. Test Pressure psi	Nominal Pipe Diameter - in. 6	8	10	12	18
200	0.64	0.85	1.06	1.28	1.91
175	0.59	0.80	0.99	1.19	1.79
150	0.55	0.74	0.92	1.10	1.66
125	0.50	0.67	0.84	1.01	1.51
100	0.45	0.60	0.75	0.90	1.35

For pipe with 18' nominal lengths. To obtain recommended allowable leakage for pipe with 20' nominal lengths, multiply the leakage calculated from the table by 0.9. If pipeline under test contains sections of various diameters, allowable leakage will be sum of computed leakage for each size. Reduce allowable leakage proportionately for sections less than 1000 ft.

C. Continuity Testing:

1. The City will perform continuity testing of the water main tracer wiring prior to acceptance of the water main. Contractor is responsible for notifying the City when system is ready for testing.

3.13 FLUSHING AND DISINFECTING

A. General: In accordance with AWWA C651 and the City of Federal Heights Standards. Acceptable chlorine disinfectants are calcium hypochlorite granules, sodium hypochlorite solutions, and calcium hypochlorite tablets.

B. Tablet Method: May not be used on solvent welded plastic pipe. May be used only when all foreign materials have been kept out of pipe. If ground water has entered pipe during installation and tablets have been installed, flush main and use chlorine-water solution method. Do not use if temperature is below 5 degrees.

C. Place tablets with non-toxic adhesive in each pipe length in top of pipe in accordance with following table:

Minimum Number of 5-g Hypochlorite Tablets
Required for Dose of 50 mg/L*

Pipe Diameter in.	Length of Pipe Section 13 ft or less	18 ft	20 ft
4	2	2	2
6	3	3	3
8	3	4	4
10	5	7	7
12	7	8	8

D. Chlorination Test: Assure valves are closed on existing system to prevent chlorine solution flowing into existing system. Retain 50 mg/L chlorinated water in pipe line for minimum of 24 hours. During retention period close all valves and hydrants to disinfect. At end of 24 hour period, chlorine in system to be no less than 50 mg/L throughout length tested. When section being tested meets 50 mg/L chlorine after 24 hours, flush main. Water samples taken shall show no coliform organisms. If water in pipe does not meet the governing health agency requirements, repeat disinfection procedure, at Contractor's expense, until requirements are met. Furnish acceptance forms from governing agency to City Engineer. Neutralize chlorine residual in piping according to AWWA C651 Appendix B as required by the City. Water sampling must be witnessed by the City Representative.

E. In location where short sections of new water main cannot be isolated, the pipe and fittings shall be swapped with disinfecting solution acceptable to the City representative.

3.14 OPERATION OF VALVES

A. Coordinate with the City for operating any valves necessary to complete project. Contractor is required to provide City 24 hours notice prior to said operation request.

3.15 CLEANUP AND RESTORATION

A. Restore all pavements, curbs, gutters, utilities, fences, irrigation ditches, yards, lawns, and other structures or surfaces to condition equal to or better than before work began, and to satisfaction of City Engineer. Deposit all waste material in designated waste areas. Grade and shape disposal site. Complete topsoil and

*Based on 3.75 g available chlorine per tablet, any portion of tablet rounded to next higher number.

reseeding of site, if required. Where disposal sites are not designated, remove and dispose of all waste material off site.

B. General cleanup of the area shall be performed on a daily basis to the satisfaction of the City Representative. Proper safety provisions, including ropes, fence, barricades, construction signs, and warning signs, shall be maintained until completion of work.

END OF SECTION

SECTION 02800

SITE CONCRETE WORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnishing, forming, jointing, placing, finishing and curing of curbs and gutters, sidewalks, cross-pans, handicapped ramps, driveways, etc. in conformance with regulations of authority having jurisdiction.

B. Related Work:

1. Pipeline Excavation, Trenching & Backfilling: Section 02222.
2. Water System: Section 02713.
3. Sanitary Sewer System: Section 02550
4. Storm Sewer System: Section 02527
5. Cast-in- Place Concrete: Section 03300

1.2 RELATED DOCUMENTS

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

B. Additional information concerning cement concrete pavement may be found on the civil drawings. In case of conflict between the drawings and information specified herein, the more stringent requirements shall govern.

1.3 REFERENCES

A. State of Colorado, Department of Transportation (CDOT): State Department of Highways Standard Construction Specifications for Road and Bridge Construction, latest edition.

B. MGPEC – Metropolitan Governement Pavementy Engineers Council

C. Reference Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents for any City Contract.

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.5 SUBMITTALS

A. Submittal Procedures: Refer to Section 01300.

B. Product Data: Submit to City For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete pavement mix, include proportions of fine and coarse aggregate, water, cement, air content and admixtures. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with requirements indicated, based on comprehensive testing of current materials.

E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials and aggregates.
2. Fiber reinforcement.
3. Admixtures.
4. Curing compounds.
5. Bonding agent or adhesive.
6. Joint fillers.

F. Shop Drawings: Reinforcement, precast sections.

G. Placement: Method proposed, if requested.

H. Batch Tickets: The Contractor shall collect delivery or batch tickets from the ready-mix driver for all concrete used on the project and turn them over to the City. Batch tickets shall provide weights of fine and coarse aggregates: weights (or gallons) of water; including surface water on the aggregates; sack mix content; quantity (cubic yards) of batch; slump; times of batching and discharging of concrete; name of batch plant; name of Contractor; type, name and amount of admixture; date and truck number.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Contractor shall have not less than 5 years successful experience with installation of similar work, whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

D. ACI Publications: Comply with the following ACI Specification, unless modified by the requirements of the Contract Documents.

1. ACI 301 – Specification for Structural Concrete for Buildings
2. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
3. ACI 305 – Hot Weather Concreting
4. ACI 306 – Cold Weather Concreting

E. Record of Work: Contractor shall keep record of time and date of placement, temperature, and weather conditions. Retain until completion and furnish copy to City Engineer and City Representative.

F. Concrete Testing Service:

3. The City will engage a qualified independent testing agency to perform quality assurance material testing.
4. Contractor shall notify the testing and inspection agency not less than 24 hours in advance of all work requiring testing or inspection services.

G. Regulatory Requirements:

1. Comply with City standards for sidewalks, curbs, ramps, gutters, and driveway approaches or aprons, including standard dimensions, profiles, thicknesses, reinforcing, and compressive strength. In the event of conflict between the Contract Documents and the standards, the more stringent requirements will apply.
2. Comply with applicable requirements of ADA Handbook, ANSI A117.1, and local and State codes and ordinances regarding walks, ramps and curb ramps. Truncated domes on ramps shall be constructed when indicated.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Furnish ready-mixed concrete mixed and delivered per ASTM C-94. When concrete is mixed in truck mixer, do not load over NRMCA rated capacity, mix at speed for not less than 70, nor more than 100 revolutions of drum or blades.

B. Deliver concrete to job and discharge entire contents within 1 ½ hours after introduction of mixing water. In hot weather or under conditions contributing to quick set of concrete, shorter times may be required.

C. Reinforcement: Deliver reinforcement to the project site bundled, tagged and marked. Use tags indicating bar size, lengths, and other information corresponding to the “Drawings. Store concrete reinforcement materials at the site in a manner to prevent damage and accumulation of direct or excessive rust.

1.8 CONSTRUCTION PERMITS AND COORDINATION

A. The Contractor shall obtain all documentation from concerned agencies such as construction permits, clearances and verification of any underground cabling or piping and ground structures and coordinate with these agencies their relocation or removal as required.

1.9 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Field Measurements: Verify dimensions and existing conditions shown on the drawings by taking field measurements. Report discrepancies to the City Engineer for clarification and make minor adjustments in layout as required by field conditions and as approved by the City Engineer, at no additional cost to the City.

C. Environmental Requirements: Perform work only under suitable weather conditions. Comply with the environmental requirements of Section 03300 for concrete placement.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves of a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcement Bars: Reinforcing bars shall be billet steel conforming to ASTM A615 Grade 40 for #5 and smaller and ASTM A615 Grade 60 for #6 and larger. Use of heat in bending bars is not permitted. Splices where permitted, shall be as specified in ACI-318.

C. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

D. Supports for Reinforcement: Chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 ANCHOR AND EXPANSION BOLTS:

A. Anchor bolts shall meet the requirements of ASTM A449, ASTM A307, or ASTM F1554. High strength bolts shall meet the requirements of ASTM A325. Expansion bolts shall be “Thrubolt Wedge Anchor” by ITW RAMSET/Redhead.

2.4 EXPANSION JOINT FILLER

A. Sealed Joints: Preformed, compressible fiber or cork filler material complying with ASTM D1751 or D1752, Type II, guaranteed compatible with expansion joint sealant materials, ½” thick unless otherwise indicated. Provide high-impact polystyrene removable “void cap” to create ½” deep reveal for installation of sealant.

B. Self-Sealing Joints: Preformed, compressible asphalt fiber joint filler complying with ASTM D994, ½” thick unless otherwise indicated. Do not use asphalt fiber filler in joints to receive elastomeric joint sealants.

C. Expansion joint material shall be provided at the following locations:

1. Each end of curb returns
2. Both edges of driveway
3. Back of sidewalk and driveway slab
4. Around structures and Inlets
5. Between new and existing concrete

2.5 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type II.

1. Fly Ash: ASTM C 618, Class C or F.

D. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:

5. Maximum Aggregate Size: ¾ inches.

6. Do not use fine or coarse aggregates containing substances that cause spalling.

E. Water: Potable.

2.6 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Calcium Chloride will not be permitted

C. Air-Entraining Admixture: ASTM C 260.

2.7 FIBER REINFORCEMENT:

A. Fibrous Reinforcing is required in cross pan, ramps, concrete for curb, gutter and sidewalks.

B. Fibrous concrete reinforcement shall consist of 100 percent virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no olefin materials. Fibrous concrete reinforcement shall be manufactured by Fibermesh Company or approved equivalent.

C. Fibrous concrete reinforcement materials shall be added to each batch of concrete at the rate of 1.5 pounds per cubic yard

D. Fiber lengths shall be one-half (1/2) inch, three quarters (3/4) inch, one and one-half (1 ½) inch and two (2) inch per manufacture.

E. Tensile strength: seventy (70) to one hundred ten (110) with a specific gravity of 0.905 grams per cubic centimeter.

2.8 CURING MATERIALS

A. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. White burlap-polyethylene sheet.

B. Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type I or II, Class B.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.

2.9 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

1. Do not use City's contracted field quality-control testing agency as the independent testing agency.

C. Proportion mixes to provide concrete with the following properties:

1. Minimum Compressive Strength (28 Days): 4000 psi.
2. Slump Limit: Maximum 4 inches.
3. Maximum water-cement ratio at point of placement: 0.44.
4. Minimum 565 lb. Cement per cubic yard.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 5.0 to 8.0 percent.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

PART 3 – EXECUTION

3.1 PROTECTION:

A. Verification of Conditions: Examine areas and conditions under which the work of this Section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

B. The Contractor is to exercise caution when working adjacent to existing structures, underground services and the like. Any damage to or displacement of any structure or service caused by the Contractor's negligence shall be repaired to its original condition at the Contractor's expense. Contractor is responsible for protecting concrete from vandalism.

3.2 PREPARATION:

A. SUBGRADE PREPARATION:

1. The Contractor shall perform all earthwork to produce a compacted subgrade conforming to ASTM D-698. Where fill material is required, it shall be composed of inorganic soils, have 100% finer than 3" size, 25% minimum of minus 200 sizes, capable of being compacted to 95% standard proctor density. Do fine hand grading as required to assure minimum thickness of concrete as indicated. Be sure any required gravel subgrade, or drainage system is in place. Be sure any required gravel base course is in place and compacted to 95% standard proctor density. Proof-roll prepared sub-base surface to check for unstable areas and need for additional compaction. Do not begin work until such conditions have been corrected and are ready to receive paving.

2. Moisture condition and compact subgrade to 95% standard proctor density.

3. Perform work only under suitable weather conditions. Do not work frozen materials

B. UTILITY TRENCHES: Do not proceed with concrete flatwork and paving installation until all utility trenches within or crossing areas to be paved, and any subsequent filling in the areas, have been properly compacted and tested.

C. FORM WORK:

1. Design, erect, support, brace, and maintain form work so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure.

2. Design formwork to be readily removable without impact, shock or damage to concrete surfaces and adjacent materials. Provide form work sufficiently tight to reduce leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to reduce leakage and fins.

3. Use steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with a nonstaining form release agent that will not discolor or deface surface of concrete.

D. FORM CONSTRUCTION:

1. Construct forms complying with ACI-347, to the exact sizes and shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plum work in finished concrete work.

2. Provide for openings, offsets, sinkages, recesses, chamfers, blocking,

screeds, anchorages, and inserts and other features required.

3. Provide openings in forms to accommodate other work, including mechanical and electrical work.

E. FORM COATINGS: Coat form contact surfaces with form-coating compound before reinforcement is placed.

F. CLEANING AND TIGHTENING: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt and other debris just before concrete is to be placed. Retighten forms immediately after concrete placement as required to reduce mortar leaks.

G. RE-USE OF FORMS: Clean and repair surface of forms to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new form work.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install as indicated on the Drawings. Reinforcing bars shall have a minimum of 2” clear cover unless otherwise noted on the Drawings. Lap splices for reinforcing shall be a minimum of 30 bar diameters. Provide bent corner bars to match and lap horizontal reinforcing at corners and intersections in concrete footings and walls.

3.4 JOINTS

A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
3. Provide tie bars at sides of pavement strips where indicated.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet minimum to 100 feet maximum unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface for joint sealant.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
6. Extend joint fillers full width and depth of joint, not less than 0.5-inch or more than 1-inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.

D. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

3. Plastic joint strip where applicable for control joints on sidewalks only.

F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Remove loose material from compacted subgrade surface immediately before placing concrete.

3.6 INSTALLATION:

A. GENERAL: Comply with applicable requirements of Section 03300 regarding concrete placement, consolidation, preparation for finishing, and curing of concrete installed under this Section.

B. CURBS AND GUTTERS: Construct to profiles indicated or required by applicable public works standards. Provide wheelchair ramps at street intersections and driveway approaches, in accordance with ADA Handbook, ANSI 117.1, and local and State code requirements or ordinances. Provide expansion joints at 90 ft. o.c. maximum.

C. Notify the City not less than 8 working hours in advance of any pour and as soon as form work and reinforcing are substantially complete.

D. Where sections of existing cross-pan are removed, 30 inch long epoxy coated No. 5 tie bars shall be installed in the existing concrete at each end of the removal section according to the following procedure:

1. Holes with a diameter 1/8 inch greater than the required bar diameter shall be drilled laterally into the hardened concrete slabs at one half the slab depth, 24 inches maximum on center, 15 to 16 inches deep. Each hole shall be cleaned out with compressed air using a wand attachment that fits into the hole and is long enough to reach to the back of the hole. Each hole shall be brushed out with a stiff bristled cylindrical brush that is at least ¼ inch larger than the diameter of the hole. Each hole shall be blown out with compressed air a

second time using a wand attachment that fits into the hole and is long enough to reach to the back of the hole. Each hole shall be blown out until there is no longer any evidence of dust, debris or loose material in the hole.

2. An approved epoxy shall be used and installed according to the manufacturer's Instructions. Epoxy shall be placed in the back of each hole with an applicator that will reach the end of the drilled hole. A sufficient amount of epoxy shall be placed in each hole to insure that the bar will be completely covered with epoxy. Epoxy shall be placed on the bar before inserting the bar into the hole. The bar shall be inserted into the hole using a twisting motion to facilitate covering the bar and the inside surface of the hole with epoxy minimizing voids or air pockets.

E. See Drawings regarding items to be embedded in concrete, including but not restricted to the miscellaneous steel, expansion joints, anchor bolts, etc.

F. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.

G. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

H. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete.

I. Remove rejected concrete from the project site and dispose of in an acceptable location.

J. Isolate flatwork from building elements, walls, columns with expansion joints unless otherwise indicated.

K. Saw cutting of divider joints may be used providing cutting occurs as soon as it can be done without dislodging coarse aggregate and before initial shrinkage stresses have occurred.

L. Consolidate concrete placed in forms by vibrating, hand-spading, or rodding. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Vibration of forms and reinforcing will not be permitted. Bring slab surfaces to the correct level; smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

M. Roughen surfaces of set concrete at all joints, except where bonding is obtained

by use of concrete bonding agent, and clean surfaces of coatings loose particles and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and to not leave loose particles or aggregate, or damaged concrete at the surface.

N. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

O. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

P. Consolidate concrete by mechanical vibrating equipment. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

Q. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified with expansion joints at intervals of approximately 50 feet minimum to 100 feet maximum and tooled control joints at 10' o.c. Provide expansion joints at connections to existing concrete. If results are not approved, remove and replace with formed concrete.

R. Walks: Minimum 4" thick, with expansion joints at intervals of approximately 50 feet minimum to 100 feet maximum and tooled control joints at intervals equal to width of walks or maximum 5 feet o.c. Tool edges to rounded profile and finish as noted herein or shown on the drawings. Pitch walks ¼" per foot for drainage unless otherwise indicated.

S. Approaches: Minimum 10" thick, with #4 rebar spaced 12" o.c.b.w. unless otherwise indicated or required by City. Construct to radius of flare indicated, and taper or warp into alignment with adjacent curbs, gutters, and walks. Place approaches over compacted subgrade.

T. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

U. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 CONCRETE FINISHING

A. General: No dusting or topping of the surface, or sprinkiling with water, to facilitate finishing shall be permitted.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

C. Exposed horizontal and vertical surfaces shall be finished as indicated on the Drawings.

D. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture.

E. For flatwork areas, after floating, test surface for trueness with a 10 foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

F. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to ½-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

G. After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface as follows:

1. Broom finish as indicated on the Drawings. Repeat operation if required to provide a texture acceptable to the City.

2. On inclined slab surfaces, provide a coarse, non-slip finish by scoring

surface with a stiff-bristled broom, perpendicular to line of traffic.

H. Vertical Exposed Faces: After form removal, clean ends of joints and repair any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by the City.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold and hot temperature, and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of the cement and proper hardening of the concrete. Provide barricades or other suitable barriers to prevent pedestrian or vehicular traffic until concrete has sufficiently hardened.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

1. Apply specified curing compound at full strength with coverage rate not to exceed 200 square feet per gallon.

3. If rainy weather is imminent, steps shall be taken to properly protect the concrete from washing or addition of excess water until such time as it has sufficiently hardened, (minimum 7 day strength). Use canvas or tarp coverings to resist scouring from rain water.

4. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, no minus
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: For City Contracts, the City will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. For non-City contract work the contractor shall be responsible for meeting all criteria in this section. Sampling and testing for quality assurance may include the following:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.
5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 50 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
7. When total quantity of a given class of concrete is less than 50 cu. yd., City Engineer may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.

9. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.

B. Test results shall be reported in writing to the City Engineer and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by City Engineer but will not be used as the sole basis for approval or rejection.

D. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by City Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Repair or replace broken or defective concrete, as directed by the City using methods meeting the City's approval.

C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 7 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just before final inspection.

E. Protection from vandalism and traffic is the responsibility of the Contractor

3.12 CLEANUP AND RESTORATION

A. General cleanup of the area shall be performed on a daily basis to the satisfaction of the City Engineer and City Representative. Proper safety provisions, including ropes, fence, barricades, construction signs and warning signs shall be maintained until completion of work.

B. After completing concrete operations, clean surfaces, pick up excess materials and clean work area.

END OF SECTION

SECTION 02810

Underground Sprinkler System Installation

PART 1 - GENERAL CONDITIONS

1.01 GENERAL STATEMENT

The specifications set forth herein pertain to the installation of an underground irrigation system.

1.02 RELATED WORK SPECIFIED ELSEWHERE
Section 02821 – Seeding, Fertilizing, and Mulching
Section 02920 - Soil Preparation
Section 02930 - Sodding
Section 02950 - Trees, Shrubs and Ground Cover

1.03 QUALITY ASSURANCE

A. Irrigation Drawings:

The irrigation drawings are essentially diagrammatic. Due to the scale of the drawings, all characteristics of the system (i.e., sleeving, fittings, etc.) may not be represented. The contractor shall carefully inspect the site and plan his work accordingly, supplying any materials and equipment necessary to install said characteristics.

The contractor shall notify City of any discrepancies between site dimensions, grade differences, obstructions, etc., and those on the drawings that might not have been known during preparation of irrigation drawings. If such written notifications are not made, contractor shall assume all expenses and responsibility for any revisions necessary.

Work called for on the Drawings by notes or on details shall be furnished and installed whether or not specifically mentioned in the specifications.

Design locations of heads, valves and lines are approximate. Contractor shall make minor adjustments of locations to avoid conflicts with planting, buildings and other obstacles. All finish grades shall be approved prior to installation of the irrigation system.

B. Experience and Observations (City Contracts only):

1. No materials of any kind shall be installed on the project until they have been approved by the city. Approval of materials is for design purposes only and shall indicate that materials visually meet specifications, but this acceptance shall not relieve contractor of any guarantees. Contractor shall be responsible for the total performance of such substitution to equal or surpass the original design in every respect.

2. Before final acceptance of the project, the contractor shall show evidence to the consultant that all submittals, etc., have been received by the owner.

3. Contractor shall give the City forty-eight (48) hours notice with request for staking or for field observation. Head and valve staking must be approved prior to commencement of installation. Contractor to verify site conditions before commencing work. Contractor to notify City in written form of any site irregularities prior to commencing work. Initiation of irrigation installation implies contractor acceptance of existing conditions.

C. Ordinances and Regulations:

Contractor shall observe all state and local laws, ordinances, regulations and applicable codes concerning the materials and installation of the irrigation system. Should a conflict arise between ordinances, laws, codes, regulations and specifications, the most stringent requirements will prevail in any case.

1.05 SUBMITTALS (CITY CONTRACTS ONLY)

A. Material List:

1. A material list of all products and materials to be used in the project shall be submitted to the City prior to installation of irrigation system.

2. City reserves the right to reject any and all materials that have been installed but have not been approved.

3. Contractor may request an approved equal to a product specified on the plans. Contractor must submit cut sheets of the product seven (7) days prior to bid opening to the consultant. Consultant shall respond to the request within three (3) days of receiving product information.

4. Manufacturer's warranties shall not relieve the contractor of his liability for project guarantee. Such warranties shall only supplement the project guarantee.

B. Operating and Maintenance Manuals:

1. Contractor is to deliver to City's representatives the following before final acceptance of the irrigation system:

a. Index sheet of Contractor's address and phone number.

b. List of materials and manufacturer's representatives with addresses and phone numbers.

C. Operating and maintenance instructions of all equipment with shutdown and start-up procedures for the irrigation system.

D. Additional Equipment:

1. Equipment to be furnished as part of this contract to the owner at the completion of the project before final acceptance of irrigation system:

a. Two (2) manual drain valve keys of appropriate length;
b. Two (2) gate valve or stop and waste valve keys of appropriate length;
c. Three (3) quick coupler keys and two (2) matching hose swivels;
d. Two (2) sets of special tools used for maintaining and adjusting each type of sprinkler head and valve supplied;
e. Two (2) keys for each automatic controller;
f. Two (2) sprinkler heads and nozzles for each type used.

E. As-Built Drawing:

1. Before final acceptance of the irrigation system, contractor shall supply City with a reproducible Mylar As-Built Drawing. Drawing shall include dimensioned locations of all equipment and piping as listed in the irrigation schedule on the plans. Drawing to include dimensioned changes in location of sprinkler heads, zoning changes, connection to existing water lines, and any other items as requested.

1.06 PROTECTION OF PROPERTY AND SAFETY MEASURES

A. Property and Utilities:

1. All trees, shrubs, flowers, fences, buildings, walks, roadways, and other property shall be protected from damage. Any damage to said property shall be repaired or replaced to the owner's satisfaction at the contractor's expense. Open trenches left exposed shall be flared and barricaded as per O.S.H.A. regulations by the contractor. Contractor shall restore all areas to their original condition. Contractor shall be responsible to contact utility companies and the owner's representative for staked locations of all utilities on the property. If staked utilities are damaged by the contractor, the utilities shall be repaired at the contractor's expense.

2. All trenching and other work within three feet of existing trees shall be done by hand so as not to damage tree roots or limbs. All trenches shall be no less than one foot from the trunk of any tree.

3. Promptly notify consultant of unexpected sub-surface conditions.

B. Replacement of Paving and Curbs:

1. Damage caused by trenching, crossing existing and/or proposed roadways, paths, curbing, etc., shall be kept to a minimum and all damaged areas shall be restored to their original condition at the contractor's expense.

This will include compaction of subgrade to ninety-five percent (95%) relative compaction.

Restoration shall take the following course:

a. Match existing paving sections for asphalt paving. Thoroughly compact sub-base, base course, and bituminous course, matching grade of existing paving. No rough or rolled grades will be allowed.

b. Blacktop curbs - hot mix bituminous curb mix tamped and shaped to match adjoining curbs.

c. Concrete paving - concrete to match adjoining concrete work, with expansion joints.

d. Sidewalks - concrete to match adjoining concrete work.

1.07 MATERIAL HANDLING, STORAGE AND CLEAN UP

A. Material Handling and Storage:

Contractor shall be cautious in handling and installing pipe and materials. Consultant reserves the right to reject any and all materials that are damaged. Damaged and defective pipe and equipment is to be removed from the site. Contractor shall make arrangements with the owner to store materials on site. Do not expose plastic piping to prolonged sunlight.

B. Clean Up:

Contractor shall endeavor to keep the site clean at all times. At the completion of the project, the contractor shall remove all construction equipment and surplus materials from the premises leaving the area in a clean and acceptable condition. Surplus materials shall include unsuitable excavated materials, rock, trash, and debris. Any equipment or debris which is not removed shall be removed at the expense of the contractor.

1.08 FLUSHING, TESTING AND COVERAGE

A. Flushing:

All lines shall be thoroughly flushed to eliminate any foreign matter before sprinkler heads are installed.

B. Testing:

1. In the presence of the consultant, the contractor shall conduct a pressure test on the mainline pipe at a pressure of 100 PSI for a period of two (2) hours. Any leaks or breaks during the test shall be repaired and the mainline will be tested until accepted. All test equipment and pumps shall be supplied by the contractor as part of the contract.

2. The contractor is responsible for providing the proper amount of water on sod and plant material to establish and sustain optimum plant growth. The watering program is to be included on As-built drawings.

C. Coverage:

After the sprinkler heads have been installed, and before installation of sod, the contractor shall conduct a coverage test in the presence of the consultant to determine if irrigated areas are receiving the proper amount of water. As directed by the consultant, the contractor shall make adjustments for proper coverage at no additional expense. This shall include changing of nozzle patterns and degrees of arc. Contractor shall perform, at no additional expense, the required work to correct any coverage problems due to deviations from irrigation plans or to problems caused by installing according to plans when it is obvious that the plans are inadequate, without bringing it first to the attention of the consultant. No overspray is permitted on any structure.

Any areas which do not conform to the designed characteristics of the drawings and unauthorized changes or poor installation practices shall be repaired or replaced by the contractor at his expense.

1.09 PRELIMINARY INSPECTION

A. Preliminary inspection will occur after completion of entire irrigation system. Provide 48 hours notice to consultant for inspection.

B. Preliminary inspection will evaluate the performance, coverage, appearance and conformance of the system to that of the drawings. Contractor shall rework or replace items that do not meet city's approval.

C. Consultant will provide punch list of items to be corrected.

D. Contractor will correct all punch list items at this expense.

1.10 FINAL INSPECTION

A. Upon completion of punch list items, contractor will give consultant 48 hours notice to set up final inspection. Final inspection will take place after all as-built drawings, controller charts and submittals have been provided to and accepted by the owner.

B. If, after inspection, the consultant determines that all work conforms to the drawings, he will issue a written notice of acceptance.

C. Final acceptance will not be given until all punch list items and subsequent new items are corrected. Funds shall be withheld from the contractor to pay for any subsequent inspection as deemed necessary by the owner to ensure compliance with contract drawings, specifications and details.

D. If the consultant determines that the irrigation system is obviously not completed to warrant a final inspection, the contractor shall pay the consultant to cover costs for final inspection.

1.11 WINTERIZATION

Contractor shall be responsible for draining of the irrigation system at the close of the 2009 sprinkling season and for start up of the system in the spring of 2010 without being requested by owner. Contractor shall use compressed air or an acceptable equivalent to drain system. Use procedures that are industry standards. Contractor shall adjust system (sprinkler heads, coverage, etc.) as part of the start up procedures.

1.12 WARRANTY

It shall be the responsibility of the contractor to insure the satisfactory operation of the entire irrigation system and the workmanship and restoration of the project area. The entire system, including materials, shall be guaranteed in writing to be complete and remain operable in every detail by the contractor for a period of one (1) year from date of substantial completion of project, and the contractor agrees to make any adjustments or repair any defects occurring within the one-year guarantee period within seven (7) calendar days from receipt of notice of malfunction by the owner. If contractor neglects to perform these duties within the specified time, the owner may make such repairs at the contractor's expense; provided however, that in the case of an emergency, wherein the judgment of the owner, delay would cause serious loss or damage, repairs or replacement may be made by verbal communication and without notice being sent to the contractor, and the contractor shall pay the cost thereof. Any settling of irrigation trenches/backfill material during the guarantee period shall be repaired at contractor's expense. Contract documents shall govern irrigation replacement the same as new work. Replacements are to be made at no cost to the owner. Any vandalism to the irrigation system prior to final acceptance shall be repaired and/or replaced at contractor's expense.

PART 2 - PRODUCTS

2.01 MATERIALS

A. P.V.C. Pipe

1. This specification describes the properties and performance required for polyvinyl chloride pipe. Pipe shall be suitable for use at maximum hydrostatic working pressure of 200 PSI or 160 PSI as noted on plans. Pipe shall be made from clean, virgin, NSF approved, type 1, grade 1 P.V.C., conforming to Astin Resin specification D1784-60 and project standard D2241 for P.V.C. 1120 SDR 26 or SDR 21. P.V.C. Pipe is to be belled end and solvent weld. Solvent cement and primer shall be of the type prescribed by manufacturer.

2. Marking and Declaration of Compliance

Marking shall show the size, series, identification, manufacturer's trade name at intervals of not more than 20 feet. Pipe shall include the seal of

approval of the National Sanitation Foundation spaced at intervals required by NSF regulations.

B. P.V.C. Fittings:

All pipe fittings to be schedule 40 P.V.C. (ASTM D2466 and D1784) unless specifically noted otherwise. Solvent cement to conform to ASTM D2564.

C. Brass Pipe and Fittings:

1. Brass pipe shall be 85% red brass, (ANSI) Schedule 40.
2. Fittings shall be medium brass, 125 pound class, screwed type.

3. Use a dielectric union wherever a copper based metal (copper, brass, bronze) is connected to an iron based metal (iron, galvanized and stainless steel).

D. Copper Pipe:

Copper pipe shall have the requirements of Type K, ASTM B88. Fittings shall be copper or cast bronze. Silver solder shall be used for joints.

E. Sprinkler Heads:

Sprinkler heads shall be of the type and model as indicated on drawings.

F. Backflow Preventer:

Backflow preventer shall be of the type, model and size as indicated on drawings. The backflow preventer shall meet all local regulatory requirements.

G. Automatic Control Valves:

Automatic control valves shall be of the make specified, designed to operate with the specified controller with size and model as listed on drawings. Control valve shall be normally closed type and shall have manual bleed nut and manual flow control.

H. Drip Valve Assemblies:

Drip valve assembly shall be of the type, size and style as indicated on the drawings. Strainer shall have 120 mesh nylon screen with 1/2" blow-out. Pressure reducing valve shall have manual adjusting nut.

I. Drip Emitters and Tubing:

Drip emitters shall be of the type, style and size as indicated on the drawings. Drip tubing shall conform to ASTM D1248 and ASTM D3350. Capillary tubing shall have 1/8" i.d.

J. Drip Line Blow Out Stubs:

Install drip line blow out stubs at all ends of drip tubing.

K. Quick Couplers:

Quick coupler valves shall be of the type, size and style as indicated on the drawings. Quick coupler valves shall be two piece with rubber locking cover.

L. Gate Valves:

Gate valves up to 2-1/2" and larger shall be brass with non-rising stem and I.P.S threads. Gate valves shall be as shown on drawings.

M. Automatic Controller:

The automatic controller shall be furnished and located as shown on the plans. The controller shall be of the type, size and model number as shown. Controller shall be equipped with primary line surge protector. Install valve output surge protection arrestors for control wiring and common.

N. Control Valve Wiring:

Irrigation control wiring shall be #14 gauge solid A.W.G. and shall be U.F., U.L. approved. Control wires to be red, common wires to be white.

O. Valve Boxes:

Valve boxes shall be of the type, size and style as indicated on the details. A Carson #910-12 box shall be used for control wire splices. Use one (1) valve box for each valve installed. Where multiple valve boxes occur, arrange in symmetric order and appearance. No valve box extensions will be accepted. On the underside of all control valve boxes shall be markings clearly indicating controller number and valve number.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Trenching:

1. Trenching and installation of irrigation system shall not commence until final grading has been completed and approved by the owner.

2. Trenches shall be cut to true line and grade, and shall be excavated so that the pipe shall drain uniformly toward the drain valves deemed necessary to properly drain the system. Minimum grade of piping to drain shall be 3"/100'. All debris and rocks shall be removed from trenches. For piping 3" and larger, trench width shall be sufficient for installation of pipe with a clearance of at least 4 inches horizontally on both sides of pipe within

trench.

3. Pipe pulling may be used if soil conditions are acceptable to the consultant.

4. Installation Depth of Piping:

   Depth of mainline from top of pipe is 24"

   Depth of lateral (rotor) from top of pipe is 18”

   Depth of lateral (pop-up) from top of pipe is 12”

   Depth of shrub (pop-up) from top of pipe is 18”

   Depth of wiring – side of mainline

B. Plastic Pipe and Fittings:

1. All pipe and fittings shall be installed as per manufacturer's recommendations. No pipe shall be installed in temperatures of 40 degrees F or less. No pipe shall be installed on non-compacted fill dirt. Plastic pipe shall be snaked horizontally in trench and square cut with burrs removed from inside of pipe. Provide for thermal expansion and contraction. For threaded connections, use sealants that are recommended by the manufacturer for use with plastic. Do not use oil based pipe joint compounds. Assemble threaded connections by tightening 1 to 1-1/2 turns beyond finger tight. Keep piping clear of dirt and pipe scale. Keep open ends of assembled piping capped. Teflon tape is to be used on all plastic threaded joints.

2. Solvent weld joints shall be made according to manufacturer's recommendations. Allow joints to set at least 24 hours before pressure is applied to the piping.

C. Backfilling:

1. All backfilling shall be done with approved soil, free of any debris including rock and debris 1" in diameter or larger, and shall be puddled and/or mechanically tamped to prevent settling. Backfilling shall not be done with frozen or caked soil. Excess debris encountered during backfill process shall be removed at the contractor's expense. Backfill shall be compacted to 95% standard proctor density (ASTM D698-78). Any backfill soil removed due to unsuitability shall be replaced with new, approved soil at the contractor's expense. Any settling during the warranty period of the backfill material shall be repaired at the contractor's expense, including any damage to other items affecting by the settling.

2. All lateral lines shall be installed in trenches with a minimum of 6" clearance.

3. Do not install lateral lines within 2' of lines of other trades.

D. Installation of Piping Under Paving:

Contractor to coordinate installation of sleeving with other applicable trades. All piping that is to be located under areas where asphalt or concrete paving is to be installed shall at an 18" depth below top of road base. Piping is to be encased in sand 4" on all sides. Add backfill in 6" lifts and use mechanical tamping to reach 95" standard proctor density.

Contractor is to match and install new paving and base with existing paving and base where cutting of paving is necessary for installation of piping. Contractor must obtain written approval from the consultant for the process.

Installation of piping under existing walks is to be done with jacking or boring. Any cracking or breaking of the walk is to be repaired at contractor's expense. Contractor shall repair or replace to its original condition any damage caused by settling of sleeving during the warranty period.

E. Sprinkler Heads:

All sprinkler heads located in turf areas shall be adjusted vertically to be flush with final finish grades. Install heads as per details with spacing according to plans. Install heads on double swing joint assemblies. Angle of nipples relative to lateral lines shall be no more than 45 degrees and no less than 15 degrees. Locate rotary sprinklers 6” (spray heads 3”) away from walls, fences and paved areas. Under no circumstances shall the spacing exceed the maximum spacing recommended by the manufacturers.

F. Gate Valves:

Installation of gate valves shall be as indicated on the details.

G. Backflow Preventer:

Installation of backflow preventer shall be as indicated on the details. Install as per local and state codes. The most stringent requirement for backflow prevention shall prevail in case of a conflict.

H. Automatic Control Valves:

Installation of automatic control valves shall be as indicated on the details. All control valves shall be installed as close as possible to the locations as shown on plans.

I. Drip Valve Assemblies:

Installation of drip valve assemblies shall be as indicated on the details.

J. Drip Emitters and Tubing:

Installation of drip emitters and tubing shall be as indicated on the details. Drip tubing is to be installed at a depth of 4" below top of grade. In this case, top of grade does not include mulch or rock layer. Drip line blow out stubs are to be installed at all ends of drip tubings. Install drip tubing in turf areas as lateral piping.

K. Quick Coupling Valves:

All quick coupling valves shall be installed as double swing joint assemblies of schedule 45 PVC. Angle of nipple relative to mainline shall be no more than 45 degrees and no less than 15 degrees. Install as per detail.

L. Automatic Controller:

1. Automatic controller shall be installed as per manufacturer's recommendations and/or irrigation details. Each controller shall have its own separate ground wire and reduced, laminated as-built drawing installed in the door. Controller charts shall be legible and color coded to show valve numbers and their respective zones. Charts are to be hermetically sealed between two layers of 20 mil. Thick plastic sheets and approved prior to final acceptance.

2. All work performed as electrical installation shall conform to applicable codes. All high voltage electrical work shall be performed by a licensed electrician. The contractor shall be responsible for the electrical connection of the controller with the metered electrical line at the base of the controller as provided by the owner.

3. Install one valve output surge protection arrestor on each control and common wire.

4. Install a circuit breaker and electrical on/off switch for each controller.

M. Control Wiring:

Installation of control wires shall be strung as close as possible to the mainline with such wires to be located on one side of pipe. Wiring to be installed in separate trench if not along mainline. All underground electrical connections shall be made with Rainbird Pentite connectors. Any splices not within control valve boxes shall be installed in a Carson #910-12 valve box. The contractor shall leave a minimum loop of 24" at each control valve, each splice and every 100 feet of wiring. Wiring is to be bundled every 20 feet with one (1) control wire used for every control valve. Install two (2) spare #14-1 wires along complete entirety of mainline from controllers to farthest control valve on each and every branch of mainline. Color to be blue.

N. Drain Valves:

Manual drain valves shall be installed as per details. Contractor shall supply, locate and install drain valves so as to drain entire mainline.

END OF SECTION

SECTION 02821

SEEDING, FERTILIZING, AND MULCHING

PART 1: GENERAL

1.1 DESCRIPTION: The project area outside of street will be fertilized, seeded, and mulched except for areas. Dryland seed mix shall be placed in all disturbed areas.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

Section 02810 - Underground Sprinkler System
Section 02821 – Seeding, Fertilizing, and Mulching
Section 02920 - Soil Preparation
Section 02930 – Sodding
Section 02950 – Trees, Shrubs and Ground Cover

1.3 QUALITY ASSURANCE:

A. All seed materials shall be subject to inspection and approval. The City reserves the right to reject at any time or place prior to acceptance, the work and all seed which in the City's opinion failed to meet these Specification requirements. Inspection is primarily for quality; however, other requirements are not waived even though visual inspection results in approval. Inspection shall be made periodically during seeding, at completion, and at the end of warranty periods, by the City.

B. U.S. Department of Agriculture Rules and Regulations under Federal Seed Act and equal in quality to standards for Certified Seed.

C. Manufacturer's printed recommendations.

1.4 SUBMITTALS:

A. Manufacturer's statement of fertilizer analysis.

B. Contractor shall furnish the City with seed certification and analysis.

C. At completion of work, furnish written warranty to City based on requirement of Paragraph 1.8.

1.5 DELIVERY, STORAGE, AND PRODUCT HANDLING:

A. Seed: Seed shall be labeled in accordance with the latest U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. (March 1940, reprinted with amendments August 1963, October 1964, and October 1965; and Amendments, February 11 and June 18, 1965, and Requirements Under the Federal Seed Act for Labeling and Treating Seed, August 1965.) Seed shall be furnished in sealed standard containers unless exception is granted in writing by the City. Seed that has become wet, moldy, or otherwise damaged in transit or in storage will not be accepted.

B. Fertilizer: Deliver in original, unopened containers with manufacturer's guaranteed chemical analysis, type, and trade name attached. Store in a dry location. Non-flowing material will be rejected.

1.6 JOB CONDITIONS:

A. Contractor shall be responsible for proper repair of any underground pipe or electrical wiring damaged by operations under this section. Repairs shall be made by contractors designated by the City with cost being charged to the Contractor. Install protection around newly seeded areas to protect from vehicle traffic. Remove when instructed by City.

B. Areas disturbed for the convenience of the Contractor or due to the neglect of the Contractor, as determined by the City, shall be restored to their original condition, to the maximum practicable extent, by and at the expense of the Contractor.

C. Vehicular traffic and construction equipment shall be restricted to established roadways and areas designated by the City.

D. Maintain until date of acceptance of established seeded area by City.

1.7 POST-CONSTRUCTION INSPECTION: A post-construction inspection will be made as required by the Contract. Designated seeded areas found to be deficient of plant growth shall be replanted with material as originally specified. Deficient areas are defined as a barren site one (1) square foot or larger not having a uniform stand of grass consistent with the majority acceptable germinated cover of 70%. An initial inspection shall be made 30 days after completion of seeding operations. The final warranty inspection (to insure viability during a full growing season) will be made two years following Final Acceptance of completed Contract.

All reseeded areas shall be maintained by the Contractor until grass/planting is established and accepted by the City.

1.8 WARRANTY: Seeded areas shall be warranted for one growing season to be in a healthy, vigorous growing condition. During the original warranty period seeded areas that die due to natural causes, failure of germination, etc., or in the opinion of the City are unhealthy, shall be replaced at once and at the expense of the Contractor. Such replacements shall be installed as specified, equal to the original planting.

PART 2: MATERIALS

2.1 FERTILIZER: Apply di-ammonium phosphate fertilizer (18:46:0).

2.2 SEED: Seed which has become wet, moldy, or otherwise contaminated or damaged in transit or in storage will not be acceptable. Weed seed shall not exceed 0.5 percent by weight of the total pure live seed and other material in the mixture. A seed mixture consisting of the following kinds of seed with corresponding percent purity and percent germination shall be broadcast applied at a bulk rate per acre (drilled seeding at half the rate of broadcasting) as follows:

DRYLAND SEED MIX

Common Name	% of Total	PLS Per Acre
Crested Wheatgrass	20%	20
Blue Grama	5%	5
Buffalo Grass	15%	15
Kentucky Bluegrass	5%	5
Sheep's Fescue	25%	25
Perennial Ryegrass	20%	20
Barley or Oats	10%	10
Total	100%	100 lbs.

2.3 WATER: Supplemental water applied to the seeded area shall be clean, fresh, and free from harmful substances.

2.4 MULCH:

A. Mulch shall consist of certified weed free field or marsh straw or hay derived from oats, barley, wheat, rye certifdied under the Colorado Department of Agriculture weed free forage certification program and inspected as regulated by the weed free forage act, Title 35, Article 27.5 CRS.

B. Hydraulic Mulch: Mulch shall be wood cellulose fiber for hydraulic mulching. The mulch shall not contain any substance or factor, which might inhibit germination or growth of specified seed. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall gave an ability to become evenly dispersed and suspended when mixed in water.

C. Weight specifications from manufacturers shall refer to the air-dry weight of the fiber. Packaging shall be no greater than 100-pound packages and shall be clearly marked by the manufacturer showing air-dry weight.

D. Mulch shall be Silva Fiber or approved equivalent. Provide "Plantago" with crosslinker soil tackifer or approved equivalent.

PART 3: EXECUTION

3.1 BED PREPARATION: Thoroughly loosen soil to a minimum depth of four inches; remove rocks, debris, and clods. Accumulated debris shall be disposed by the contractor. The seeding Contractor shall perform all finish grading required by the Drawings to maintain drainage into catch basins, drainage structures, etc., and as required to provide a roughened and well-contoured surface prior to proceeding.

3.2 SEEDING:

A. Notify City for review and acceptance of soil preparation prior to seeding. Work shall not be performed when conditions are unlikely to provide satisfactory results.

B. Hydraulic Seeding shall be used for confined areas and on slopes greater than 2:1. Hydraulic seeding equipment shall include a pump capable of being operated at 100 gallons per minute and at 100 pounds per square inch pressure. The equipment shall have a nozzle adaptable to hydraulic seeding requirements. Storage tanks shall have a means of of agitation and a means of estimating the volume used or remaining in the tank.

C. The Contractor shall employ a drill/mechanical spreader for seeding for areas that have sufficient area and slopes less than 2:1. Depending upon the seeding recommendation, it may be necessary to have separate boxes for fluffy grasses and small seeded grasses. After applications of seed, the seeded areas shall be harrowed, lightly disced, or hand raked to cover the seed. (In areas inaccessible to a mechanical spreader, hand broadcast seed, in two directions, 90º to each other, using double the stated application rate).

3.3 FERTILIZING: Apply fertilizer at a rate of 5 pounds per 1,000 square feet.

3.4 MULCHING:

A. Protect seeded areas against erosion by spreading specified hydro-mulch with tackifier immediately after seeding operations. Spread uniformly by hydraulic method at the rate of 2000 lbs./acre). Mulch shall penetrate soil slightly and result in a water insoluble thin and open structured ground cover film when dry.

B. After seeding has been completed, mulch shall be applied uniformly applied at a rate of 2 tons/acre (4,000lbs/acre). Mulch shall be mechanically crimped to a depth of 2 inches using a crimper. Mulch shall be hand crimped and covered with a tackifier in areas where mechanical crimping is not possible. Crimping shall produce an exaggerated v-shape form protruding out of the ground several inches.

C. The seeding area shall be mulched and crimped within 4 hours after seeding. Areas not mulched and crimped within four hours after seeding or prior to

precipitation or windy conditions on site shall be reseeded with the specified seed mix prior to mulching and crimping.

3.5 WATERING: The Contractor shall apply supplemental watering to the seeded areas to insure proper germination of seed, daily for three weeks.

Irrigation water shall be applied at rates that do not result in appreciable runoff and soil

3.6 GRASS ESTABLISHMENT:

A. If at any time before completion and acceptance of the entire work covered by this Contract, any portion of the surface becomes sullied or otherwise damaged following seeding, the affected portion shall be repaired to meet these Specifications.

B. Reseed and mulch spots or barren areas larger than one (1) square foot not having a uniform stand of grass consistent with the majority acceptable germinated cover as determined by the City. First seeding inspection shall be made 30 days after initial seeding operation.

3.7 CLEANUP: Upon completion of work, remove debris and leave area in clean, acceptable condition. All objects or debris which may interfere with maintenance operations, seed and mulch bags, and other packaging material shall be removed from site. Remove excess mulch immediately from trees, shrubs, and sod to prevent damage to same.

3.8 MAINTENANCE:

A. The maintenance period shall begin immediately after site preparation and seeding of each area and shall continue for two years following final completion in accordance with the following requirements:

1. Protect prepared areas from erosion and traffic.
2. Repair and reestablish grades and reapply soil amendments in settled, eroded, and disturbed areas to specified tolerances and requirements until final acceptance.

B. The Contractor shall be responsible for the maintenance of installed erosion control blankets and the stability of all embankments until final acceptance, and for replacing any portions which have become displaced due to carelessness or negligence or due to damage resulting from natural causes.

C. The Contractor shall notify the City for the final warranty inspection one years following acceptance of completed Contract.

D. Any areas which require reseeding after the final warranty period shall be maintained until establishment and acceptance by the City.

END OF SECTION

SECTION 02920

SOIL PREPARATION

PART 1 - GENERAL

1.01 INCLUDED - Work of this Specification Section generally includes provisions for soil amendments on areas to be seeded, sodded, or otherwise planted as part of earthwork operations.

1.02 RELATED - General and Supplemental Conditions and all of Division One Sections govern and are hereby made a part of the work of this Section.

Section 02810 – Underground Sprinkler System
Section 02821 – Seeding, Fertilizing and Mulching
Section 02930 – Sodding
Section 02950 – Trees, Shrubs and Ground Cover

1.03 DELIVERY/STORAGE/HANDLING - Deliver, unload, store, and handle materials and products in dry, weatherproof, waterproof condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, or vandalism. Deliver materials and products in original unopened packaging containers prominently displaying manufacturer name, proprietary, volume, quantity, contents, instructions, conformance to local, state, and federal law. Remove and replace: cracked, broken, spoiled, or contaminated items; and corrosive elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire or jobsite damage.

A. SOIL ADMENDMENT shall be delivered to site in bulk, measured on volume basis.

B. DELIVERY & INSPECTION - Notify City Representative of delivery schedule in advance so material may be inspected upon arrival at jobsite. Unaccepted material shall be removed immediately from jobsite.

PART 2 - PRODUCTS

2.01 SOIL AMENDMENTS:

A. Provide the following in all areas:

1. Shredded or pulverized manure at least one year old, low in mineral and woody material; shall be windrowed, heated to a minimum of 1450 F and contain a minimum of one million parts of active soil bacteria per cubic inch; shall contain not less that 50% decomposed organic matter by weight, calculated on an oven-dry basis; shall have an acidity in range of pH 7.0 to 8.0; shall not have an objectionable odor wet or dry; and shall meet following mechanical analysis:

	% PASSING	% RETAINED
(5cm) screen	100	0
1" (2.5cm) screen	90 - 100	0 - 10
1/2" (1.3 cm) screen	50 - 100	20 - 50
#100 mesh sieve	0 - 15	85 - 100

2. CONTRACTOR shall provide following information:
   a. SPECIFIC LOCATIONS from which soil amendment was obtained.
   b. PRESENT OWNER(S) of those properties.
   c. APPROXIMATE AMOUNTS of material available.
   d. TEST RESULTS showing mixture of composition and analysis.
   e. LOADING TICKETS showing amounts of soil amendment delivered to the site.

3. TESTS shall be by qualified soils laboratory, in accord with accepted soils amendments testing procedures, and shall be at Contractor expense.

B. CHEMICAL FERTILIZER - Tripple Super Phosphate in following chemical composition as approved by Landscape Architect:
   1. SOD AREAS
      a. NITROGEN - 0%
      b. PHOSPHOROUS - 46%
      c. POTASH - 0%

PART 3 - EXECUTION

3.01 PREPARATION & TILLING OF SOD AND SEED AREAS - Upon completion of finish grading, soil surface shall be loosened by rototilling to minimum depth of 6", and materials over 2" in diameter shall be removed. Spread soil amendment evenly over area at a rate of 4 cy/1,000 s.f. and mix thoroughly into soil surface to minimum depth of 6" by means of rototiller or soil mixer (rippers, discs, chisel plows, are not acceptable). After completion of proceeding, spread chemical fertilizers evenly over surface at rate of 15 lbs/1000 sf. and lightly mixed into soil. Surface shall then be finish graded to appropriate elevations and compaction. (Refer to SUBSECTION 02950 for use of soil preparation in tree and shrub plantings.)

3.02 PREPARATION OF PERENNIAL/ANNUAL BEDS - Loosen soils as above, in 3.01. Spread 3" of the approved soil amendment or peat moss (Aspen humus is not to be used as a soil amendment for perennial/annual beds) and mix thoroughly into the soil surface to a minimum depth of 6" as in 3.01 above.

END OF SECTION

SECTION 02930

SODDING

PART 1 - GENERAL

1.01 INCLUDED - Work of this Spec Section generally includes provision for turf grass sod in areas indicated on the landscape drawing(s).

1.02 RELATED - General and Supplemental Conditions and all of Division One Sections govern and are hereby made a part of all work of this Section.
Section 02810 – Underground Sprinkler System
Section 02821 – Seeding, Fertilizing and Mulching
Section 02920 – Soil Preparation
Section 02950 – Trees, Shrubs and Ground Cover

1.03 QUALITY ASSURANCE - Materials, items, accessories, manufacturers, processes, proprietary, are listed in Part 2 - PRODUCTS (and Part 3 - EXECUTION) of this Specification Section.

A. QUALITY OF MATERIALS - Sod materials shall be subject to inspection and approval by the City. Rejected sod material shall be replaced at the Contractor's expense.

1.04 REFERENCES - Comply with requirements of manufacturer, codes, specifications, and standards cited in this Specification Section, except where more stringently shown or specified, comply with the construction documents.

A. STANDARDS - U.S. Department of Agriculture Rules and Regulations under Federal Seed Act and equal quality to standards for Certified Seed.

B. Cut sod using an approved method, in accordance with local governing American Sod Producers Association.

1.05 SUBMITTALS:

A. CERTIFICATES OF INSPECTION FOR MATERIALS - State, Federal, or other inspection certificates shall accompany invoice for materials showing source or origin. File with General Contractor prior to acceptance of material.

B. MAINTENANCE INSTRUCTIONS - At completion of work, furnish three copies of written maintenance instructions to General Contractor for maintenance and care of installed sod through its full growing season. Maintenance will be responsibility of Sodding Contractor until final acceptance of project. Owner will take over maintenance after that date.

1.06 PRODUCT DELIVERY/STORAGE/HANDLING:

A. Deliver sod properly loaded on vehicles and protected from exposure to sun,

wind, heating, in accord with standard practice and labeled in accord with Federal Seed Act.

B. CHEMICAL FERTILIZER - Deliver chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to State Law, bearing name and warranty of producer.

C. SOD ROLLS shall not be dropped from loading carts, trucks or sod pallets. Sod damaged in transit or storage will not be accepted. Notify General Contractor of delivery schedule in advance so material may be inspected upon arrival at jobsite. Unacceptable material shall be removed immediately from jobsite.

1.07 JOB CONDITIONS - Sodding Contractor shall be responsible for proper repair of lawn watering system, other underground pipe or electric wiring damaged by operations under this Section. Repairs will be made by contractors designated by the General Contractor with cost being charged to contractor responsible for damages.

A. DAMAGED AREAS shall be repaired to re-establish grade and condition prior to sodding.

B. SOD DESTRUCTION - Responsibility for vandalized sod will be determined per PLANT MAINTENANCE AND ACCEPTANCE, PART 3, Section 02950. Sodding Contractor shall install barriers for proper protection and traffic control.

1.08 GUARANTEE - Sod shall be guaranteed for one growing season to be in a healthy, vigorous growing condition. During guarantee period, sod areas that die due to natural causes, or that are in General Contractor's opinion, unhealthy, shall be replaced at once, and at expense of the Sodding Contractor. Such replacements shall be installed as originally specified and guaranteed.

PART 2 - PRODUCTS

2.01 SOD/FERTILIZER:

A. SOD shall be Colorado grown:

65% tall fescue (3 varieties)
25% smooth brome
10% bluegrass (2 varieties)

1. SOD SHALL HAVE VIGOROUS ROOT SYSTEM, been regularly fertilized, watered, mowed, free of weeds and objectionable grasses, and provide a thick turf. Note supply source and mixture on Bid form. Each piece of sod will have a sandy-loam soil base that will not break, crumble or tear during sod installation. Sod shall be cut in strips 18" (50cm) wide, with a soil base not less than 5/8" (1.75cm), nor more than 3/4" (2cm) thick. Sod shall be cut no more than 24 hours prior to delivery, kept damp on pallets at the site, and laid in place within 24 hours of delivery.

B. CHEMICAL FERTILIZER - Inorganic mixture with following chemical composition:
   1. NITROGEN - 18%.
   2. PHOSPHOROUS - 46%.
   3. POTASH - 0%.

PART 3 - EXECUTION

3.01 PREPARATION:
   A. LAYOUT of sodded areas is indicated on landscape drawing(s). Sodding Contractor shall verify locations on-site prior to starting operation.
   B. PREPARATION - Sodded areas shall be free of debris, and/or rocks larger that 1" which may hinder tilling, sodding, finish grading or subsequent operations. Sodding Contractor shall perform finish grading required by drawings, to maintain drainage into catch basins, drainage structures, etc., and to provide a smooth, well-contoured surface prior to proceeding.
      1. FINISH GRADES - It shall be Sodding Contractor's responsibility to assure finished grades of sod are such that drainage of storm and irrigation waters will occur and ponding of water will be prevented.
      2. IRRIGATION HEADS will be adjusted to proper watering height according to depth of the sod material but lower than compacted grass blade height to enable lawnmowers to freely cut grass without damage to sprinkler system.
      3. BASE PREPARATION - Soil shall be prepared in accordance with Spec SUBSECTION 02920 (Soil Preparation).
   C. TILLAGE - Sodded areas shall be thoroughly tilled to an average depth of 6" by plowing, harrowing, or disking until soil is sufficiently pulverized. Work shall not be performed when conditions will not provide satisfactory results.

3.02 FERTILIZING - Distribute chemical fertilizer uniformly at rate of 1 lb. per 1,000 sq. ft. Fertilizer shall be distributed 30 days after installation.

3.03 SODDING - Soil on which sod is laid shall be lightly moist, sod ends and sides shall be butted tightly together, laid with longest dimensions parallel to contours and continuous rows. Vertical joints between sod strips shall be staggered, and the sod shall be compacted by rolling so it will be incorporated with ground surface insuring tight joints between adjacent pieces. All rows terminating on designated property lines will be cut equal to a straight line. Topsoil shall be added along exposed edges to match adjacent grade. Feather topsoil out approximately 1' from edge of sod. Sod shall be laid flush with adjacent walks, curbs, etc.
   A. Secure sod on slopes of 3.5:1 or more with wood pegs as required to prevent slippage.

3.04 WATERING - Sod shall be initially watered upon completion of convenient work areas until installation is complete and irrigation system can be operated under full control. Water sod sufficiently to moisten subsoil at least 2" deep, in a manner not to cause erosion or damage to adjacent finished surfaces.

3.05 MAINTENANCE & ACCEPTANCE - Maintenance period shall begin immediately after each area is sodded, and continue until final acceptance of landscaping work. During this time Sodding Contractor shall be responsible for watering, mowing, spraying, weeding and related work as necessary to insure that sodded areas are in vigorous growing condition until final acceptance. The City shall direct Sodding Contractor on what sod areas need to be replaced during this period.

3.06 CLEAN-UP - Pallets, unused sod, and other debris shall be removed from site, and paved areas over which operations have been conducted shall be cleaned.

END OF SECTION

SECTION 02950

TREES, SHRUBS AND GROUND COVER

PART 1 - GENERAL

1.01 INCLUDED - Work of this Spec Section generally includes provision for trees, shrubs, ground covers, and non-plant materials required to complete installation of planting indicated on landscape drawing(s).

1.02 RELATED - General and Supplemental Conditions and all of Division One Sections govern and are hereby made a part of all work of this Section.
Section 02810 – Underground Sprinkler System
Section 02821 – Seeding, Fertilizing and Mulching
Section 02920 – Soil Preparation
Section 02930 – Sodding

1.03 QUALITY ASSURANCE - Materials, items, accessories, manufacturers, processes, proprietary, are listed in Part 2 - PRODUCTS and Part 3 - EXECUTION of this Spec Section.

A. INSPECTION & APPROVAL - The City reserves right to reject at any time or place prior to final acceptance of the installation, any materials and plants which, in his opinion, fails to meet specifications. Inspection of plants are primarily for quality, size and variety, but other requirements are not waived even though visual inspection results in approval. Plants may be inspected where growing, but inspection at place of growth shall not preclude the right of rejection at site. Rejected plants and other materials shall be promptly removed from site.

B. TIME OF PLANTING - Landscape Contractor shall inform City three days prior to commencement of planting; thereafter planting operations shall be continued during favorable weather conditions. Planting may be conducted under unseasonable conditions, without extra compensation on full responsibility of Landscape Contractor.

1. No planting is to be done after November 1st without approval of Landscape Architect.

C. The work of this section shall be performed by an experienced landscape contractor having not less than five years successful experience in landscape projects of similar size and scope as this project.

1.04 REFERENCES - Comply with requirements of manufacturer, codes, specifications, standards, cited in this Spec Section, except where more stringently shown or specified comply with construction documents.

A. STANDARDS - Plants shall be first-class representatives of the specified species or variety, in healthy condition with normal well-developed branch and root

systems, free of objectionable features, and shall conform to requirements of USDA Standard for Nursery Stock, AAN Standardized Specifications, The American Joint committee on Horticulture (AJCH) (plant names shall meet standards of AJCH), the American National Standard Institute (ANSI) (nursery stock shall meet ANSI standard specifications), and Colorado State Nursery Act of 1965. Landscape Contractor shall be responsible for certificates of inspection of plant materials that may be required by Federal, State or other authorities to accompany shipments of plants.

B. DRAWINGS - Plant list quantities are provided as a convenience only. It is the responsibility of the Landscape Contractor to bid and install the plan as shown.

1.05 SUBMITTALS:

A. CERTIFICATES OF INSPECTION FOR PLANT MATERIALS - State, Federal or other inspection certificates shall accompany invoice for plant materials, showing source or origin and shall be filed with Landscape Architect prior to acceptance of material.

B. MAINTENANCE INSTRUCTIONS - At completion of work, furnish three copies of written maintenance instructions to the City for maintenance and care of installed plants through their full growing season. Maintenance will be responsibility of Landscape Contractor until final acceptance of project.

C. GUARANTEE - At completion of work, furnish written guarantee to Landscape Architect based upon requirements of PLANT GUARANTEE REPLACEMENT, PART 3, of this Section.

D. SAMPLES of wood chip mulch, rock mulch, cobble mulch, protective loops, tree wrapping materials, weed control fabric, and any other products or materials called out in this Spec Section shall be submitted to the City.

1.06 PRODUCT DELIVERY/STORAGE/HANDLING:

A. DELIVERY:

1. FERTILIZER - Deliver to site in original unopened containers bearing manufacturer guaranteed chemical analysis, name, trade name, trademark and conformance to Local, State and Federal Laws.
2. PLANTS shall be containerized or balled and burlapped, properly pruned and prepared for shipping in accord with recognized standard practice. Root system shall be kept moist and plants shall be protected from adverse conditions due to climate and transportation between the time they are dug and actual planting.
3. IDENTIFICATION - Each plant shall be identified by means of grower's label affixed to plant. Grower's label shall give data necessary to indicate conformance to specifications. Use durable waterproof labels with water resistant ink which will remain legible for at least 60 days. Notify City prior to delivery of plant materials to site so that pre-planting inspection may be made or indicate delivery schedule in advance so plant material may be

inspected upon arrival at job site, whichever is more appropriate.

4. UNACCEPTABLE PLANT MATERIALS - Remove immediately from job site.

B. STORAGE - Deliver balled and burlapped stock direct from nursery. Plants not planted within four hours shall be heeled-in with provisions for watering.

C. HANDLING - Do not drop plants. Do not lift plants by trunk, stems or foliage. Ball of plant shall be natural, not made, and plant shall be handled by ball. No plant shall be accepted if ball is broken or trunk is loose in ball or the root ball is not fully formed.

1. PROTECTION - Plants shall be protected from drying out or other injury. Minor broken and damaged roots and branches shall be pruned before planting. Major damage shall be cause of rejection as determined by Landscape Architect.

1.07 JOB CONDITIONS - Landscape Contractor shall be responsible for proper repair of lawn watering system or other underground pipe or electrical wiring damaged by operations under this Section. Repairs will be made by appropriate Contractors designated by the City with fair cost being charged to the Landscape Contractor.

A. PLANT DESTRUCTION – For City Contracts, Landscape Contractor shall inform the City in writing if special tree protection and traffic control must be installed to protect planting from damage after the City assumes responsibility for maintenance.

B. PLANT RELOCATION - If plant relocation is necessary due to interference with irrigation heads, existing plant material, underground piping or wiring, Landscape Contractor shall notify the City and receive approval of a new location.

C. ADJACENT WORK - No planting work shall commence until the adjacent walk improvements, drainage improvements, irrigation installation except for drip systems, and finish grading is completed. If requested, the irrigation system shall have been tested in the presence of the City Representative, and be in operating order prior to any planting.

D. CONFIRMATION OF ORDERS - Within ten (10) days after the execution of the contract, the Landscape Contractor shall furnish the City with copies of the supplying nurseries' confirmation of the Landscape Contractor's orders for all plant materials required by the plans and specifications. The plant materials shall also have been tagged and available for inspection.

E. UTILITIES - Prior to the preparation of planting area, the Landscape Contractor shall ascertain the location of all electrical cables, all conduits, all utility lines and supply lines so that proper precautions may be taken not to disturb or damage any subsurface improvements. In the event any are uncovered, the Landscape Contractor shall promptly notify the City who shall arrange to relocate the plant material, if possible.

F. STRUCTURES - The Landscape Contractor shall take all necessary precautions

to avoid damage to any wall or structure while installing planting. The Landscape Contractor shall be responsible for damage to any wall or structure caused by his operations.

PART 2 - PRODUCTS

2.01 PLANT MATERIAL/BACKFILL/INSTALLATION/MULCH:

A. PLANT LIST - Planting and materials list indicated on drawing sheets are a part of the Specifications. Plants shall be kind and sizes specified in that list. Quantities listed are for convenience only and not for bidding purposes, the Landscape Contractor is to bid and install the landscape per the Drawings.

B. SIZE - Minimum acceptable sizes of plants measured before pruning with branches in normal position, shall conform to measurements as specified in plant list furnished. Larger plants than specified may be used at no additional cost to the Owner.

C. SOURCE:

1. HARDINESS ZONES - Shrubs grown in Hardiness Zones 2, 3, 4 and 5 only will be accepted. Hardiness Zones are defined in US Department of Agriculture publications. Grower's certificates may be required when doubt exists as to origin of plant material.
2. NURSERY GROWN - Plants shall be nursery grown. The term "nursery grown" shall include gathered native plants and imported plants that have been growing in a nursery for a minimum of one growing season. Plants shall have been root-pruned during their growing period in nursery in accord with standard nursery practice. Ground cover plants are excluded from one-year minimum. Evergreen trees may be excluded from the one-year minimum.

D. PROCUREMENT - Entering of a proposal and execution of a contract will be construed as evidence that Landscape Contractor has made successful procurement arrangements for plant materials as specified.

E. TREES AND SHRUBS:

1. TREES shall be supplied and installed by Landscape Contractor.
2. SHRUBS shall be supplied and installed by Landscape Contractor in suitable containers as indicated.
3. GROUND COVERS AND PERENNIALS shall be supplied and installed by the Landscape Contractor.
4. ANNUALS shall be supplied and installed by the Owner.

F. INSECTS, PESTS & PLANT DISEASES - Plants shall be healthy, free of diseases, insects, their eggs, larvae or parasites of any objectionable or damaging nature.

2.02 PLANT BACKFILL MATERIAL:

A. PLANTING MIX - Use one part soil amendment as per Spec SUBSECTION 02920, two parts existing soils; thoroughly blended to a consistent mixture.

B. EXISTING SOILS - Use soils stockpiled on site, free from toxic substances, sticks, debris, vegetation and stones over 1" (2.5 cm) in maximum dimension.

C. CHEMICAL FERTILIZER - Use 21 gram Agriform planting tablet with NPK Analysis 20-10-5 or approved equivalent.

2.03 METAL EDGING - 14 gage steel edging in 10' lengths with 18" U-shaped steel pins as supplied by the manufacturer.

2.04 MULCH:

A. ROCK MULCH in Shrub Beds shall be 1 1/2" "Gold Ore" rock. Mulch shall be free of soil, stoned, sticks, debris or other foreign matter. Submit sample for approval.

B. MULCH in Perennial Beds shall be 1/2" x 1/2" x 4" fibrous wood mulch tightly packed to match Interlocken Park standard wood mulch.

C. BUILDING ZONE MULCH shall be a grey crusher fine. Submit sample for approval.

2.05 TREE WRAPPING MATERIALS shall be first quality 4" wide Bituminous impregnated tape, corrugated or crepe paper, brown in color, specifically manufactured for tree wrapping and having qualities to resist insect infestation.

2.06 STAKING AND GUYING MATERIAL:

A. STAKES shall be 6' x 2" diameter pointed CCA treated lodge pole tree stakes as supplied by Direct Landscape Supply, Littleton, Colorado, (303) 797-7733 or approved equivalent.

B. PROTECTIVE LOOPS shall be grommeted 1-1/2" or 2" nylon strapping of sufficient length to avoid contact of wire or grommets with the trunk of the tree, and of a composition durable enough to last two years. Ends shall be heat sealed to prevent fraying.

C. GUY WIRE shall be 2-strand, twisted pliable, pliable galvanized iron wire, not lighter than 12 gauge, with twist ties for tension.

2.07 WEED CONTROL FABRIC shall be "Mirafi 140N" Typar Style 3401 by Dupont, Dewitt "Weed Barrier" spunbonded, nonwoven polypropylene fabric (4 oz/s.y.) or approved equivalent.

PART 3 - EXECUTION

3.01 INSPECTION - Verify grades established prior to beginning planting operations. Areas to be planted shall be brought to lines and grades designated or approved. Landscape Contractor shall place plant material according to planting plans or as directed by the City. Approval of plant locations shall not constitute approval of grades.

3.02 INSTALLATION:

A. TREES shall be located as per plan.

B. POSITIONING PLANTS - Shrubs are to be planted as indicated on the drawings. Shrubs and trees are to be placed in position prior to planting, as per drawing(s), for final acceptance as to location by the City.

C. PLACING PLANTS - Planting shall be done in accord with good horticultural practice of region. Plants of upright growth shall be set plumb and plants of prostrate type shall be set normal to ground surface. Plants are to be faced to give best appearance with relationships to surroundings.

D. EXCAVATION OF PLANTING PIT - After preparation of soil and/or planting areas, the plant pit shall be excavated in a cylindrical shape with vertical sides and flat or saucer-shaped bottom. Diameter of plant pit shall be at least twice the spread of ball or container. Plant pits shall be excavated below finish grade as required to accommodate the ball. Refer to planting details.

E. CHEMICAL FERTILIZER - Insert tablets in planting pit 6" to 8" deep spaced evenly around root ball. Apply tablets at the rate suggested in the manufacturer's specifications for the size of plant being installed.

F. ROOT CARE - Do not remove protective wrapping of root ball or bare roots until plant is positioned accurately in planting pit. Extreme care shall be taken to prevent breakage of root ball and roots. After plant is positioned, REMOVE WIRE AND THE TOP TWO-THIRDS OF THE METAL BASKET, burlap and twine from root system; root balls and root crown shall be placed as shown on details for either a flat or sloping grade and allowance shall be made for root ball settling in planting pit.

G. PRUNING AND WATERING - Plant material shall be pruned only to remove dead, injured or lower branches. All cuts shall be made flush, leaving no stubs. All trees and shrubs shall be watered immediately after planting, staking and guying. All planting shall be watered the same day it is planted.

H. STAKING AND GUYING:

1. For all the trees, the Landscape Contractor shall drive stakes vertically into firm soil outside the plant pit (for metal tree stakes, place the blade on tree side). The Landscape Contractor shall run a double strand of wire through one grommet in the strap, wrap the strap around trunk at maximum one-half height of tree, and run wire through other grommet and back to stake. Strap and wire attachment between the stake and tree shall be adjusted so that straps are under just enough tension to avoid visible sag in lines. Rigid guying shall not be accepted. Straps and wires shall be placed so as to be perpendicular to the trunk. Stakes shall be parallel or slightly angled away from the trunk.
2. Landscape Contractor shall place stakes according to tree height or caliper as follows: deciduous trees under 2 inches - one stake oriented northwest; deciduous trees larger than 2 inches but less than 3 inches and evergreen trees less than 5 feet in height - two stakes oriented northwest and southeast; deciduous trees 3 inches and larger and

evergreen trees 5 feet and larger - three stakes with on oriented northwest and the other two oriented 120o in either direction from northwest. All trees shall have a sod-free base per 3.03 B, below. This sod free area shall be extended where necessary to include all stakes. The Landscape Contractor shall return to the site and remove stakes on all deciduous trees smaller than 2 inches in diameter between May 21 and June 7 the following spring unless instructed otherwise by the City.

I. All deciduous trees planted from April 1 to November 1 shall be wrapped by the Landscape Contractor between November 1 and November 15 of the year in which they are planted. Specified tree wrap shall be cut in a continuous strip of sufficient length to wrap the tree. This wrapping shall begin at the ground line with overlapping wraps of 1-1/2 inches terminating above the lowest main branch of the tree. Final wrap shall be secured with tape in a minimum of three places. The Landscape Contractor shall return to the site and remove wrap between May 21 and June 7 the following spring.

3.03 MULCHING:

A. MULCH -

1. Mulch shrub beds and building zone as designated on landscape plans to a depth of 4" with the specified mulch. Ground cover, perennial and annual beds are to be mulched to a depth of 2".
2. Plant masses in turf areas are to be mulched as a group whenever possible. Where plant spacing exceeds 5' o.c., or 3' between evergreen tree driplines, mulch plants individually per 3.03, B below.

B. ALL TREES in lawn areas shall be mulched with the specified wood mulch to a depth of 4". Tree rings shall be free of all grass and weeds and shall be 2' in diameter for deciduous trees and to the dripline for evergreen trees unless otherwise noted.

3.04 WEED CONTROL FABRIC - Install the specified weed control fabric under mulch in all shrub beds and building zones per manufacturer's recommendations. Ground cover, perennial and annual areas do not receive weed control fabric.

3.05 METAL EDGING - Install metal edging around shrub beds as shown in the Drawing(s). Shrub masses in turf areas do not receive metal edging. Provide a spade dug edge for these beds.

3.06 PRUNING:

A. NEW PLANT MATERIAL - Prune minimum necessary to remove injured twigs and branches, deadwood and suckers. Any damaged or dead roots or branches shall be pruned back to, and slightly above, nearest healthy side bud, but at an angle from remaining portion not exceeding 45 degrees. Evergreens shall have only damaged or dead foliage and/or branches trimmed. Leaders will not be

pruned.

B. HOSE DOWN PLANTING AREAS with a fine spray to wash the leaves of the plants.

3.07 PLANT MAINTENANCE & ACCEPTANCE - Maintenance period shall begin immediately after plant material is installed and continue until final acceptance of landscape work.

A. FINAL ACCEPTANCE of planting work will be made upon completion of work under this Contract. Plants must be in excellent and vigorous condition. Excessively pruned plants which, in opinion of the City Representative, are no longer excellent representatives of their species shall be replaced prior to Final Acceptance.

3.08 PLANT GUARANTEE REPLACEMENT:

A. For a period of one (1) year after Final Acceptance of all work and at no additional cost to the Owner, the Landscape Contractor is to replace any trees and shrubs that are dead, or that are, in the opinion of the City Representative, in unhealthy or unsightly condition, or that have lost their natural shape due to dead branches or excessive pruning of dead branches. Inadequate or improper maintenance by the Owner shall not be cause for replacement provided the Landscape Contractor inspects site at intervals necessary to assure proper maintenance practices, shall have submitted monthly reports throughout the guarantee period to the Owner, and shall immediately have informed the Owner of any improper or inadequate maintenance practices observed. Adverse site conditions are natural causes for the purpose of this contract. The Contractor shall be required to replace rejected plant material until a replacement lives to the end of the guarantee period.

B. All replacement planting is to be executed within ten (10) days of notice to replace such plants or as agreed to by the City Representative.

C. Replacement plants are to be installed in accordance with the original specifications and its cost considered to be included in the bid price for all City Contracts. All areas damaged by tree or shrub planting or replacement operations are to be fully restored to their original condition as specified.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.1 DESCRIPTION:

A. This section covers cast-in-place concrete, including furnishing materials, transporting, placing, finishing, curing and other appurtenant items of construction.

B. Inform City at least 24 hours in advance of time and places at which Contractor intends to place concrete. All preparation work for concrete placements shall be substantially completed at least 4 hours prior to the scheduled start of concrete placement to allow for the City's review and any necessary corrections.

1.2 QUALITY ASSURANCE:

A. Reference standards.

1. Except as noted or modified in this Section, all concrete materials, transporting, placing, finishing and curing shall conform to requirements of following standard specifications:

a. American Concrete Institute Standards (ACI)

(1) 301 Specifications for Structural Concrete for Buildings.
(2) 304 Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
(3) Committee 304 Placing Concrete by Pumping Methods.
(4) 305R Hot Weather Concreting.
(5) 306.1 Standard Specification for Cold Weather Concreting and 306R Cold Weather Concreting.
(6) 309 Recommended Practice for Consolidation of Concrete.

b. American Society for Testing and Materials (ASTM).

c. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, Section 601 Structural Concrete

B. Contractor shall keep at least one copy of above listed ACI publications, latest edition, in project field office at all times.

C. Any material or operation specified by reference to the published specifications of a manufacturer shall be complied with unless directed otherwise by the City.

D. In case of a conflict between the referenced specifications or standards and this Specification, the one having the more stringent requirements, as determined by the City, shall govern.

1.3 SUBMITTALS: All submittals shall be made in accordance with Section 01300 for City Contracts. Mix designs, shop drawings and catalog information shall be submitted for related equipment and components, in order to show that concrete and items selected and to be installed by the Contractor generally conform with the Contract Documents. Submittal information includes, but is not necessarily limited to the following:

A. Miscellaneous product information.

1. Catalog information and shop drawings for: water stops, admixtures, bonding agents, membrane curing compound, joint sealer, embedded items, non-shrink grout, wedge-type expansion anchors, and other concrete appurtenances.

B. Proposed concrete mix design. (Note: Contractor shall be responsible for fully informing the concrete supplier of all specification requirements regarding the concrete mix before the proposed mix design is submitted.)

1. The proportions of ingredients shall be selected to produce the proper placeability (slump), durability (air content), strength, maximum water-cement ratio and other required properties of Sections 2-1 and 2-2.

The proportion of ingredients shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement by the methods of placing and consolidation employed on the work, but without permitting the materials to segregate or excessive free water to collect on the surface.

2. Prior to commencing concrete work, submit and obtain City's review of certified test reports describing proposed concrete mix design, which shall be prepared in compliance with ACI Standard 301-84, Sections 3.8 and 3.9 with concrete proportions established on the basis of previous field experience or laboratory trial batches, except as modified herein. Test reports shall also include:

a. Fine aggregates - Source, type, gradation, deleterious substances and bulk specific gravity on basis of weight of saturated surface - dry aggregate. ASTM C128.
b. Coarse aggregate - Source, type, gradation, deleterious substances and bulk specific gravity on basis of weight of saturated surface - dry aggregate. ASTM C127.
c. Ratio of fine to total aggregates.

d. Weight (saturated surface dry) of each aggregate per cubic yard.
e. Total water content in gallons per cubic yard.
f. Slump on which design is based (shall be within 2-inch of maximum slump permissible for each mix design).
g. Brand, type and quantity of cement.
h. Brand, type and quantity of admixtures.
i. Water-cement ratio (shall be not greater than specified in Part 2-2).
j. Air content (shall be within 2% of maximum air content permissible).

C. Ready-mix delivery tickets.

1. Submit delivery tickets for each load at time of delivery indicating following:

a. Quantity delivered with Mix Identification Number.
b. Quantity of each material in batch.
c. Outdoor temperature in shade.
d. Time at which water was added.
e. Elapsed time between when water was added and concrete load was in place.
f. Amounts of initial and supplemental water added, including any corrections for water in aggregate. Note: Total water amount shall result in a water/cement ratio not greater than the maximum permissible.
g. Name of individual authorizing supplemental water.
h. Numerical sequence of delivery by indicating cumulative yardage delivered on each ticket.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Cement.

1. Store in weather-tight enclosures and protect against dampness, contamination and warehouse set.
2. Do not use cement that has become caked or lumpy.

B. Aggregates.

1. Stockpile to prevent excessive segregation, or contamination with other materials or other sizes of aggregates.
2. Use only one supply source for each aggregate stockpile.
3. The bottom 6 inches of all aggregate piles in contact with ground shall not be used.
4 Frozen or partially frozen aggregates shall not be used.

C. Admixtures.

1. Store to prevent contamination, evaporation, or damage.
2. Protect liquid admixtures from freezing or harmful temperature ranges.
3. Agitate emulsions prior to use.

D. Rubber and plastic materials.

1. Store in cool place away from direct sunlight.

E. Mixing and transporting ready-mixed concrete.

1. Maximum elapsed time from time water is added to mix until concrete is in place shall not exceed 1 hours when concrete is transported in revolving drum truck bodies. Comply with ASTM C94.

1.5 JOB CONDITIONS:

A. Environmental requirements:

1. Do not place concrete during rain, sleet, or snow unless adequate protection is provided and City's approval is obtained.
2. Do not allow rain-water to increase mixing water or damage surface finish.
3. For cold or hot weather concreting conditions, lab cured cylinder tests may not be an accurate indication of field achieved strengths. Under these weather conditions, the City may require pullout tests in accordance with ASTM C900 Lok-Test, or equivalent, or job cured cylinder breaks to determine field strength (cylinders to be job cured in same manner as the in-place concrete.) Testing shall be paid for by the City. Refer to Section 03300, part 3-10 for related items to be furnished by Contractor. If cold or hot weather concreting practices specified in Sections 1-5.B and 1-5.C are not adhered to, the City may require Contractor, at Contractor's expense, to provide additional pullout tests in accordance with ASTM C900, Lok-Test, or equivalent job cured cylinder tests.
4. Changes in temperature of the concrete shall be as uniform as possible and shall not exceed 5^{o}F. in any 1 hour or 50^{o}F. in any 24-hour period.

B. Cold Weather Concreting. Conform to ACI 306.1"Standard Specification for Cold Weather Concreting" and 306R "Cold Weather Concreting" in addition to this specification.

1. Cold weather is defined as a period when, for more than three consecutive days, the average daily outdoor temperature drops below 40ºF. The average daily temperature is the average of the highest and lowest temperatures during the period from midnight to midnight.
2. Temperature of concrete when placed shall not be less than following:

Minimum Concrete Temp., ºF

Air Temp. ºF	Sections with least dimension Under 12"	12" and Over
30 to 45	60	50
0 to 30	65	55
Below 0	70	60

If water or aggregate has been heated, the water and aggregate shall be combined in the mixer before cement is added. Cement shall not be added to mixture of water and aggregate when the temperature of the mixture is greater than 100ºF.

3. When placed, heated concrete shall not be warmer than 80ºF.
4. Prior to placing concrete, all ice, snow, surface and subsurface frost shall be removed, and temperature of surfaces to be in contact with new concrete, including subgrade materials and massive embedments such as rock and large metallic embedments, shall be raised to a minimum of 35 ºF. and a maximum of 60 ºF. The entire mass of all massive embedments must be raised to this temperature range.
5. Protect concrete from freezing during specified curing period. See Part 3-9, Curing, for temperature to be maintained during initial curing period.
6. When the mean daily temperature of the atmosphere is less than 40ºF., forms shall be left in place a minimum of 5 days to aid in retaining heat.
7. Heated enclosures shall be strong and windproof to insure adequate protection of corners, edges and thin sections.
8. Do not permit heating units to locally heat or dry concrete.
9. Do not use combustion heaters during first 24 hours unless concrete is protected from exposure to exhaust gases which contain carbon dioxide.
10. If air temperatures drop below 35ºF., the Contractor shall install a high-low temperature gauge into the most exposed portion of concrete during the curing protection period. The gauge shall be equipped to register the lowest overnight temperature. If the concrete temperature drops below the specified temperature, the curing period shall be extended until the degree-days (above) are satisfied.
11. Refer to ACI 306 for further requirements.

C. Hot Weather Concreting: Conform to ACI 305R, "Recommended Practice for Hot Weather Concreting@ in addition to this specification.

1. Take precautions when ambient air temperature is 90ºF. or above. These measures may include installation of wind breaks, shading, fog spraying, sprinkling, ponding, or wet covering of a light color.
2. Temperature of concrete when placed shall not exceed 85ºF.
3. Cool forms and reinforcing to a maximum of 90ºF. by spraying with water prior to placing concrete.
4. Do not use cement which has reached a temperature of 170ºF. or more at the time it enters the concrete mix.
5. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.

6. Do not place concrete when evaporation rate (actual or anticipated) equals or exceeds 0.20 pounds per square foot per hour, as determined by Figure 2.1.5 of ACI 305.
7. Set-retarding and water-reducing admixtures may be used with City's approval when ambient air temperature is 90ºF. or above to offset accelerating effects of high temperature.
8. Refer to ACI 305 for further requirements.

D. Protection from Mechanical Injury: During the curing period, the concrete shall be protected from damaging mechanical disturbances particularly load stresses, heavy shock and excessive vibration. All finished concrete surfaces shall be protected from damage caused by construction equipment, materials, or methods and by rain or running water. Self-supporting structures shall not be loaded in such a way as to over-stress the concrete.

PART 2: PRODUCTS

2.1 CONCRETE MATERIALS:

A. Cement shall conform to the "Standard Specification for Portland Cement", ASTM C150, Type II combined. Once cement type is chosen, the type and source shall remain the same throughout the project.

1. Fly ash may be Class C or F, ASTM C618.

B. Aggregates.

1. Fine aggregate - ASTM C33.
2. Coarse aggregate - ASTM C33 Size M67
3. Once aggregates are chosen, the same source and type of aggregates shall be used throughout the project.
4. Do not use fine or coarse aggregate that contains properties that may cause spalling.

C. Water.

1. Shall be clean, fresh and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or reinforcement.

D. Admixtures.

1. Use only as specified or reviewed and acceptable to City.
2. Include any admixtures to be used in the proposed concrete mix designs.
3. Do not use admixtures which cause accelerated setting of cement.
4. Calcium chloride is not permitted.

5. Air-entraining Agent: ASTM C260. Use Procrete AES Air-entraining admixture or equivalent acceptable to City.
6. Water-Reducing and Retarding: ASTM C494. Water reducing admixture shall be added at the plant and shall be Pozzolith 322N by Masterbuilders or equivalent acceptable to City. Use retarders only as specified or with City's approval.

2.2 CONCRETE PRODUCTION:

A. Ready-mixed concrete.

1. Mixed and delivered, ASTM C94.
2. Retempering. Indiscriminate addition of water to increase slump shall be prohibited.

   Concrete shall be mixed only in quantities required for immediate use. Concrete which has partially set shall not be retempered, but shall be discarded.

   When concrete arrives at the project with slump below that suitable for placing, first the concrete shall be remixed for at least one minute at mixing speed; if the slump is still too low, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. The water must be incorporated by additional mixing equal to at least half of the total mixing required. Such addition must be reviewed by the City.

B. Batching and mixing equipment.

1. Conform to "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete," ACI 304.

C. Proportioning.

1. Proportion ingredients to produce a well-graded mix of high density and maximum workability consistent with approved mix design.
2. All concrete shall contain 5 to 8 percent entrained air after the addition of all admixtures.
3. Strength and General Requirements.

   a. Design and proportion concrete to meet the following minimum compressive strengths and other criteria:

Location	Design Maximum Strength 28-Day (PSI)	Required 7-Day Strength (PSI)	Max Slump (Inches)	Minimum Cement Content (Lbs./Yd)	Minimum Fly Ash Content** (Lbs./Yd)	Water Ratio*
Flatwork Concrete	4,000	2,600	4	564	90	0.45
Structural Concrete	4,500	3,000	4	564	100	0.41

*The maximum water-cement ratio by weight, which shall be based on all water in the mix, including correction for moisture in aggregates, shall be based on the total cementitious materials including cement and fly ash.

**Maximum of 15% of total cementitious materials (cement and flyash combined) shall be flyash. Between October 1 and April 1, do not use flyash in slab-on-grade concrete mix and revise the cement content to 700 lb/yd (650 lb/yd for flatwork) due to cold weather curing. Submit mix design for the applicable weather conditions anticipated.

4. Slump.

   a. Keep as low as possible consistent with proper handling and thorough compaction.

5. Mixing - Minimum time.

   a. Central mixed concrete, 1 minute for mixer capacities of one cubic yard or less, plus 15 seconds for each cubic yard or fraction thereof of additional capacity.
   b. Truck mixed concrete, 100 revolutions after introduction of all ingredients.

D Grout: Concrete for the grout shall be an approved batch meeting the following requirements: All concrete shall develop 4,000 psi compressive strength within 28 days, the cement shall be Type II, the stone aggregate shall have a maximum diameter of one-half inch, the slump shall be within a range of 4 to 6 inches, and the entrained air shall be 7 2 percent. Use Procrete AES Air-entraining admixture or equivalent acceptable to City. Maximum flyash content shall be 20 percent of total cementitious material. If "cold weather concrete" conditions exist, flyash will not be permitted. Flyash shall be Class F (ASTM C618). Use stiffer mix or other measures as approved for steeper slope application. The water/cement ratio shall not exceed 0.48. .

2.3 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves of a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.4 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

D. Supports for Reinforcement: Chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.5 EXPANSION JOINT FILLER

A. Sealed Joints: Preformed, compressible fiber or cork filler material complying with ASTM D1751 or D1752, Type II, guaranteed compatible with expansion joint sealant materials, ½" thick unless otherwise indicated. Provide high-impact polystyrene removable "void cap" to create ½" deep reveal for installation of sealant.

B. Self-Sealing Joints: Preformed, compressible asphalt fiber joint filler complying with ASTM D994, ½" thick unless otherwise indicated. Do not use asphalt fiber filler in joints to receive elastomeric joint sealants.

2.6 CONCRETE ACCESSORY MATERIALS:

A. Curing Materials.

1. Sheet material: ASTM C171
2. Liquid membrane: membrane curing compound shall be in accordance with ASTM C309 and shall be non-toxic and suitable for potable water

tanks, where applicable. Membrane curing compound shall be sprayable, 18% minimum solids content, Master Builders MB-429 or equivalent acceptable to City.

B. Non-Shrink Grout: Non-shrink grout shall be "Masterflow 713" by Masterbuilders or "SikaGrout 212" by Sika Corporation, US Grout “5 Star”,or equivalent acceptable to the City. Grouts with iron filings are not acceptable. The grout shall be compatible with the surface to be bonded.

C. Neat Cement Grout: Neat cement grout, where specified, shall be a mixture of Portland cement and water with a water/cement ratio of 0.40 by weight. The cement used shall be of the same type and source as used in the other concrete on this project. The grout shall contain approximately 2500 lbs. of cement and 1000 lbs. of water per cubic yard and shall have a consistency similar to thick paint.

D. Wedge-Type Expansion Anchors: Expansion bolts and anchors fastened to concrete shall be stainless steel; "KWIK-BOL" manufactured by Hilti, Inc., Phillips Red Head wedge anchors, or equivalent acceptable to City.

PART 3: EXECUTION

3.1 INSPECTION:

A. General.

1. Assure that excavations and form work are completed.
2. Assure that dirt, mud, encrusted concrete, debris and excess water has been removed.
3. Check that reinforcement is properly positioned and secured in place.
4. Verify that expansion joint material, anchors, and other embedded items are secured in proper position.

3.2 PREPARATION:

A. General.

1. Remove any hardened concrete and foreign material from inner surface of conveying equipment.
2. Prepare slab subgrades in accordance with ACI 301, Chapter 11.
3. Moisten subgrade prior to placement, but do not cause water to pond, nor muddy or soft spots to appear.
4. Designate limits of each placement and obtain City's approval of entire installation prior to proceeding.

B. Concrete placed against gravel or crushed stone.

1. Prevent loss of water from concrete with a minimum 2-inch layer of material having 25 percent fines passing a # 4 sieve.

C. Concrete placed against rock.

1. Remove all loose pieces of rock.
2. Clean exposed rock surface in accordance with Soils Engineers recommendations.

D. Concrete placed against hardened or existing concrete.

1. Prior to placing fresh concrete against surface of hardened concrete, complete the following:

a. Remove all laitance, foreign substances (including curing compound), wash with clean water, and thoroughly wet hardened surface before placing fresh concrete.
b. Apply epoxy bonding agent at blockouts, cutouts and in locations directed by City.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 PLACEMENT:

A. Conveying.

1. Convey concrete from mixer to final position as rapidly as practicable without segregation or loss of material.

2. Use only metal or metal-lined chutes with maximum length of 20 feet, having a maximum slope of 1 vertical to 2 horizontal, and a minimum slope of 1 vertical to 3 horizontal.

3. Provide a hopper at the end of long-belt conveyors and chutes not meeting the requirements in 2. above.

4. Conveying by pumping methods shall conform to ACI 304, Chapter 9.
    a. Maximum loss of slump, 2-inches.
    b. Do not pump concrete having a slump of less than 2 inches.

B. Depositing.

1. Deposit concrete in a continuous operation until section is completed.
2. Concrete shall be deposited as nearly as practicable to its final position to avoid segregation due to rehandling or flowing.
3. Place concrete in approximately horizontal layers 24-inches maximum thickness.
4. Each layer of concrete shall be plastic when covered with following layer.
5. Provide vertical joints as necessary to comply with these requirements.
6. Maximum height of concrete free fall, 5 feet.
7. Pump concrete or use a tremie having varying lengths for placing concrete in columns and walls to prevent free fall of more than 5 feet.
8. Concrete shall not be dropped through reinforcing steel nor subjected to any other procedure which will cause segregation.
9. Place and consolidate concrete in wall or column forms at least 24 hours prior to the time concrete or any reinforcing steel is placed in the system to be supported by such walls or columns except as noted below.
10. Do not exceed 6 feet of vertical height for any portion of a wall.
11. Allow concrete to thoroughly settle before top is finished.
    a. Remove all laitance, debris, and surplus water from surfaces at tops of forms by screeding, scraping, or other effective means.
12. Overfill forms wherever top of a wall will be exposed to weathering and after concrete has settled, screed off excess.

C. Consolidation.

During and immediately after placement, thoroughly vibrated around all reinforcements, embedments, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness.

3.5 FINISHING EXPOSED SURFACES:

A. Finishing unformed surfaces.

1. Slabs for aprons, slabs-on-grade, top of walls and manhole bases.

    a. Provide surface conforming to proper elevation and contour. Except as noted otherwise on the Drawings, all walks and slabs shall slope ¼-inch per foot away from buildings. All other walks, exterior concrete steps, etc. shall be pitched to drain out with a slope of ⅓-inch per foot. Tops of retaining walls shall be pitched back (into the backfill) ¼-inch per foot, unless designated otherwise by the City. All aggregates shall be completely embedded in mortar by screeding.

(1) Screeded surfaces shall be free of surface irregularities.
(2) Maximum variation from a plane surface in any 10 foot section shall be 3 inch.

2. Finishes.

a. Unless selection of finishes is made in the Specifications or on the Drawings, the following finishes shall be used, as applicable.

(1) Troweled Finish – Use for floors in finished areas and where called for on Drawings.
(2) Broom Finish - Use for concrete stairs, landings, sidewalks, concrete path, curb and gutters.

b. The following finishes shall be utilized on this project unless specified or detailed otherwise.

(1) Broom Finish:
Slabs shall be given a coarse transverse-scored texture by drawing a broom across the surface. This operation shall follow immediately after floating operations specified above for floated finish. Provide a uniform abrasive texture of constant color. On paths, broom at right angles to normal traffic direction.

3.6 REPLACEMENT, REPAIRING AND PATCHING OF DEFECTIVE CONCRETE:

A. Removal and replacement of defective concrete

1. After forms have been removed, any concrete which is not formed as shown on the Drawings, is out of alignment or level beyond the required tolerance, or which shows a defective surface which cannot be properly repaired or patched or which cannot be shown to prevent water migration through concrete surfaces or joints (where applicable) shall be removed and replaced at the Contractor's expense.
2. Concrete walls, slabs, beams, etc., cannot have any honeycombing, cold joints, cracks greater than 0.1 mm wide, or leakage (where a watertest is specified) of water through the concrete thickness or joints. If in the opinion of the City the honeycombing, cold joints, cracks or leakage are excessive, the Contractor shall be required to remove the complete concrete pour and replace it. Where minor honeycombing, cold joints, cracks or leakage occurs, it shall be repaired as indicated in Part 3-7.B and C below.

B. Repair of tie holes, blockouts, cutouts and defective concrete.

1. Immediately after form removal, repair, to the satisfaction of the City, all repairable surface defects, including tie holes, in concrete surfaces. In all

cases, repair work shall be completed within 24 hours of removal of the forms.

2. Replace, to satisfaction of City, within 48 hours after adjacent forms have been removed, all other honeycombed and defective concrete areas which cannot be immediately repaired as noted in item 1 above.
3. Cut out and remove to sound concrete, with edges square cut to avoid feathering, all honeycombed or otherwise defective concrete.
4. Repair work shall conform to Chapter 9, ACI 301 and these specifications. At all blockouts, tie-holes and cut-outs, after being thoroughly cleaned, apply an epoxy bonding agent and fill with non-shrink grout, as specified in the materials section of this specification. Color shall be added to match surrounding concrete.
5. Perform in a manner that will not interfere with thorough curing of surrounding concrete. Adequately cure all repair work.

3.7 CURING:

A. General.

1. Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures and shall be maintained without drying at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete. A list of all intended curing methods including a description of materials shall be submitted to the City for review.
2. Initially, the concrete temperature shall be maintained at or above 70ºF. for 3 days or at or above 50ºF. for 5 days. Continue curing as required to achieve the specified 28-day strength. See Part 1-5 Job Conditions for additional information.

B. Keep concrete continuously moist for at least 7 days after placement by use of:

1. Use membrane curing compound as noted below.

C. Membrane curing compound (conforming to ASTM C-309).

1. May be used in lieu of water curing on concrete slabs, walls and other miscellaneous concrete areas where approved by City.
2. Spray apply in 2 coats perpendicular to each other at coverages recommended by manufacturer.
3. Cover unformed surfaces with curing compound within 30 minutes after final finishing.

4. Apply curing compound immediately to formed surfaces if forms are removed before end of specified curing period. Patching of tie holes and defective concrete should be completed during form removal operations and prior to application of curing compound. Curing compound sprayed in tie holes is to be cleaned out before patching tie holes. Forms may be

left in place for all or part of the curing period; wood forms shall be kept wet.

5. Protect compound against abrasion during curing period.

3.8 QUALITY ASSURANCE:

A. Concrete tests for City Quality Assurance – For City Contracts, testing will be performed by an independent testing agency contracted by the City. Contractor shall be responsible for his quality control.

1. Shall be provided by the City for City Contracts, except where noted otherwise in these specifications, and shall be in accordance with the requirements of ACI 301, Chapter 16 - Testing, except as noted or modified in this Section. Test specimens shall be taken by an ACI Certified Concrete Field Testing Technician - Grade 1 in accordance with the "Standard Method of Making and Curing Concrete Test Specimens in the Field," ASTM C31.

a. Strength test.

(1) Mold and laboratory cure five cylinders from each sample.
(2) Test cylinders per ASTM C39 as follows. Test two cylinders at 7 days and two cylinders at 28 days for acceptance. Keep the remaining one as a spare to be tested as directed by City.
(3) The fifth, spare cylinder for each sample may be eliminated after the first several concrete placements of each type of concrete if, in the opinion of the City, test results are consistent and within specifications.

b. Minimum samples.

(1) Collect the following minimum samples for each 28-day strength concrete used in the work for each day's placing:

Concrete Quantity	Number of Samples
50 cubic yards or less	one
50 to 100 cubic yards	two
100 cubic yards or more	two plus one sample for each additional 100 cubic yards

c. Sample marking.
(1) Mark or tag each sample of compression test cylinders with date and time of day cylinders were made.
(2) Identify location in work where concrete represented by cylinders was placed.

(3) Identify delivery truck or batch number, air content, and slump.

d. Slump test.
   (1) Conduct test for each strength test sample and whenever consistency of concrete appears to vary.
   (2) Slump tests shall be made using "Method of Test for Slump of Portland Cement Concrete@ (ASTM C143).

e. Air content.
   (1) Conduct test from one of first three batches mixed each day and for each strength test sample.
   (2) Samples indicating low air contents by the pressure method air content tests in accordance with ASTM C231 shall be verified by the gravimetric method, ASTM C138, and the volumetric method, ASTM C173, before adding additional air entraining admixture in the field.

2. For City Contracts, the Contractor shall provide the following to the City and the Testing Agency at no cost to the City:

   a. Incidental labor required to facilitate testing.
   b. Minimum one day's advance notice when concrete is to be placed.
   c. Storage facilities for concrete test cylinders; including, when necessary, a specially prepared box with high-low thermometer and thermostatically controlled heating devices in accordance with Section 9.2 of ASTM C31 for storage of the cylinders for the first 24 hours after molding.
   d. Materials, samples, and access to materials as required for testing.
   e. Reimbursement of costs for testing and inspection resulting as a consequence of the following:
      (1) Work not in compliance with the Contract Documents.
      (2) Testing requested by the Contractor or Subcontractor such as additional cylinders or pullout tests for early breaks, etc.
      (3) Testing to verify the adequacy of work done, without prior notice, without proper supervision, or contrary to standard construction practice.

3. The use of testing services shall in no way relieve the Contractor of his responsibility to furnish materials and construction in full compliance with the Drawings and Specifications.

B. Acceptance of Concrete.

1. If the 7-day strength tests fall below the 7-day strength deemed necessary to achieve the specified 28 day strength, the City shall have the right to require conditions of temperature and moisture necessary to secure the required strength and may require pull out tests in accordance with ASTM C900 or core tests in accordance with ASTM C-42.

2. Strength level of concrete will be considered satisfactory so long as average of all sets of two consecutive strength test results equals or exceeds specified 28-day strength and no individual strength test result falls below specified strength by more than 500 psi.

C. Failure of Test Cylinder Results.

1. Upon failure of the 28-day test cylinder results, City may require Contractor at his expense, to obtain and test at least three pullout tests or 2-inch diameter cored samples from area in question.
2. Concrete will be considered adequate if average of three pullout or core tests is at least 85 percent of, and if no single core is less than 75 percent of the specified 28-day strength.
3. Upon failure of the pullout or core test results, City may require Contractor, at Contractor's expense, to perform load tests as specified in ACI 318, Chapter 20.
4. In the event an area is found to be structurally unsound, the City may order removal and replacement of concrete as required. The cost of the pullout or core tests, and the load test and the structural evaluation shall be borne by the Contractor.
5. Fill all pullout or core holes as specified for repairing defective concrete.

END OF SECTION

SECTION 03315

FLOWABLE CONCRETE BACKFILL

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section covers all work necessary to furnish and install flowable concrete backfill as trench backfill within the street pavement area and at other locations indicated on the drawings or referenced in the Contract Documents for City Contracts.

1.2 QUALITY ASSURANCE

A. All work shall be performed as specified herein and in accordance with the latest revisions of the following applicable codes and standards.

1. Federal, State and local codes, regulations and ordinances.
2. American Society of Testing and Materials (ASTM)

B. In case of conflict or disagreement between codes, standards, laws, ordinances, rules and regulations or within any document itself, the more stringent condition shall govern.

1. Where work required by the drawings and specifications is above the standard required by local regulations, the work shall be completed as shown and/or specified.

1.3 RELATED WORK

A. Consult all other specifications sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete operational installation.

1.4 SUBMITTALS:

A. Proposed Mix Design:

1. Prior to commencing flow-fill work, submit proposed mix design with certification that the mix design and components comply with the proportions and physical properties of this section.

PART 2 – PRODUCTS

2.1 FLOW-FILL MATERIALS:

A. Cement: ASTM C150, Type II.

B. Aggregates:

1. Fine aggregate: AASHTO M6.
2. Coarse aggregate: AASHTO M43, Size #57 or #67.

C. Water: Shall be clean, fresh, and from a potable source.

D. Admixtures:

1. Air-entraining agent: ASTM C260.
2. Fly ash shall not be used.

2.2 PRODUCTION

A. Flow-fill shall be mixed and delivered in a ready-mixed state.

B. Proportion ingredients to produce a well-graded flowable mix that is consistent with the submitted mix design.

1. Weights shall be based upon aggregates in a saturated, surface dry condition.
2. Air entraining agent shall be used to increase flowability.

C. Proportions: Per cubic yard of concrete

1. Cement : 42 to 50 pounds
2. Sand: 1845 to 1850 pounds
3. Coarse Aggregate: 1700 to 1750 pounds
4. Air Entrainment: 5.0 Ounces
5. Water: Three hundred twenty-five pound (325 lbs) (39.0 gal).
   a. The amount of water shall be such that the flowfill flows into place properly without excessive segregation.

D. Physical Properties:

1. Minimum twenty-eight (28) day compressive strength: One hundred (100) psi.
2. Slump: Six inches (6”) to eight inches (8”).

PART 3 – EXECUTION

3.1 PREPARATION:

A. Install all pipe, fittings, appurtenances, and bedding in accordance with the applicable specification sections or as indicated or shown on the Drawings.

3.2 PLACEMENT:

A. Trench shall be backfilled with flowfill above the bedding elevation to the finished subgrade.

1. Flowfill shall be vibrated to assure voids will not be present in the flowfill or around or under pipe, fittings and appurtenances.

B. Maximum layer thickness for flowfill shall be three (3) feet.

1. Do not place additional layers until the flowfill has lost sufficient moisture to be walked on without indenting more than two (2”).

3.3 ROAD SURFACE REPLACEMENT

A. Do not commence surface work until flowfill has attained sufficient strength to support construction equipment without observable deformation.

B. Excavate excess flowfill to the subgrade elevation.

C. Place base course, gravel surfacing, or pavement in accordance with applicable specifications sections or as indicated or shown on the drawings.

END OF SECTION

SECTION 03411

PRECAST CONCRETE VAULTS

PART 1: GENERAL

1-1. DESCRIPTION: The work required under this Specification consists of furnishing all plant labor and materials, and performing all construction operations in connection with installation and erection of precast concrete vaults, and all related embedded and attached items.

1-2. DESIGN: Precast vaults shall be designed to accommodate H-20 vehicle loads. Concrete shall have a minimum 28-day compressive strength of 4,500 psi, and reinforcing steel shall be of grade 60. The roof slab shall be at least 8-inches thick, and the walls at least 6-inches thick. Wall reinforcement shall have a clear distance of 1 inch from the inner face of the vault.

The design of the walls shall be of sufficient strength to absorb thrust from the pipeline applied at the points or restraint shown on the drawings.

The Contractor shall submit design calculations signed and sealed by an Engineer licensed to practice in the State of Colorado, shop drawings showing details of construction, and a certification that the design of the vault has been approved by the City of Federal Heights.

1-3. OPENINGS AND PENETRATIONS: Openings shall be provided as shown on the Drawings, and may be cast or core drilled; percussion drilling shall not be used. Pipe openings shall be of sufficient diameter to accommodate the pipe and sealing grout. The roof opening(s) shall have additional reinforcement, set at 45^{o} from the edges of the vault and extending 2 feet beyond the opening(s); and shall be sized to accommodate the specified ring and cover. Openings for tie rods shall provide a minimum of 1-inch clearance between that opening and the opening for the pipe.

PART 2: MATERIALS

2-1. Vaults. Vaults shall be Meter Vaults by Amcor Precast or approved equal.

2-2. Concrete Grade Rings: Precast concrete grade adjustment rings shall be used to bring the manhole cover to the correct elevation. These rings shall be not less than 6 inches wide and furnished in heights to allow for 1-inch adjustment. Total adjustment height, with grade rings and casting shall not exceed 12 inches.

2-3. Anchors. Anchors shall be epoxy type with all stainless steel metal components. Anchors shall be no less than ½-inch and shall be of sufficient length to extend to the center of the wall or floor.

2-4. Manhole Steps. Manhole steps shall be of grade 60 reinforcing steel coated with polypropylene as anufactured by M.A. Industries of Peachtree, Georgia. A tapered pin, or mandrel, shall be cast into the wall for the M.A. step, or the step shall be cast in place. The mandrel shall be of the dimension and material recommended by the step manufacturer. Steps shall not be inserted into vault walls until they have cured to the strength specified in ASTM C478.

2-5. Access Cover : Access cover shall be 24" diameter Rexus Manhole Cover as manufactured by CertainTeed. Access Cover shall be located such that the Hinge is facing in the direction of traffic.

PART 3: EXECUTION

Vaults shall be installed in accordance with the manufacturer standard recommendations. All joints shall be gasketed so as to form a water-tight seal.

The completed installation shall have a sloping floor to grated sump and vertical walls.

END OF SECTION

SECTION 05500

MISCELLANEOUS METALWORK

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of furnishing and installing all miscellaneous metalwork. This includes the following items:

Structural Steel
Hardware
Galvanizing
Anchor Bolts

1-2 RELATED WORK SPECIFIED ELSEWHERE: Cast-In-Place Concrete - Section 03300.

1-3 QUALITY ASSURANCE: American Society for Testing and Materials (ASTM), American Institute of Steel Construction (AISC), American Welding Society (AWS) and manufacturers recommendations.

1-4 SUBMITTALS: Submit shop drawings for all fabricated components, and handrails. Submit literature for all fasteners, inlet and manhole steps, handrail, and hardware.

PART 2: MATERIALS

2-1 STRUCTURAL STEEL: Structural steel shall meet the requirements of the ASTM Standard Specification for Structural Steel ANSI/ASTM A36. Structural steel tubes shall meet the requirements for ASTM A500.

2-2 HARDWARE: All hardware, including nuts, bolts, chain, and washers shall be cadmium-plated, or zinc plated and chromate sealed and shall conform to ASTM Standard A 325.

2-3 GALVANIZING: Exposed structural and miscellaneous steel items, where called for on the plans, shall be hot dip galvanized in accordance with ASTM A123, A153, and A386 as applicable.

A. GALVANIZE REPAIR PAINT: Use a high zinc dust content paint for regalvanizing welds in galvanized steel, complying with mil spec Mil-P-21035, Galvanox or approved equal.

2-4 ANCHOR BOLTS: Anchor bolts shall be stainless steel, cast-in-place except where shown otherwise on drawings.

PART 3: EXECUTION

3-1 FABRICATION: All fabrication shall be equal to the best practice in modern sheet metal and structural steel shops. Welding shall be performed by a qualified welder, and welds exposed to view shall be ground smooth. After fabrication, all steel items shall be cleaned and prepared for galvanizing.

3-2 HANDLING: Care shall be exercised in the handling and shipping of all miscellaneous metalwork to prevent bending and distortion, scratching, and exposure to the elements.

3-3 INSTALLATION: Installation shall be as shown on the drawings.

END OF SECTION

SECTION 09900

PAINTING

PART 1: GENERAL

1-1 DESCRIPTION: The work to be performed in accordance with the requirements of this Specification consists of furnishing all materials, equipment, supplies, and accessories required and of performing all operations needed in connection with the painting of the various parts of the work.

No paint shall be applied to permanently finished equipment, which is considered to be acceptable by the City. All equipment which arrives on the job site only primed shall be painted in accordance with the appropriate painting system described following. All shop prime coats by equipment manufacturers shall be applied to surfaces as specified herein with paint that is approved and compatible with accepted topcoat paint.

A “Summary of Items to be Painted” under this contract is given in Section 1-5.

1-2 MANUFACTURER'S RECOMMENDATIONS: All paint shall be mixed and applied with strict conformance to the paint manufacturer's directions, which will take precedence over this Specification. Selection of paints to be applied to each specific substrate material shall be verified with the paint manufacturer and his approval obtained.

1-3 MATERIALS SUBMITTAL: The paints to be used on the various substrate materials shall be of the best quality commercial and industrial grades and shall be manufactured by nationally known and approved paint manufacturers with local representation. The Contractor shall submit to the City, in time to allow the City reasonable review time, a minimum of three copies of a Painting Schedule. This Schedule shall give the information listed below for all the paints he intends to use on all items requiring paint. This shall be done for substituted paints as well as those listed in the Painting Systems.

A. Name of the manufacturer of the paint;
B. Generic name of paint (chemical composition type such as alkyd, epoxy, vinyl, etc.);
C. Trade name and number of each specific paint;
D. Number of coats to be applied for each paint;
E. Dry film thickness to be achieved for each coat;
F. Spreading rate at which each coat will be applied;
G. Color name and number accompanied by color chart;
H. Results of accepted tests (ASTM, Fed. Std.) for hardness, abrasion, impact, humidity etc.
I. MSDS Sheets

Paints shall be supplied to the jobsite in unbroken containers on which will be labeled the designated name, formula, or specification number, batch number, color, date of

manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.

With the approval of the City, the field applied primer coat may be omitted when the equipment or material installed has a satisfactory primer coat that is compatible with the top coats. Some paint systems require no primer coat when one or more coats of the paint are used as the topcoat. In these cases, primers will not be required, but only when omitting the primer is in accordance with the paint manufacturer's directions.

1-4 COLORS: The exact colors to be used on the various substrate materials will be confirmed by the City from color charts provided to him by the Contractor as a portion of the Painting Schedule. General colors to be submitted for use on the various materials are listed herein.

Unless specifically instructed otherwise by the City, the following color code shall apply to all piping and equipment connected to it.

Pipe System	Color
Potable Water	Safety Blue

1-5 PAINTING SCHEDULE: A tabular summary of the items to be painted under this contract are listed below. The applicable paint systems are described in Section 2-2.

A. CITY TO MAKE FINAL COLOR SELECTION

Item		Color	Painting System
(1)	Paint all exposed ductile-iron and cast iron piping in all facilities	Piping Color Code	(B1a)
(2)	Paint all exposed miscellaneous metals including piping system supports.	Same as piping system	(B1a)

DO NOT PAINT:

Aluminum materials
Galvanized materials
Stainless Steel materials including piping
Bronze and Brass

PART 2: MATERIALS

2-1 DESCRIPTION: The following are the general painting systems. The Painting Schedule to be submitted by the Contractor shall contain painting systems similar and equal to those listed below, for each substrate category.

2-2 PAINTING SYSTEMS:

A. Miscellaneous Metal Surfaces: Paint shall be similar and equal to that manufactured by Tnemec Company.

(A1) Interior/Exterior - (Polyamide Epoxy)

Surface Preparation: Remove all grease, oils and contaminants. Remove all weld spatters and grind rough and sharp welds to smooth, rounded contour and blast clean to near-white blast finish (NACE No. 2). Surface to be dry.

Paint Name and No.	Dry Mil. Thickness	Spreading Rate
Coat No. 1 Pota-pox Primer 20-1255	4 ± 1	220 sq. ft./gal.
Coat No. 2 Hi-Build Epoxoline 66*	4 ± 1	150 sq. ft./gal.
Coat No. 3 Hi-Build Epoxoline 66*	4 ± 1	150 sq. ft./gal.

*Where in contact with potable water use Series 20, Pota-Pox.

B. Pipe and Fittings: Paint shall be similar and equal to that manufactured by the Tnemec Company.

(B1) All interior ductile and cast-iron, steel pipe and fittings. All interior DIP or CIP, including fittings, shall be painted and shall be supplied with factory prime coat.

Surface Preparation: Remove all grease, oils and contaminants from factory prime coat Surface to be dry.

Use system (A1).

(B1a) Submerged or adjacent to water - Paint system (A1).

PART 3: EXECUTION

3-1 MANUFACTURER'S RECOMMENDATIONS: All paint shall be mixed and applied in strict conformance to the paint manufacturer's directions, which will take precedence over this Specification. Selection of paints to be applied to each specific substrate material shall be verified with the paint manufacturer and his approval obtained.

3-2 SHOP APPLIED PRIME COAT: Any prime coat which shall be shop applied shall meet the requirement stated in this Specification. The manufacturers of such items shall

submit the information required in paragraph 1-3 of this section, for each manufactured item. The Contractor shall coordinate shop prime coat painting and finish coat painting to ensure compatibility.

3-3 SURFACE PREPARATION: Surface preparation of each substrate material shall be as described in the painting systems breakdown and completed prior to beginning the painting operation.

All piping and other metal surfaces to be painted shall be thoroughly cleaned of grease, oil, and contaminants by the use of solvents recommended by the manufacturer of the paint which will be applied. When blasting is required in the surface preparation of a painting system, the blasting shall be performed in conformance to the "Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive" as written by the National Association of Corrosion Engineers, 2400 West Loop South, Houston, Texas, hereinafter referred to as NACE. Blasting shall be accomplished in a manner and with the appropriate grit to limit the depth of finished surface profile to $^{1}/_{3}$ of the dry mil thickness of the paint. Any dust permits required for field blasting shall be obtained by the Contractor.

Acceptance of final blasted steel surfaces will be made by the City utilizing the visual standards test method No. NACE TM-01-70 or an illuminated magnifier comparator (Keane-Tator) to visually compare the specified NACE surface with the steel actually being blasted. NACE standards of quality are called out for each painting system where blasting is required as a portion of the surface preparation. The Steel Structures Painting Council (SSPC) through its specifications recognizes several methods of surface preparation as being equivalent to the NACE standards. The NACE and SSPC standards referred to are:

NACE No. 1:	White Metal Blast	(SSPC-SP5)
NACE No. 2:	Near-White Blast	(SSPC-SP10)
NACE No. 3:	Commercial Blast	(SSPC-SP6)
NACE No. 4:	Brush-Off Blast	(SSPC-PS7)

The Contractor shall continue to blast the surface of the steel until such time as the City is satisfied that the steel being blasted is of a quality equal to the specified NACE grade.

All dust created by the blasting operation must be removed immediately after the blasting operation by vacuuming. The first coat of paint should be applied to the steel as soon as possible and always the same day that the blasting is done.

3-4 APPLICATION METHODS: Exterior painting shall not be done during damp weather when ambient temperature is below 50ºF or when the wind is blowing at a rate greater than 10 mph. Paint manufacturer's directions for cold weather applications shall be followed explicitly. All fresh work shall be protected from damage. For interior work, the temperature shall not be allowed to fall below 50ºF while paint is being applied or while it is drying.

All paint shall be evenly applied in a uniform coat. The finished painting shall show no drops, runs, or sagging of materials.

In addition to preparatory sanding, each coat, except the last, shall be fine-sanded. Avoid cross scratches and swirls.

Each coat of paint shall be given at least 48 hours to dry before the next coat is applied, unless otherwise directed by the manufacturer's instructions.

All metalwork which has been shop-painted with rust-inhibitive prime coat shall be handled with care to preserve such coating. Before painting, the Contractor shall repaint all defective or damaged areas with an approved prime coat after cleaning and removing rust.

On metal surfaces, each coat of paint shall be applied at the rate specified to achieve the minimum dry mil thickness required. In no case shall the stated spreading rate be exceeded. Deficiencies in film thickness shall be corrected by the application of an additional coat(s) of paint. Where conditions are other than normal because of the weather or because painting must be done in confined spaces, longer drying times will be necessary. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry.

Special care shall be taken when painting surfaces in contact with potable water or water in the treatment process so that adequate curing is accomplished. No paint or curing agents shall be used that could impart a taste, odor or discoloration to the water in the process. Manufacturer's instructions shall be strictly followed.

Where thinning is necessary, only the products of the manufacturer furnishing the paint or for the particular purpose, shall be allowed; all such thinning shall be done strictly in accordance with the manufacturer's instructions, as well as with the full knowledge and approval of the City. Where two or more coats are specified, the first coat shall be tinted a shade lighter than the following coat, and progressively shade to the color specified for the final coat, and be subject to approval.

3-5 CLEAN-UP/TOUCH-UP WORK: Upon completion, carefully remove all spatterings of paint material from adjoining work, glass, plumbing fixtures, trim and concrete surfaces. A detailed inspection of paint work shall be made and disfigured portions thereof shall be satisfactorily touched up or refinished to produce an acceptable job. All disused implements of service, rubbish and debris, resulting from the work shall be removed from the premises and the entire project left in a neat, clean, and acceptable condition.

END OF SECTION

SECTION 15000

INTERIOR PIPING AND PLUMBING

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of furnishing all interior piping, fittings, jointing materials and ancillary components; and installing all interior piping, fittings, jointing materials, ancillary components, and City furnished materials. Small piping and valves, floor drains, and all of the work, equipment or materials needed to complete the piping systems as shown on the drawings is included in the work of this specification. Exterior piping materials and their installation are not included.

1-2 RELATED WORK SPECIFIED ELSEWHERE:
Painting - Section 09900.

1-3 QUALITY ASSURANCE: American Water Works Association (AWWA). American National Standards Institute (ANSI).

1-4 SHOP DRAWINGS: Submit in accordance with Section 01300. Shop drawings of piping and equipment with installation details including all dimensions shall be submitted to the City; and shall be approved by the City prior to fabrication, shipment, and/or installation of the components.

PART 2: MATERIALS

2-1 Pipe, Fittings, Flanges and Joints. All interior pipe and fittings shall be flanged unless otherwise noted on the drawings. All flanged ductile-iron pipe shall conform to ANSI Specification A21.15 and, unless otherwise shown on the plans, be faced and drilled to a 125-pound template. Joints in flanged pipe shall have inserted therein red rubber ring gaskets, full face width and not less than 1/8-inch thickness. The exterior surfaces of all ductile-iron pipe and fittings shall be coated with a shop applied prime coat in accordance with Section 09900 of these specifications; and the interior shall be Portland-cement lined in accordance with ANSI Specification A21.4. Exposed pipe, including fittings, shall not be provided with a bituminous coat. Any pipe delivered to the job site with a bituminous coat will be rejected and shall be immediately removed from the job site by the Contractor.

All ductile-iron pipe shall comply to ANSI A21.51 and (unless shown on the drawings) shall be Class 53 except that pipes through concrete or otherwise inaccessible which shall be Class 55. Pipe shall have cement lining. Wall and floor sleeves shall be Class 50.

2-2 Pressure Gauges. The pressure gauges shall be similar and equal to Wika Model 9767096. The gauge shall be 2.5" size, liquid filled, with a pressure range of 0-300 psi and shall be equipped with a piston-type pressure snubber. Each gauge shall include a corporation stop, shut off cock, and brass piping.

2-3 Pipe Couplings. Flanged couplings for ductile-iron pipe shall be similar and equal to Smith-Blair No. 912.

2-4 Pipe Supports. The materials used for pipe support shall be as shown on the Drawings. Pipe supports shall be located as shown on the Drawings. Each fitting, valve or meter shall generally have supports on either side. Pipe manufactures shall approve of the type of support and spacing to prevent local overstressing of pipes. All meters shall be supported in a manner that prevents any loading or stress on the connections. Piping support shall be similar and equal to those manufactured by ITT Grinnell for the following types:

U-Bolts	Figure 137
Machine-Threaded Rods	Figure 140
Pipe Saddle	Figure 264

Steel supports shall be shop primed and painted in accordance with Section 09900 of these specifications.

2-5 Thrust Restraint. Interior piping in vaults shall be restrained at the flanged connections indicated on the drawings. Each flange in new vaults shall be restrained with two Denver Water Board type flange lugs with $^{3}/_{4}$ –inch stainless steel or Cor-Ten all thread rods, four nuts and lock nuts, and two 2 ½" x 2 ½ " x $^{3}/_{8}$" stainless steel plates. Each flange in existing vaults shall be restrained with two epoxy type anchor, two Denver Board flange lugs with stainless steel or Cor-Ten all thread rods, and two nuts.

PART 3: EXECUTION

3-1 General. Piping shall not be installed within 18 inches of walls and ceilings unless otherwise shown on the Drawings.

Provisions for maximum flexibility are not always shown and the Contractor may add flexible joints (i.e., flange coupling adapters, pipe couplings, etc.) where required and approved by the City for convenience of installation. All piping shall be installed plumb and square. Restraining rods may be required where flexible joints are in pressure pipe subject to thrust.

Exposed pipe shall be run parallel with or at right angles to the adjacent walls and floors.

Piping shall be run in a straight grade between elevations shown on the Drawings, except when not possible due to conflict with other facilities. Pipelines carrying liquid shall be installed without high points that could trap gasses or air.

All pipe, fittings, and valves delivered to the work site shall be clearly marked to identify the material, class, and thickness. All material shall be new and free of blemishes.

At locations where metal interior piping connects with metal buried piping, a dielectric or insulating gasket shall be provided.

3-2 Testing and Disinfection of Interior Piping. All piping, fittings and valves that will used for transporting potable water shall be disinfected and visually examined for leaks in accordance with the instructions from the City. In general, disinfection shall comply with AWWA C-651 "Disinfecting Water Mains". All piping, fittings and valves will be visually examined for leaks while subjected to normal operating pressures. In the event the line tested should fail, repairs shall be made and the line retested until it does comply.

3-3 Progress of the Work. All parts of the work in contact with or running through masonry or concrete work shall be installed as required to avoid cutting and unnecessary adjustments. Pipes, inserts, supports, sleeves, and other members shall be incorporated within the structure at the proper time and as required to obtain the best results. Coordination of the work of all crafts involved to accomplish a neat, practical, and efficient installation of all mechanical equipment shall be the responsibility of the Contractor.

3-4 Allowance for Expansion. All lines subject to temperature variations, shall be so installed as to allow free movement to take care of expansion and contraction. Where expansion is taken up by bends in pipelines, the Contractor shall install the line so adequate room is available for movement of the pipelines. Anchorages shall be provided at the proper joints to prevent creeping.

3-5 Installation Through and Within Concrete Structures. Unless otherwise specifically detailed on the Drawings, when a pipe (except copper or wrought steel) passes from concrete to earth or from earth to concrete, a bell and spigot, ringtite, wedgelock, or other flexible type joint or coupling shall be installed within 2′ of structure wall exterior. Particular care shall be taken to secure full support of the pipe in the earth. Where pipes terminate in or pass through concrete sections below finished grade, they shall be set in place in new structure, or a cored opening may be made in the concrete in existing structures. Location of the openings shall be accurately determined, and they shall be of sufficient size to permit passage of flanges and bells and to allow satisfactory grouting and caulking of the opening.

At locations where new pipes are to be installed through core-drilled openings in walls, the space between the pipe and the core-drilled hole shall be filled with non-shrink grout.

3-6 Small Pipe Installation. Not used.

3-7 Large Interior Piping (3" & Larger). All pipe and valves shall be carefully aligned and shall be installed in a neat, workmanlike manner. The bolts in the flange joints shall be drawn up tightly around the flange without overstraining the flanges. All joints must be made watertight. If any joint, pipe, fitting, and valves are found defective upon testing, it

shall be immediately repaired or replaced by the Contractor without cost to the City. Make-up piping and closure pieces shall be sized and measured after equipment selection has been completed and located and all permanent parts of the structure are in place. Couplings may be used when locations are approved by the City Representative. In general, the location of the piping has been fixed on the Drawing, but variations will be permitted to suit the type or make of approved equipment purchased by the Contractor. However, the general plan of fittings and connections is expected to be followed unless variations are approved by the City Representative.

3-8 Pipe Support. All piping, large and small, shall be supported and braced so no weight or load is transferred to equipment or parts of the structure not designed to take the load. All piping shall also be braced or tied together to prevent movement.

The Contractor shall submit to the City his proposed plan for supporting piping, except for pipe supports specifically detailed on the Drawings. Except where shown otherwise on the Drawings, all supports shall be a standard manufactured type. Pipe type floor supports are acceptable for piping up to 4 feet above the floor; however, the supports must be properly anchored and coated. A polyethylene bond breaker shall be installed between the pipe and the concrete. Wall brackets and braces shall be sufficiently anchored to the wall in an approved manner.

3-9 Testing and Cleanup. After each of the systems has been installed, the Contractor shall thoroughly clean all parts of the installation. All equipment, piping, valves, and fittings shall be cleaned of grease, metal cuttings, and other debris. Any flooding, stoppage, discoloration, or other damage to any of the work due to the Contractor's failure to properly install or to properly clean the systems shall be repaired without cost to the City. Following the cleaning, each system shall be completely tested in the presence of the City Representative and to his satisfaction, and all equipment shall be adjusted to operate in the most efficient and satisfactory manner. All lines shall be tested for disinfection and visually examined for leaks. In the event the line tested should fail, repairs shall be made and the line retested by the Contractor at his own expense to the City Representatives' satisfaction.

Requirements for metal surface preparation and painting are contained in Section 09900, Painting.

END OF SECTION