CITY OF SUGAR LAND

Standard Specifications

JULY 2020

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DIVISION 01

SECTION 01 21 00
ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.
5. Testing and inspecting allowances.

C. Related Requirements:

1. Section 01 22 00 “Unit Prices” for procedures for using unit prices.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Owner of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Owner's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Owner from the approved supplier.

1.3 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified by Owner.

1.4 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Engineer under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Engineer, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Engineer for Owner's purposes and only by Field Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

2.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

END OF SECTION

SECTION 01 22 00
UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

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

1.3 PROCEDURES

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

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

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

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

END OF SECTION

SECTION 01 56 26
FENCING FOR EXCAVATIONS

PART 1 - PRODUCTS

1.1 SUMMARY

A. Section includes temporary safety fencing supported on posts and constructed of materials as indicated and removed when excavation is backfilled.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement:

1. Safety fencing to be measured by linear foot of fence measured along ground; gates shall not be measured separately.

B. Payment:

1. Work performed and materials furnished as prescribed by this item, measured as provided under "Measurement", to be paid for at the unit price bid for "Safety Fencing". Price shall include full compensation for furnishing, installing and removing safety fencing and gates, including posts, bands or ties, and for manipulations, labor, tools, equipment and incidentals necessary to complete the work, removal, and patching damaged surfaces.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements previously used materials may be used when approved by Owner.

1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet apart. High-visibility orange color, nonfading.
2. Height of Fencing: 4 feet.
3. Gates: Swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones.

B. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering.

PART 3 - EXECUTION

3.1 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area except by entrance gates. Excavations within 750 ft. of schools or day care centers require special attention by Contractor to secure entry while work is in progress

1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Owner.
2. Access Gates: Install where indicated.
3. Caps to cover T-post tops.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Owner.

C. Maintain protection-zone fencing and signage in good condition as acceptable to Engineer and remove when construction operations are complete and equipment has been removed from the site.

END OF SECTION

SECTION 01 56 39
TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tree and plant protection and maintenance.
2. Planting new trees and relocating and replanting existing trees.
3. Maintenance of planted or replanted trees.

1.2 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:

1. Payment for Tree and Plant Protection will be on a lump sum basis that shall in include all items specified in this section unless payment is specified otherwise in this Section.
2. Payment for Zero Curb Cutback will be on a per linear foot basis.
3. Refer to Section 01 22 00 – Measurement and Payment for unit price procedures.

B. Protection Zone: Area surrounding individual, or as identified in the construction permit

1.3 ACTION SUBMITTALS

A. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1.4 INFORMATIONAL SUBMITTALS

A. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged, as indicated by the City of Sugar Land.

B. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

C. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1.5 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA, licensed arborist in jurisdiction where Project is located.

1.6 PROJECT CONDITIONS

A. Preserve and protect existing trees and plants that are to remain; from damage to foliage, branches, trunk, or roots; that could result from construction operations.

B. Prevent following types of damage:

1. Compaction of root zone by foot, vehicular traffic, or material storage.
2. Trunk damage from equipment operations, material storage, or from nailing or bolting.
3. Trunk and branch damage caused by ropes or guy wires.
4. Root poisoning from spilled solvents, gasoline, paint, and other noxious materials.
5. Branch damage due to improper pruning or trimming.
6. Damage from lack of water due to:

    a. Cutting or altering natural water migration patterns near root zones
    b. Failure to provide adequate watering

7. Damage from alteration of soil pH factor caused by depositing lime, concrete, plaster, or other base materials near roots
8. Cutting of roots larger than 1-1/2 inches in diameter

1.7 DAMAGE ASSESSMENT

A. When a Tree, other than those permitted for removal, are destroyed or badly damaged as result of construction operations, remove and replace with same size, species, and variety. Replace trees larger than 8 inches in diameter with 8-inch diameter tree of same species and variety.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; free of subsoil, clay lumps, gravel, and other.

B. Topsoil: Stockpiled topsoil from location shown on Drawings.

C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by Project Engineer.

1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- OD line posts, and 2-7/8-inch- OD corner and pull posts; with 1-5/8-inch- OD top rails and 0.177-inch- diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
2. Plywood Protection-Zone Fencing: Plywood framed with four 2-by-4-inch rails, with 4-by-4-inch preservative-treated wood posts spaced not more than 8 feet apart.
3. Wood Protection-Zone Fencing: Constructed of two 2-by-4-inch horizontal rails, with 4-by-4-inch preservative-treated wood posts spaced not more than 8 feet apart, and lower rail set halfway between top rail and ground.
4. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet apart. High-visibility orange color, nonfading.
5. Height of Fencing: 4 feet minimum.
6. Gates: Swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones.

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.2 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area except by entrance gates.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.

2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Engineer.
3. Access Gates: Install as needed.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Engineer.

C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by city.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Engineer and remove when construction operations are complete and equipment has been removed from the site.

3.3 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 “Earth Moving.”

B. Trenching near Trees: Where utility trenches are required within protection zones, use appropriate root pruning measures, referenced in section 3.04.

C. Do not allow exposed roots to dry out before placing permanent backfill.

3.4 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots as necessary, when encountered in the field.

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Temporarily support and protect roots from damage until they are permanently covered with soil.
3. Backfill as soon as possible, not to exceed 48 hours, according to requirements in Section 31 20 00 “Earth Moving.”
4. All roots must be removed from site and appropriately discarded within 24 hours.

B. Root Pruning at Edge of Protection Zone: Prune roots by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.5 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as necessary, when encountered field.

1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
2. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
3. Cut branches with sharp pruning instruments; do not break or chop.
4. Do not apply pruning paint to wounds.
5. All limbs must be removed from site and appropriately discarded within 24 hours.

3.6 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

C. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.7 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.8 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Engineer.

1. Have qualified contractor perform the root cutting, branch pruning, and damage repair of trees and shrubs.
2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
3. Perform repairs within 24 hours.
4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by city.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 01 57 23
ENVIRONMENTAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This section describes the required documentation to be prepared and signed by the Contractor before conducting construction operations, in accordance with the terms and conditions of the National Pollutant Discharge Elimination System (NPDES) Permit, as stated in the Federal Register Vol. 57 No. 175, issued by the Environmental Protection Agency on September 2, 1992. The Contractor shall be responsible for implementation, maintenance, and inspection of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other practices shown on the drawings or specified elsewhere in this or other specifications. The Contractor shall review implementation of the Storm Water Pollution Prevention Plan (SWPPP) in a meeting with the City Engineer prior to start construction.

1.2 PRICE AND PAYMENT PROCEDURES

B. Measurement and Payment:

1. Unless indicated in the Unit Price schedule as a pay item, NO separate payment will be made for work performed under this section. Include cost of work performed under this section in pay items of which this work is a component.

PART 2 - EXECUTION

a. A. Texas Construction General Permit (CGP)
b.

1. Construction activities that discharge storm water runoff into or adjacent to any surface water of the state are regulated by the state of Texas under the Construction General Permit (CGP)(TXR150000). The governing agency is the Texas Commission on Environmental Quality (TCEQ). One of the requirements of the Construction General Permit is to develop an SW3P. The purpose of the SW3P is to provide guidelines for minimizing sediment and other pollutants that may originate on the site, from flowing into municipal storm systems, or jurisdictional waters during construction. Construction activities are regulated according to the area of land disturbed as follows:

A. For Large Construction activities, sites that disturb five or more acres, and meet the definition of a primary operator, the following applies:
   - Prepare and implement a SW3P
   - Submit a Notice of Intent (NOI) to TCEQ
   - Post the NOI and Site Notice
   - Submit a copy of the NOI to MS4 Operator

B. For Small Construction activities, sites that disturb at least one but less than five acres, or are part of a larger common plan of development that will disturb at least one, but less than five acres and meet the definition of an operator, the following applies:
   - Prepare and implement a SW3P
   - Post a Site Notice
   - Submit a copy of the Site Notice to the MS4 Operator

C. Sites that disturb less than one acre and that are not part of a larger common plan of development that would disturb one or more acres, are not required to have coverage under the general permit.

2. 2. Refer to the General Permit definitions for Operator and Primary Operator. Additional information on the Texas Construction General Permit can be found at the following link:http://www.tceq.texas.gov/permitting/stormwater/ .

END OF SECTION

SECTION 01 71 13
MOBILIZATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements for governing the mobilization of personnel, equipment and materials at the work site for other contract items that will be performed by the Contractor.

   a. Mobilization shall include, but not be limited to:

      1) Movement of equipment, personnel, material, supplies, etc. to the Work site.
      2) Installation of temporary facilities (when not paid for separately).
      3) Establishment of office and other necessary facilities prior to the initiation of the Work.

2. Cost of the Payment Bond and Performance Bond on the Work that is delayed due to circumstances beyond Contractor's control, a closed construction season or for the convenience of the City of Sugar Land will be considered part of the mobilization item under this Contract.

PRICE AND PAYMENT PROCEDURES

B. Measurement and Payment:

1. Measurement of the Specification Item, "Mobilization", as specified herein as Mobilization Payment, will be by the "Lump Sum", as the Work progresses.
2. The adjusted contract amount as used below is defined as the original contract amount less the lump sum bid for Mobilization and any payments for materials or equipment not yet incorporated in the Work. The Contractor shall submit a lump sum amount for Mobilization Payment.

3. Partial payments of the "Mobilization Payout" shall be as follows:

   a. Upon presentation of a paid invoice for the Payment Bond, Performance Bond and required insurance, the Contractor will be paid that cost from the amount bid for "Mobilization Payment".
   b. The Mobilization of tunnel boring machines, batch plants, or other similar facilities, along with supporting materials and equipment, to the work site or to the vicinity of the Work site will be considered as partial Mobilization under this contract.
      1) The Contractor shall provide a certified statement of his expenditure for the Mobilization and setup of the facility and supporting equipment.
      2) Upon approval by the Engineer or designated representative, the certified expenditure will be paid from the amount bid for the Specification Item, “Mobilization Payment”.
      3) In no case shall the combined amount for all of these facilities be more than 10 percent of the “Mobilization Payment" lump sum bid or one (1) percent of the total contract amount, whichever is less.
   c. When one (1) percent of the adjusted contract amount is earned, (50) percent of the "Mobilization Payout” will be paid.
   d. When twenty (20) percent of the adjusted contract amount is earned, seventy- five (75) percent of the "Mobilization Payout” will be paid. Previous payments under this item will be deducted from this amount.
   e. When forty (40) percent of the adjusted contract amount is earned, one hundred (100) percent of the “Mobilization Payout” will be paid. Previous payments under this item will be deducted from this amount.

4. Payment will be made under:

   a. Pay Item: "Mobilization Payment" Lump Sum

END OF SECTION

DIVISION 09

SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following substrates:

1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.

PRICE AND PAYMENT PROCEDURES

B. Unit Prices: Refer to Section 01 22 00 “Unit Prices” for procedures related to unit prices.

C. Measurement and Payment: Payment will be made on the basis of each square foot of paint system applied each type of substrate.

1. Application of paint system shall include surface preparation, application of required filler or primer, and application of number of top coats required.

DEFINITIONS

D. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

F. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

ACTION SUBMITTALS

G. Product Data: For each type of product. Include preparation requirements and application instructions.

H. Samples:

1. For Initial Selection: For each type of topcoat product.
2. For Verification: For each type of paint system and each color and gloss of topcoat.

    a. Submit Samples on rigid backing, 8 inches square.
    b. Step coats on Samples to show each coat required for system.
    c. Label each coat of each Sample.
    d. Label each Sample for location and application area.

I. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
3. VOC content.

MAINTENANCE MATERIAL SUBMITTALS

J. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

QUALITY ASSURANCE

K. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

    a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
    b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Engineer at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

DELIVERY, STORAGE, AND HANDLING

L. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

FIELD CONDITIONS

M. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

N. Refer/Comply to manufacturers written instructions and recommendations in “MPI Architectural Painting Specification Manual” or “MPI Maintenance Repainting Manual”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AkzoNobel Paints (Glidden Professional and Devoe).
2. Benjamin Moore & Co.
3. PPG Architectural Finishes, Inc.
4. Pratt & Lambert.
5. Sherwin-Williams Company (The).

PAINT, GENERAL

B. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its “MPI Approved Products List.”

C. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

D. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

E. Colors: As selected by Engineer from manufacturer's standard range.

BLOCK FILLERS AND PRIMERS

F. Primer, Alkali Resistant, Water Based: MPI #3.

G. Block Filler, Latex, Interior/Exterior: MPI #4.

H. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.

I. Primer, Galvanized, Water Based: MPI #134.

WATER-BASED PAINTS

J. Latex, Exterior Low Sheen (Gloss Level 3-4): MPI #15.

K. Light Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss Level 5): MPI #163.

SOURCE QUALITY CONTROL

L. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.

2. Masonry (Clay and CMU): 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

PREPARATION

E. Comply with manufacturer's written instructions and recommendations in “MPI Manual” or “MPI Maintenance Repainting Manual” applicable to substrates and paint systems indicated.

F. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

G. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

H. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

I. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

J. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than SSPC-SP 3, “Power Tool Cleaning.”

K. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

L. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

APPLICATION

M. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

N. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

O. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

P. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panel boards and switch gear.
b. Tanks that do not have factory-applied final finishes.

FIELD QUALITY CONTROL

Q. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

CLEANING AND PROTECTION

R. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

S. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

T. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

U. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

PAINTING SCHEDULE

V. Concrete Substrates, Nontraffic Surfaces: Latex System (MPI EXT 3.1K):

1. Prime Coat: Primer, alkali resistant, water based.
2. Intermediate Coat: Latex, exterior, matching topcoat.
3. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4).

W. CMU Substrates: Latex System (MPI EXT 4.2A):

1. Prime Coat: Block filler, latex, interior/exterior.
2. Intermediate Coat: Latex, exterior, matching topcoat.
3. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4).

X. Steel Substrates: Water-Based Light Industrial Coating System (MPI EXT 5.1C):

1. Prime Coat: Primer, alkyd, anti-corrosive for metal.
2. Prime Coat: Shop primer specified in Section where substrate is specified.
3. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
4. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5).

Y. Galvanized-Metal Substrates: Water-Based Light Industrial Coating System (MPI EXT 5.3J):

1. Prime Coat: Primer, galvanized, water based.
2. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
3. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5).

END OF SECTION

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems on the following substrates:

1. Exterior Substrates:

   a. Concrete, vertical surfaces.
   b. Concrete masonry units (CMU).
   c. Steel.
   d. Galvanized metal.

2. Interior Substrates:

   a. Concrete, vertical and horizontal surfaces.
   b. Concrete masonry units (CMU).
   c. Steel.
   d. Galvanized metal.

PRICE AND PAYMENT PROCEDURES

B. Unit Prices: Refer to Section 01 22 00 “Unit Prices” for procedures related to unit prices.

C. Measurement and Payment: Payment will be made on the basis of each square foot of high performance coating system applied each type of substrate.

1. Application of high performance coating system shall include surface preparation, application of required filler or primer, and application of number of top coats required.

DEFINITIONS

D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

ACTION SUBMITTALS

F. Product Data: For each type of product indicated. Include preparation requirements

and application instructions.

G. Samples for Initial Selection: For each type of topcoat product indicated.

H. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

I. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

MAINTENANCE MATERIAL SUBMITTALS

J. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

QUALITY ASSURANCE

K. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Engineer will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.

   a. Wall Surfaces: Provide samples of at least 100 sq. ft.
   b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by owner at no added cost to owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

DELIVERY, STORAGE, AND HANDLING

L. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

FIELD CONDITIONS

M. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

N. Refer/Comply to manufacturers written instructions and recommendations in “MPI Architectural Painting Specification Manual” or “MPI Maintenance Repainting Manual”

O. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AkzoNobel Paints
2. Benjamin Moore & Co.
3. PPG Architectural Finishes, Inc.
4. Pratt & Lambert.
5. Sherwin-Williams Company (The).

HIGH-PERFORMANCE COATINGS, GENERAL

B. MPI Standards: Provide products that comply with MPI standards indicated and are listed in “MPI Approved Products List.”

C. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

E. Colors: As selected by Engineer from manufacturer's standard range.

BLOCK FILLERS AND PRIMERS

F. Block Filler, Latex, Interior/Exterior: MPI #4.

G. Primer, Zinc-Rich, Epoxy: MPI #20.

H. Primer, Vinyl Wash: MPI #80.

I. Primer, Epoxy, Anti-Corrosive, for Metal: MPI #101.

J. Primer, Rust-Inhibitive, Water Based: MPI #107.

K. Block Filler, Epoxy: MPI #116.

EPOXY AND POLYURETHANE COATINGS

L. Polyurethane, Two-Component, Pigmented, Gloss (Gloss Level 6): MPI #72.

M. Epoxy, Gloss: MPI #77.

N. Epoxy-Modified Latex, Interior, Gloss (Gloss Level 6): MPI #115.

SOURCE QUALITY CONTROL

O. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Masonry (Clay and CMU): 12 percent.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

PREPARATION

D. Comply with manufacturer's written instructions and recommendations in “MPI Architectural Painting Specification Manual” or “MPI Maintenance Repainting Manual” applicable to substrates indicated.

E. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

F. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

G. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi

at 6 to 12 inches.

2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, “Brush-Off Blast Cleaning.”

H. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 600 to 1000 psi at 6 to 12 inches.

I. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 11, “Power Tool Cleaning to Bare Metal.”

J. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

K. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

APPLICATION

L. Apply high-performance coatings according to manufacturer's written instructions and recommendations in “MPI Architectural Painting Specification Manual.”

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

M. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

N. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

FIELD QUALITY CONTROL

O. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and

inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

CLEANING AND PROTECTION

P. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

Q. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

R. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

S. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

T. Concrete Substrates, Vertical Surfaces: Epoxy System (MPI EXT 3.1D):

1. Prime Coat: Epoxy, gloss.
2. Intermediate Coat: Epoxy, gloss.
3. Topcoat: Epoxy, gloss.

U. CMU Substrates: Epoxy System (MPI EXT 4.2E):

1. Block Filler: Block filler, epoxy.
2. Intermediate Coat: Epoxy, gloss.
3. Topcoat: Epoxy, gloss.

V. Steel Substrates: Pigmented Polyurethane over Epoxy Zinc-Rich Primer System (MPI EXT 5.1P):

1. Prime Coat: Primer, zinc-rich, epoxy.
2. Intermediate Coat: Epoxy, gloss.
3. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6).

W. Galvanized-Metal Substrates: Pigmented Polyurethane over Vinyl Wash and Epoxy Primer System (MPI EXT 5.3D):

1. Prime Coat: Primer, vinyl wash.

2. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal.
3. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6).
4. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6).

INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

X. Concrete Substrates, Vertical Surfaces: Epoxy-Modified Latex System (MPI INT 3.1G):

1. Prime Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6).
2. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6).
3. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6).

Y. Concrete Substrates, Horizontal Surfaces: Epoxy System (MPI INT 3.2C):

1. Prime Coat: Epoxy, gloss.
2. Intermediate Coat: Epoxy, gloss.
3. Topcoat: Epoxy, gloss.

Z. CMU Substrates: Epoxy-Modified Latex System (MPI INT 4.2J):

1. Block Filler: Block filler, latex, interior/exterior.
2. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6).
3. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6).

AA. Steel Substrates: Epoxy-Modified Latex System (MPI INT 5.1K):

1. Prime Coat: Primer, rust-inhibitive, water based.
2. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6).
3. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6).

BB. Galvanized-Metal Substrates: Epoxy System (MPI INT 5.3D):

1. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
2. Intermediate Coat: Epoxy, gloss.
3. Topcoat: Epoxy, gloss.

END OF SECTION

SECTION 09 96 53
ELASTOMERIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of elastomeric coatings to the following exterior substrates:

1. Concrete.
2. Concrete unit masonry.

PRICE AND PAYMENT PROCEDURES

B. Unit Prices: Refer to Section 01 22 00 “Unit Prices” for procedures related to unit prices.

C. Measurement and Payment: Payment will be made on the basis of each square foot of elastomeric coating system applied each type of substrate.

1. Application of elastomeric coating system shall include surface preparation, application of require crack filler, application of required filler or primer, and application of number of top coats required.

ACTION SUBMITTALS

D. Product Data: For each type of product indicated.

E. Samples:

1. For Initial Selection: For each type of elastomeric coating indicated.
2. For Verification: For each type of elastomeric coating indicated and in each color and gloss.

    a. Submit Samples on same type of substrate as that to receive application, 8 inches square.
    b. Step coats on Samples to show each separate coat, including primers and block fillers as applicable.
    c. Label each coat of each Sample.
    d. Label each Sample for location and application area.

F. Product List: For each product indicated, including the following:

1. Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Manufacturer's recommended spreading rate for each separate coat, including primers and block fillers for each type of substrate as applicable.

MAINTENANCE MATERIAL SUBMITTALS

G. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged for storage in unopened, factory-sealed containers and identified with labels describing contents.

QUALITY ASSURANCE

H. Mockups: Prepare mockups of each coating system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Engineer will select one wall surfaces of at least 100 sq. ft. to represent surfaces and conditions for application of each type and texture of elastomeric coating.
2. Final approval of color and texture selections will be based on mockups.

   a. If preliminary color selections are not approved, prepare additional mockups of additional color and textures selected by Engineer at no added cost to Owner.

DELIVERY, STORAGE, AND HANDLING

I. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

PROJECT CONDITIONS

J. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 90 deg F unless otherwise permitted by manufacturer's written instructions.

K. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

L. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Water penetration through the coating.
   b. Deterioration of coating beyond normal weathering.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Material Compatibility:

1. Provide elastomeric finish coatings and crack fillers, primers, and block fillers as applicable for use within elastomeric finish coatings that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. VOC Content: Provide elastomeric finish coatings and crack fillers, primers, and block fillers that comply with requirements of authorities having jurisdiction.

ELASTOMERIC FINISH COATINGS

B. Exterior Non-Flat Waterborne, Pigmented Elastomeric Coating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. BASF Building Systems; Thoro Thorolastic.
   b. Benjamin Moore & Co.; Moorlastic.
   c. Euclid Tamms; Tamms Tammolastic.

2. Surface Profile: Smooth texture.

OTHER MATERIALS

C. Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated; VOC content complying with limits of authorities having jurisdiction.

D. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-

resistant primer compatible with substrate and other materials indicated.

E. Concrete Unit Masonry Block Filler: Elastomeric coatingmanufacturer's recommended, factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.

B. Begin coating only when moisture content of substrate is 12 percent or less when measured with an electronic moisture meter.

C. Begin coating no sooner than 28 days after substrate is constructed and is visually dry on both sides.

D. Verify that substrate is within the range of alkalinity recommended by manufacturer.

E. Verify suitability of substrates including surface conditions and compatibility with existing finishes and primers.

F. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

PREPARATION

G. Comply with manufacturer's written instructions and recommendations in the “MPI Architectural Painting Specification Manual” or “MPI Maintenance Repainting Manual” applicable to substrates and coating systems indicated.

H. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

I. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Remove incompatible primers and reprime substrate with compatible primers as

required to produce coating systems indicated.

2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.

J. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.

APPLICATION

K. Apply elastomeric coatings according to manufacturer's written instructions.

1. Use equipment and techniques best suited for substrate and type of material being applied.
2. Coat surfaces behind movable items the same as similar exposed surfaces.
3. Apply each coat separately according to manufacturer's written instructions.

L. Primers: Apply at a rate to ensure complete coverage.

M. Block Fillers: Apply at a rate to ensure complete coverage with pores filled.

N. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform finish, color, and appearance.

O. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

P. Apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration.

Q. Spray Application: Use spray equipment for application only when permitted by authorities having jurisdiction. Wherever spray application is used, do not double back with spray equipment to build up film thickness of two coats in one pass.

FIELD QUALITY CONTROL

R. Testing of Paint Materials: Owner reserves the right to invoke the following testing procedures:

1. Owner will engage the services of a qualified testing agency to sample materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of materials with product requirements.
3. Owner may direct Contractor to stop coating application if test results show materials being used do not comply with requirements. Remove noncomplying materials from Project site, pay for testing, and recoat surfaces that were coated with rejected materials. Remove rejected materials from previously coated

surfaces if, on recoating with complying materials, the two coatings are incompatible.

S. Field Testing and Inspection: Owner reserves the right to engage the services of a qualified testing agency to verify installed thickness of elastomeric coatings.

CLEANING AND PROTECTION

T. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

U. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

V. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.

W. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

COATING SCHEDULE

X. Concrete Substrates:

1. Primer: Concrete primer if required by manufacturer.
2. Elastomeric Finish Coats: Minimum two coats with a total dry film thickness of 16 to 18 mils.
3. Finish-Coat Color: As selected by the Engineer from manufacturer's standard range.

Y. Concrete Unit Masonry Substrates:

1. Primer or Block Filler: Concrete unit masonry primer if required by manufacturer.
2. Elastomeric Finish Coats: Minimum two coats with a total dry film thickness of 16 to 18 mils.
3. Finish-Coat Color: As selected by the Engineer from manufacturer's standard range.

END OF SECTION

DIVISION 26

SECTION 26 56 13.02
LUMINAIRE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for luminaires.

SUBMITTALS

B. Product Data: For each luminaire arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

    a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
4. Wiring Diagrams: For power, signal, and control wiring.

D. Samples: For products designated for sample submission in the Exterior Lighting Device Schedule. Each Sample shall include lamps and ballasts.

E. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

F. Field quality-control reports.

G. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

H. Warranty: Sample of special warranty.

QUALITY ASSURANCE

I. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

J. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

K. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

L. Comply with IEEE C2, "National Electrical Safety Code."

M. Comply with NFPA 70.

WARRANTY

N. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: One year from date of Substantial Completion.

EXTRA MATERIALS

O. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: one of each type and rating installed. Furnish at least one of each type.
2. Glass and Plastic Lenses, Covers, and Other Optical Parts: one of each type and rating installed. Furnish at least one of each type.
3. Ballasts: one of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: one of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
3. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure

to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, matches finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

   a. Color: As selected from manufacturer's standard catalog of colors.
   b. Color: STA Black.
   c. Color: As selected by Owner from manufacturer's full range.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or

thicker) complying with AAMA 611.

a. Color: Black.

O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USES ONLY" and include specific lamp type.
b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
f. CCT and CRI for all luminaires.

LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

P. Comply with UL 773 or UL 773A.

Q. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

FLUORESCENT BALLASTS AND LAMPS

R. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (- 17 Deg C) and Higher: Electronic or electromagnetic type rated for 0 deg F (- 17 deg C) starting and operating temperature with indicated lamp types.
2. Temperatures - 20 Deg F (- 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

S. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.
2. Sound Rating: Class A or Class A except Class B for T12/HO ballasts.
3. Total Harmonic Distortion Rating: Less than 20 percent.
4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power

factor, Class P, automatic-reset thermal protection.

5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.

6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

T. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures [**0 deg F (- 18 deg C)**] [**- 20 deg F (- 29 deg C)**] and higher.

BALLASTS FOR HID LAMPS

U. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: - 22 deg F (- 30 deg C).
3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

V. Auxiliary, Instant-On, Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent of light output.

W. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.

   a. Restrike Range: 105- to 130-V ac.
   b. Maximum Voltage: 250-V peak or 150-V ac rms.

2. Minimum Starting Temperature: - 40 deg F (- 40 deg C).

HID LAMPS

X. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), CCT color temperature 1900 K, and average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower

internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

Y. Low-Pressure Sodium Lamps: ANSI C78.43.

Z. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and CCT color temperature 4000 K.

AA. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and CCT color temperature 4000 K.

BB. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and CCT color temperature 4000 K.

FINISH

CC. The luminaire is Hot-Dip Galvanized and has a powder coat finish. The finish is a three-stage process which consists of drying, powder application and curing.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicate structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

FIELD QUALITY CONTROL

D. Inspect each installed fixture for damage. Replace damaged fixtures and components.

E. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

F. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."

b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
d. IESNA LM-64, "Photometric Measurements of Parking Areas."
e. IESNA LM-72, "Directional Positioning of Photometric Data."

G. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 26 56 19.01
IN-ROAD WARNING LIGHT (IRWL)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for in-road warning lights (IRWL).

PART 2 - PRODUCTS

2.1 GENERAL

A. Products: Subject to compliance with requirements, provide the following products:

1. **RS320 Road Spot:** Ultra-bright **In-Road Warning Light (IRWL)** controlled by any of the Spot Devices SC320-series network controllers. The **RS320** flashes a warning to motorists, pedestrians, light rail vehicles, and industrial vehicles based on a variety of inputs, including pedestrian activation, vehicle activation, and calendar activation.

CHARACTERISTICS

B. Light Characteristics:

1. Directionality is unidirectional or bidirectional.
2. Three LEDs in each direction.
3. White color (special order).
4. Luminance of 2.5 million cd/m^2
5. Daylight distance visibility greater than 400 feet.
6. Night distance visibility greater than .5 mile.
7. Flash pattern and duration Internet configurable.

C. Operating Characteristic:

1. Power consumption 1W per LED.

D. Physical Characteristics:

1. Stainless steel housing.
2. Aluminum anchor.
3. Polycarbonate windows.
4. Factory-installed, wet-mateable, and hermetic.
5. 7.5 lbs

6. 3 in depth X 4 in width X 9.5 in length.
7. Maximum above-roadway height 5 mm.

8. Stainless steel, modular lighting element.
9. Ultrabright LEDs command attention at >400 feet.
10. Configurable flash patterns and duration.
11. Autodim™ adjusts lights to ambient conditions.
12. MUTCD and CalTrans compliant.
13. Manufactured in the USA in an ISO 9001 facility.
14. 2 year warranty.

END OF SECTION

SECTION 27 21 00.01
WIRELESS COMMUNICATION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Minimum acceptable equipment, electrical requirements, installation, configuration, and testing of wireless communication system at traffic signal intersections or other similar facilities throughout the City of Sugar Land.

B. Wireless Communication System equipment shall be:
1. Wireless Subscriber Module: Cambium PMP 400 Model#4941SM AES (4.9 GHz) w/ power supply
2. Communication Switch: Cisco IE2000 (model# IE-2000-8TC-G-B) with built in power supply, 8 x 10/100Base-TX Ports, 2 x GE (Gigabit Ethernet) Combo Ports
3. Cisco Switch Power Supply(PWR-IE65W-PC-AC)
4. Cisco Switch Din Rail(STK-RackMnt-2955)
5. Fiber Optic transceivers (GLC-LX-SM-RGD)
6. Surge Protector: Citel MJ8-POE-B
7. Cable: CAT 5e (must meet Belden 7929A spec)

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement - This item will be measured by each Wireless Communication System (intersection) with the relevant equipment (including mounting hardware, jumpers, etc,) installed complete in place and made fully operational. This item will also cover any relocation of existing equipment as specified in plans.
   a. Wireless Subscriber Module, Communication Switch, and Surge Protector will be listed in quantities as subsidiary to this item.
   b. Length of cable required will be listed in quantities as subsidiary to this item.

B. Payment - The work performed and materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid for “Wireless Communication System”. This price shall be full compensation for furnishing, installing, configuring, and testing the communication equipment/system; and for all labor, tools, equipment and incidentals necessary to complete the work.

PART 2 - PRODUCTS

2.01 GENERAL DESCRIPTION

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Furnish, install and configure Wireless Communication System equipment as shown on the plans and as directed by the City's Traffic Engineer.

C. Adjust antenna polarities and channel plans on equipment to minimize interference from other sources. If the interference analysis shows possibility for interference at the City sites, conduct in-field monitoring to determine if actual interference exists.

D. Provide all licenses, where required, for any software, hardware, or equipment in the system.

2.02 WARRANTY

A. Material, workmanship and labor furnished shall be covered by Supplier(s)/Manufacturer(s) guarantee and/or warranty for a minimum period of twenty-four (24) months.

1. Warranty period shall begin the day the Wireless Communication System is activated by the City of Sugar Land, either as new order or warranty repair.
2. Successful bidder shall bear all expenses connected with return of any material, which the City deems necessary to return for adjustments during warranty period.
3. Successful bidder shall bear all labor cost associated with warranty items and maintenance in a timely manner; the quality of timely service is determined by the City's Traffic Engineer and shall not exceed twenty-four (24) hours from the Time of Notification (TON) to initial field response by the successful bidder or their representative.

    a. Successful bidder shall provide maintenance and field service (i.e. trouble calls) during the warranty period.
    b. Supplier(s)/Manufacturer(s) shall make all engineering data, diagrams, software changes or improvements, which increases performance of equipment purchased under this bid, available to the City of Sugar Land at no additional cost.
    c. Supplier(s)/Manufacturer(s) shall have field engineers or technicians available on request to assure satisfactory initial operation, and to consult with City's Traffic Engineer, or his representative, on any special circuitry that may be required in certain applications.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Contractor Experience Requirements: Minimum requirements for the Contractor or designated subcontractors involved in the installation and testing of the Wireless Communication System are:

1. Three years experience in the installation of Wireless Communication Systems.
2. Two installed WER systems where Systems have been in continuously satisfactory operation for at least 1 year. Submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the system.

B. Provide all necessary documentation of subcontractor qualifications pursuant to contract award.

C. System Installation: Provide and install materials, including support, calibration and test equipment, to ensure an operating and functional wireless system. This includes installation of Wireless Communication System equipment with power and data cables, and the Power and Grounding System. Prior to beginning installation, inspect each site to verify suitability of installation and submit an installation design and a grounding and lightning protection design to the Engineer for approval prior to installation. This installation includes:

1. Antenna Mounts: Providing and installing antenna mounts, standoffs, brackets and hardware, transmission line, hanger kits and grounding kits. Install all antennas at specified center lines. Perform antenna alignment for each path and compare with path calculations.

2. System Power and Grounding: Connect equipment to the 115 Volt circuits provided at the sites. Bond all equipment racks in accordance with the approved Installation Specification. Ground all equipment racks to the single point ground for the site. Provide grounding and lightning protection for all cable runs on the support tower and at the equipment entry point. Subscriber module and WAP should be grounded with 10 AWG wire.
3. System Optimization: Following installation of the completed system, optimize the equipment at each site in accordance with the specifications to provide a complete, operational system.
4. Wiring: Install wiring meeting the requirements of the National Electrical Code. Cut all wires to proper length before assembly. Do not double back any wiring to take up slack. Neatly lace wires into cable with nylon lacing or plastic straps. Secure all cables with clamps. Provide service loops at all connections.
5. Transient Suppression: On all DC relays, provide diodes or other protective devices across the solenoids and holding coils for transient suppression.
6. Power Service Protection:

   a. Furnish equipment containing readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

b. Provide circuit breakers or fuses that are sized such that no wire, component, connector, PC board or assembly shall be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element of wiring.

7. Fail Safe Provision: Design the equipment such that the failures of the equipment will not cause the failure of any other unit of equipment. Provide automatic recovery from power failure within 5 seconds after resumption of power.
8. Connectors and Harnesses: Make all external connections by means of connectors. Key the connectors to preclude improper hookups. Color code and/or appropriately mark all wires to and from the connectors.
   a. Provide connecting harnesses of appropriate length and terminated with matching connectors for interconnection with the communications system equipment.
   b. Uniquely color code patch fibers with mixed connectors for easy identification.
   c. All cat5e cable connections should be grounded with RJ45 connection and protected from the environment by heat shrink tubing.
   d. The City should inspect the connection before the heat shrink tubing is applied.
   e. Plate all pins and mating connectors with not less than 20 microns of gold. For connectors utilizing solder type connections, cover each soldered connection with a piece of heat shrink tubing securely shrunk to insure that it protects the connection.
   f. Clearly identify all assemblies with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.
9. Software: Provide any and all programming and software required to support the Wireless Communication System.
   a. Install the programming and software in the appropriate equipment at the time of acceptance testing, for use in the acceptance testing.
   b. Provide software updates free of charge during the warranty period.

D. Technical Assistance: Ensure that a manufacturer's technical representative is available on site to assist the Contractor's technical personnel at each installation site and with Wireless Communication System equipment installation and communication system configuration. Do not power up the WER equipment without the permission of the manufacturer's representative.

1. System Testing: Conduct System Testing at the manufacturer's facility as well as after installation at the designated City locations:

   a. Test each hop of the proposed system. As a minimum, test transmit power and frequency, receiver performance and frequency, proper operation of switch over, proper operation of alarms and switches and bit error rate (BER) testing for the configured hop. Prior to beginning the manufacturer's test, provide the City's Traffic Engineer with a copy of the test procedure as well as the proposed test date(s).
   b. Following completion of equipment installation and operational optimization, submit the Acceptance Test Plan to the City's Traffic Engineer for review and Approval. During the official Acceptance Testing, provide

the technical staff to conduct the measurements and adjustments called for in the testing. The City of Sugar Land reserves the right to participate in the testing as the Official Test Witness. On each page of the Acceptance Test Document, provide for data recording of the test results, and the name of Contractor's representative conducting the test as well as a suitable field for the test date and signature of City's Traffic Engineer. Upon City's approval of the Test Plan and the Test Schedule, the Acceptance Testing may begin. This includes:

1) Intersection-level testing of the individual system paths: testing of the installed system paths includes:
2) Measuring and recording the transmitter/receiver channel frequency and polarity.
3) Measuring and recording the transmitter power.
4) Measure and record the receiver fade margin.
5) Perform a one hour Bit Error Rate Test (BERT) on the primary equipment and record results.
6) Verify the operation of all local alarm and control points using the alarm/monitoring equipment provided.
7) System-level Test: Following intersection-level testing of the individual system paths, test each hop on an end-to-end testing and perform a BERT on the primary equipment.

2. Test and verify the operation of the alarm and monitor equipment in accordance with the Acceptance Test criteria.

END OF SECTION

DIVISION 31

SECTION 31 05 13.13
GRADE BORROW MATERIAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes soil materials for embankment.
   1. Embankment is defined as

MEASUREMENT AND PAYMENT

B. Unit Prices.

   1. Payment for borrow is on cubic yard basis calculated by theoretical quantities using average end area method based on Drawings.
   2. Refer to Section 01 22 00 – “Unit Prices” for unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

REFERENCES

D. ASTM D 698 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.

E. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

SUBMITTALS

F. Conform to requirements of Section 01 33 00 - Submittal Procedures.

G. Submit location and description of proposed borrow area for approval.

H. Submit material samples for testing.

PART 2 - PRODUCTS

2.1 SOIL MATERIAL

A. Grade borrow material used for embankment free of lumps greater than 6 inches, rocks larger than 3 inches, organic material, chemical waste or other contamination, and debris. Take borrow material from sources approved by Owner.

B. Use material with plasticity index not less than 12, nor more than 30 when tested in accordance with ASTM D 4318. If imported soils must be stabilized more than 20 then use plasticity index of 30 unless approved by Owner. Do not use blend of cohesive and granular soils to achieve required plasticity index.

PART 3 - EXECUTION

3.1 PREPARATION

A. Notify Owner 5 calendar days in advance of opening borrow source to permit obtaining samples for qualification testing. When material does not meet specification requirements, locate another source of borrow.

B. Clear approved source area of trees, stumps, brush, roots, vegetation, organic matter, and other unacceptable material before excavation.

TESTS

C. Test and analyze soil materials in accordance with ASTM D 4318 and ASTM D 2216.

EXCAVATION

D. Provide adequate drainage of surface water so that surface water runoff does not enter borrow pit excavation.

HAULING

E. Use covered trucks.

EMBANKMENT

F. Conform to requirements of Section 31 24 00 “Embankment”.

END OF SECTION

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section governs the furnishing of all labor, equipment, tools, and materials, and the performance of all work for clearing, grubbing, and disposal of material within the work site required for construction of a site in accordance with specification requirements.

1.2 DEFINITIONS

A. Clearing consists of cutting off trees and brush vegetative growth to not more than a specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.

B. Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing at, or close to, existing grade and disposing of fallen timber and surface debris.

C. Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.

D. Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm trunk diameter and disposing of all fallen timber and surface debris.

E. Grubbing consists of excavation and disposal of stumps and roots boulders and rock fragments of specified size to not less than a specified depth below existing ground surface.

1.3 MEASUREMENT AND PAYMENT

A. This item will be measured by the Station unless otherwise shown on the bid documents.

B. For Station measurement, the work performed in accordance with this item and measured as provided under “measurement” will be paid for at the unit price bid for “Clearing and Grubbing.” This price is full compensation for pruning of designated trees, and shrubs; removal and disposal of structures and obstruction; backfilling of holes: furnishing and placing concrete for plugs; and equipment, labor, tools and incidentals.

1.4 SUMBITTALS

A. Burn permits shall be submitted to the owner prior to burning of vegetation.

B. Notice of Intent (NOI) and Stormwater Pollution Prevention Plan (SWPPP) or cause for exemption.

C. Proof of legal disposal of all hazardous material shall be required when hazardous material is involved.

1.5 STORAGE AND PROTECTION

A. Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, water courses, root systems of trees which are to remain.

B. Repair any damaged items to approval of Engineer/Architect. Replace any trees designated to remain, if damaged, as directed by Engineer /Architect.

C. When shown on the plans, treat cuts on trees with an approved tree wound dressing within 20 minutes of making a pruning cut or otherwise causing damage to the tree.

1.6 WASTE MANAGEMENT AND DISPOSAL

A. Follow all local and state regulations when burning, if burning of brush is approved, pile and burn at approved locations.

B. Testing, removal and disposal of hazardous materials will be in accordance with the contract.

PART 2 – PRODUCTS

N/A

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspect site and verify with Engineer/Architect, items designated to remain.

B. Locate and protect utility lines. Preserve in operating condition active utilities traversing site:

1. Notify Engineer/Architect immediately of damage to or when unknown existing utility lines are encountered.

2. When utility lines which are to be removed are encountered within area of operations, notify Engineer/Architect in ample time to minimize interruption of service.

C. Notify utility authorities before starting clearing and grubbing.

D. Keep roads and walks free of dirt and debris.

3.2 CLEARING

A. Clear areas shown on the plans of all obstructions, except those landscape features that are to be preserved. Such obstructions include but are not limited to remains of houses and other structures, foundations, floor slabs, concrete, brick, lumber, plaster, septic tank drain fields, basements, abandoned utility pipes or conduits, equipment, fences, retaining walls, and other items as specified on the plans. Remove vegetation and other landscape features not designated for preservation, curb and gutter, driveways, paved parking areas, miscellaneous stone, sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron, and debris, whether above or below ground. Removal of live utility facilities is not included in this item. Remove culverts, storm sewers, manholes and inlets in proper sequence to maintain traffic and drainage.

B. In areas receiving embankment, remove obstructions not designated for preservations to 2 ft. below natural ground. In areas to be excavated, remove obstruction to 2 ft. below the excavation level. In all other areas, remove obstruction to 1 ft. below natural ground. When allowed by the plans or directed, cut trees and stumps off to ground level. Plug the remaining ends of abandoned underground structures over 3 inches in diameter with concrete to form a tight closure. Backfill, compact, and restore areas where obstructions have been removed, unless otherwise directed. Use approved material for backfilling. Accept ownership, unless otherwise directed, and dispose of removed materials and debris at location off the sight in accordance with local, state and federal requirements.

END OF SECTION

SECTION 31 14 13.23

SALVAGING AND PLACING TOPSOIL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the removal, storage and placement of approved topsoil to the depths and area shown on the Drawings or as directed by Owner.

PRICE AND PAYMENT PROCEDURES

B. Salvaging, removal and placing topsoil materials will not be measured for payment, but shall be included in the unit price bid for the item of construction in which these activities are used.

C. This specification is applicable for projects or work involving either inch-pound or SI units.

ACTION SUBMITTALS

D. Product Data: For each type of product indicated.

INFORMATIONAL SUBMITTALS

E. Product test reports.

QUALITY ASSURANCE

F. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.

1. The soil-testing laboratory shall oversee soil sampling.
2. Report suitability of tested soil for turf growth.

    a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having the following characteristics:

   a. pH value of between 5.5 and 6.5.
   b. Liquid Limit: 50 or less.
   c. Plasticity Index: 20 or less.
   d. Gradation: Maximum of 10 percent passing No. 200 sieve.

2. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.
3. Topsoil shall be readily able to support the growth of planting and native grassland seeding and planting.
4. Obtain topsoil from naturally well-drained areas where topsoil occurs at a minimum dept of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

B. Water:

1. Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. Protect trees in the area of construction. Where removal of trees is indicated on the Drawings, they shall be marked as directed by the Owner.

B. Do not operate construction equipment or stockpile construction materials under the canopies of trees, unless otherwise indicated.

C. Do not place topsoil materials within the drip line of trees until tree wells. Keep source and stockpile areas drained during the period of topsoil removal.

D. Remove existing topsoil from area indicated on Drawings. Stockpile in a windrow along the right of way or spread over an area that is ready for topsoil application in accordance with the Drawings or as directed by the Owner.

E. Remove and dispose of trash, wood, brush, stumps, rocks over 1 1/2 inches (37.5 mm) in size. Remove and dispose of other objectionable material encountered as directed by Owner prior to beginning of work. Grass and other herbaceous plant materials may remain. Break up large clumps.

F. After grading has been completed to the required alignment, grades and cross-sections, and prior to spreading salvaged topsoil, scarify clay or tight soil surfaces by plowing furrows approximately 4 inches (100 mm) deep along horizontal slope lines at 2 foot (600 mm) vertical intervals. Spread salvaged topsoil as soon as grading has been completed. Spread topsoil to form a cover of uniform thickness indicated. Sprinkle and roll topsoil after it has been placed and shaped to provide a suitable seed bed.

END OF SECTION

SECTION 31 20 00
EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades for; slabs on grade, walks, pavements, turf and grasses, and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Sub-base course for concrete walks and pavements.
5. Sub-base course and base course for asphalt paving.
6. Excavating and backfilling for utility trenches.

DEFINITIONS

B. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

C. Base Course: Aggregate layer placed between the sub-base course and hot-mix asphalt paving.

D. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

E. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

F. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without

additional compensation.

H. Fill: Soil materials used to raise existing grades.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Sub-base Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below sub-base, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

QUALITY ASSURANCE

M. Pre-excavation Conference is to be scheduled by the contractor 72 hours prior to commencement.

PROJECT CONDITIONS

N. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

O. Do not commence earth moving operations until plant-protection measures specified in Section 01 56 39 “Temporary Tree and Plant Protection” are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 and Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: To Be Specified in Scope
2. Plasticity Index: To Be Specified in Scope

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Sub-base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

ACCESSORIES

I. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

J. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards

created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

EXCAVATION, GENERAL

D. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

EXCAVATION FOR STRUCTURES

E. Excavate to indicated elevations and dimensions within a tolerance of plus or - 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

F. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 “Temporary Tree and Plant Protection.”

EXCAVATION FOR WALKS AND PAVEMENTS

G. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

EXCAVATION FOR UTILITY TRENCHES

H. Excavate trenches to indicated gradients, lines, depths, and elevations.

I. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit or as indicated.

J. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.

K. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicate lines cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 01 56 39 “Temporary Tree and Plant Protection.”

SUBGRADE INSPECTION

L. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

M. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner, without additional compensation.

UNAUTHORIZED EXCAVATION

N. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Owner.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Owner.

STORAGE OF SOIL MATERIALS

O. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

UTILITY TRENCH BACKFILL

P. Place backfill on subgrades free of mud, frost, snow, or ice.

Q. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

R. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in “Cast-in-Place Concrete” Section 033053 “Miscellaneous Cast-in-Place Concrete.”

S. Place and compact initial backfill of sub-base material with satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

T. Place and compact final backfill of satisfactory soil to final subgrade elevation.

U. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

SOIL FILL

V. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

W. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

SOIL MOISTURE CONTROL

X. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

COMPACTION OF SOIL BACKFILLS AND FILLS

Y. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 8 inches in loose depth for material compacted by hand-operated tampers. Use only machines intended for soil compaction.

Z. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

AA. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 and ASTM D 1557:

1. Under pavement, structures, building slabs, steps, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

GRADING

BB. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

CC. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: + or - 1 inch
2. Walks: + or - 1 inch.
3. Pavements: + or – ½ inch.

DD. Grading inside Building Lines: Finish subgrade to a tolerance of ½ inch when tested

with a 10-foot straightedge.

SUB-BASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

EE. Place sub-base course and base course on subgrades free of standing water, mud, frost, snow, or ice.

FF. On prepared subgrade, place sub-base course and base course under pavements and walks as follows:

1. Shape sub-base course and base course to required crown elevations and cross-slope grades.
2. Place sub-base course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact sub-base course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698 ASTM D 1557.

DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

GG. Place drainage course on subgrades free of standing water, mud, frost, snow, or ice.

HH. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

FIELD QUALITY CONTROL

II. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

JJ. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

KK. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owner.

LL. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace

soil materials to depth required; re-compact and retest until specified compaction is obtained.

PROTECTION

MM. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

NN. Repair and reestablish grades to their specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

OO. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

DISPOSAL OF SURPLUS AND WASTE MATERIALS

PP. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation and compaction of materials for roadways.
2. Excavation and compaction of materials for roadside ditches.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for roadway excavation, with or without subgrade, is on cubic yard basis. Unless specified otherwise under the borrow (off-site) material or embankment fill work item, measurement for payment shall be based on the cut quantity shown on the drawing.
2. No payment will be made for material excavated under the following conditions:

    a. More than 2 feet outside of vertical planes behind back of curbs.
    b. For portion within limits of trench for utilities 24-inch and greater constructed by open-cut methods.
    c. As indicated otherwise on Drawings.

3. Measurement for the bid item “Regrade Ditches” is on a linear foot basis. No separate payment will be made for reshaping and regrading roadway ditch shoulder slope and side slope adjacent to installed temporary pavement upon removal of temporary pavement.
4. If specified, off-site borrow material including placement and compaction will be paid by final in-place quantity on cubic yard basis.
5. If specified and shown on the drawing, embankment fill including placement and compaction will be paid by final in-place quantity on cubic yard basis.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

REFERENCES

D. Excavation shall be in conformance with TxDOT 110 or as directed by the Engineer.

E. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12.44 ft-lbf/ft3).

F. ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).D. ASTM D 3017 - Standard Test Method for Water content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

H. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide backfill which is excavated material, graded free of roots, lumps greater than 6 inches, rocks larger than 3 inches, organic material, and debris.

B. Provide structural backfill which is select material meeting following requirements:

1. Plasticity Index: Not less than 12 nor more than 20.
2. Maximum Liquid Limit: 45.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify and flag surface and aerial utilities.

B. Notify utility companies to remove or relocate utilities.

C. Identify, stake, and flag known utility locations below grade. Make temporary or permanent relocation of underground pipes, ducts, or utilities where indicated on Drawings.

D. Upon discovery of unknown or badly deteriorated utilities, or concealed conditions, discontinue work. Notify owner/city and obtain instructions before proceeding in such areas.

E. Obtain approval of top soil quality before excavating and stockpiling.

PROTECTION

F. Protect following from damage or displacement:

1. Trees, shrubs, lawns, existing structures, and other features outside of grading limits.

2. Utilities either above or below grade, which are to remain.

TOPSOIL REMOVAL

G. Strip off topsoil from area to be excavated to minimum depth of 6 inches, unless indicated otherwise on Drawings.

H. Stockpile topsoil in designated location for reuse. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

SOIL EXCAVATION

I. Excavate to lines and grades shown on Drawings.

J. Remove unsuitable material not meeting specifications. Backfill with embankment materials and compact.

K. Record location and plug and fill inactive water and oil wells. Conform to Texas Commission on Environmental Quality, Texas Department of Health, Texas Natural Resource Conservation Commission, and Texas Railroad Commission requirements. Notify owner/city prior to plugging wells.

L. At intersections, grade back at minimum slope of one inch per foot. Produce smooth riding junction with intersecting street. Maintain proper drainage.

M. When area is inadvertently over excavated, fill area in accordance with requirements.

N. Remove material not qualified for use and excess soil not being reused from site.

COMPACTION

O. Maintain optimum moisture content of subgrade to attain required density.

P. Compact to following minimum densities at moisture content of optimum to 3 percent above optimum as determined by ASTM D 698, unless otherwise indicated on Drawings:

1. Areas under future paving and shoulders: Minimum density of 95 percent of maximum dry density.
2. Other areas: Minimum density of 90 percent of maximum dry density.

TOLERANCES

Q. Top of Compacted Surface: +/- ½ inch in cross section, or in 16-foot length.

FIELD QUALITY CONTROL

R. Test and analysis of soil materials will be performed in accordance with ASTM D 4318, ASTM D 2216, and ASTM D 698.

S. Compaction testing will be performed in accordance with ASTM D 698 or ASTM D 2922 and ASTM D 3017.

T. A minimum of three tests will be taken for each 1000 linear feet per lane of roadway.

U. When tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at no additional cost to City.

PROTECTION

V. Prevent erosion at all times. Maintain ditches and cut temporary swales to allow natural drainage in order to avoid damage to roadway. Do not allow water to pond.

W. Distribute construction traffic evenly over compacted areas, where practical, to aid in obtaining uniform compaction. Protect exposed areas having high moisture content from wheel loads that cause rutting.

X. Maintain excavation and embankment areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density.

END OF SECTION

SECTION 31 23 23.13
BACKFILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Material Classifications.

B. Utility Backfill Materials:

1. Manufactured sand (Cement Sand)
2. Gem sand
3. Pea gravel
4. Crushed stone
5. Crushed concrete
6. Bank run sand
7. Select backfill
8. Random backfill

C. Material Handling and Quality Control Requirements.

MEASUREMENT AND PAYMENT

D. Unit Prices:

1. No payment will be made for backfill material. Include payment in unit prices for applicable utility installation.
2. Refer to Section 01 22 00 - Measurement and Payment for unit price procedures.

E. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

DEFINITIONS

F. Unsuitable Material:

1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.
4. Materials contaminated with hydrocarbons or other chemical contaminants.

G. Suitable Material:

1. Materials meeting specification requirements.
2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

H. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

I. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.

J. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.

K. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.

L. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.

M. Foundation: Either suitable soil of trench bottom or material placed as backfill of over excavation for removal and replacement of unsuitable or otherwise unstable soils.

N. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

REFERENCES

O. ASTM C 33 - Standard Specification for Concrete Aggregate.

P. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

Q. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.

R. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.

S. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

T. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in

Aggregates.

U. ASTM D 1140 - Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.

V. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

W. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

X. ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

Y. TxDOT Tex-110-E - Determining Particle Size Analysis of Soils.

Z. TxDOT Tex-460-A - Material Finer Than 75 Φm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

SUBMITTALS

AA. Conform to requirements of Section 01 33 00 - Submittal Procedures.

BB. Submit description of source, material classification and product description, production method, and application of backfill materials.

CC. Submit test results for samples of off-site backfill materials.

DD. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.

EE. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as specific bid item.

TESTS

FF. Perform tests of sources for backfill material as indicated.

GG. Verification tests of backfill materials may be performed by City in accordance ASTM Standards.

PART 2 - PRODUCTS

2.1 MATERIAL CLASSIFICATIONS

A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application

is defined in utility installation specifications and Drawings either by class, product descriptions, or as indicated.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):

   a. Plasticity index: non-plastic.
   b. Gradation: D_{60}/D_{10} - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.

2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):

   a. Plasticity index: non-plastic to 4.
   b. Gradations:

      1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
      2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
      3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.

3. Class III: Clay gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):

   a. Plasticity index: greater than 7.
   b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.

4. Class IVA: Lean clays (CL).

   a. Plasticity Indexes:

      1) Plasticity index: greater than 7, and above A line.
      2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.

   b. Liquid limit: less than 50.
   c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
   d. Inorganic.

5. Class IVB: Fat clays (CH)

   a. Plasticity index: above A line.
   b. Liquid limit: 50 or greater.
   c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
   d. Inorganic.

6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

PRODUCT DESCRIPTIONS

C. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification.

D. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:

1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

E. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and pre-approved by Owner, provided that physical property criteria are determined to be satisfactory by testing.

F. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:

1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.
2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.

G. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

Sieve	Percent Retained
3/8”	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

H. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in

accordance with ASTM C 136:

Sieve	Percent Retained
3/8”	95 to 100
No. 4	60 to 80
No. 8	15 to 40

I. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Retained
1/2”	100
3/8”	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

J. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Owner.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A,Part I.
5. Crushed Stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.

K. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.

1. Gradations, as determined in accordance with Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment by Ranges of Nominal Pipe Sizes		
	>15”	15”-8”	<8”
1”	95-100	100	-
3/4 “	60-90	90-100	100
1/2 “	25-60	-	90-100
3/8 “	-	20-55	40-70
No. 4	0-5	0-10	0-15
No. 8	-	0-5	0-5

L. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 32 01 29 Rigid Paving Repair, to meet plasticity criteria.

M. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or clay (CH) where allowed by applicable backfill installation specification.

N. Cement Stabilized Sand: Conform to requirements of Section 31 23 23.53 Cement Stabilized Sand.

O. Concrete Backfill: Conform to Class B concrete as specified in Section 03 31 00 Structural Concrete.

P. Flexible Base Course Material: Conform to requirements of applicable portions of Section 32 12 16 Asphalt Paving, Section 31 32 13.16 Cement Soil Stabilization, and Section 32 11 23 Aggregate Base Course.

MATERIAL TESTING

Q. Source Qualification: Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:

1. Gradation: Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
2. Plasticity of material passing No. 40 sieve.
3. Los Angeles abrasion wear of material retained on No. 4 sieve.
4. Clay lumps.
5. Lightweight pieces.
6. Organic impurities.

R. Production Testing: Provide reports to Owner from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.

S. Assist Owner in obtaining material samples for verification testing at source or at production plant.

PART 3 - EXECUTION

3.1 SOURCES

A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.

B. Identify off-site sources for backfill materials at least 14 calendar days ahead of intended use so that Owner may obtain samples for verification testing.

C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Owner, expense for sampling and testing required to change to different material will be credited to Owner through change order.

D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.

E. Owner does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

MATERIAL HANDLING

F. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.

G. Establish temporary stockpile locations for practical material handling, control, and verification testing by Owner in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

H. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.

I. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

FIELD QUALITY CONTROL

J. Quality Control:

1. Owner may sample and test backfill at the following locations:

   a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
   b. On-site stockpiles.
   c. Materials placed in Work.

2. Owner may re-sample material at any stage of work or location if changes in

characteristics are apparent.

K. Production Verification Testing: City's testing laboratory will provide verification testing on backfill materials, as directed by Owner. Samples may be taken at source or at production plant, as applicable.

END OF SECTION

SECTION 31 23 23.23
PROOF ROLLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for furnishing and operating heavy pneumatic tired compaction equipment for locating unstable areas of embankment, sub-grade and flexible base courses.

PRICE AND PAYMENT PROCEDURES

B. Direct payment will not be made for the materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

SUBMITTALS

C. Provide the following:

1. Plan describing the condition of each roller proposed for the work, as well as the type of traction (self-propelled or drawn), type of roller, size, weight, tire pressure (if appropriate) and configuration of each individual roller.
2. Operating speed proposed for each individual roller.
3. Proof rolling shall be in accordance with TxDOT 216.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Standard Proof Roller:

1. Loading platform or body suitable for ballast loading supported on a minimum of two (2) axles with not more than two (2) pneumatic tired wheels per axle.
2. Pneumatic proof rolling equipment with multiple pivotal axles and more than two tires along the front or rear axle axis shall have articulating axle supports to equally distribute the load to all tires over uneven surfaces.
3. Provide proof roller unit under working conditions with a minimum contact width of 7-1/2 feet (2.3 meters).
4. Gross roller weight may be varied uniformly from 25 tons to 50 tons (23 mega grams to 45 mega grams) by ballast loading.

a. Capable of operating under various loads with variable air pressures up to 145 psi (up to 1000 kilopascals) and shall be smooth tread impart a minimum ground contact pressure of 75 pounds per square inch (520 kilopascals).
b. Full of liquid (i.e. when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position).
c. Operating load and tire pressure shall be within the range of the manufacturer's chart as directed by the Owner.

5. Proof roller shall be drawn by a power train of adequate tractive effort or may be of a self-propelled type.
6. Equip proof rolling equipment with either a reverse mode transmission or be capable of turning 180 degrees in the street width.

a. When a separate power train is used to draw the proof roller, the power train weight shall not be considered in the weight of the proof roller.
b. Power train shall be rubber-tired when rolling subgrade and base materials.
c. Cleated or track-type power train may be used on earth and rock embankments.

B. Alternate Equipment:

1. With the written approval of the City, Contractor may utilize alternate equipment on embankment courses, subgrade, and base courses subject to the requirements of the standard proof roller except with respect to minimum contact width, axle/tire arrangement and tire tread.
2. Alternate equipment for stability testing of embankments shall be restricted to equipment that can be shown to impart a stress distribution on the embankment structure equivalent to or greater than the stress induced by the concentrated weight of a standard proof roller.

C. Equipment Submittals:

1. Standard proof rollers and proposed alternate equipment must be approved by the Owner prior to their use.
2. The Contractor shall furnish the Owner with charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.
3. Alternate equipment submittals for proof rolling of embankments shall be signed and sealed by a registered Professional Engineer licensed in the State of Texas.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. General:

1. Load and tire inflation pressures shall be adjusted as directed by the Owner.

Use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base. The entirety of prepared surfaces to be tested by this method shall be proof rolled by a minimum of two passes of the proof roller tires. Each succeeding trip of the proof roller shall be offset by not greater than one tire width.

2. When alternate equipment is proposed and only one axle meets minimum requirements, only the qualifying axle shall be used to proof roll.
3. If the operation of the proof roller shows an area to be unstable, the substandard area shall be brought to satisfactory stability and uniformity by additional curing, compaction, or by removal and replacement of unsuitable materials. The re-worked area shall then be proof rolled.
4. Proof rollers shall be operated at speeds directed by the City of Sugar Land.
5. Acceptable limits of elastic and plastic deformation of prepared subgrade courses shall be established by proof rolling Test Sections of representative soil conditions, previously tested and approved for density and moisture requirements of the governing subgrade and earth embankment items.
6. Proof rolling of first course base over a plastic subgrade may be waived by the Owner if it is determined that the prepared first course base will be damaged by the proof roller.

B. Roadway Construction:

1. Proof roll shall be performed BEFORE & AFTER subgrade stabilization for new roadway construction and in the reconstruction of existing streets unless otherwise directed by the Engineer.
2. Proof rolling of the curb course base shall be substituted for proof rolling of final course base at the discretion of the Engineer.
3. Proof rolling may be waived only by the Engineer where construction is limited to turn lanes or where the site is otherwise congested.

C. Trenches:

1. Trenches shall be proof rolled where no limitations to the operation of the proof roller exist as may be determined by the Engineer subject to the provisions hereunder.
2. Trenches shall be proof rolled in new roadways or in existing roadways under reconstruction.
3. Trenches shall be proof rolled at the street subgrade elevation by longitudinal and perpendicular passes of the roller as may be dictated by the width of the trench.
4. Proof rolling of trenches in existing paved streets shall be limited to pavement cross-sections capable of sustaining the weight of the proof rolling equipment without imparting damage to the remaining pavement structure as determined by the Owner.

END OF SECTION

SECTION 31 23 23.33
FLOWABLE FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for furnishing, mixing, transporting and placing flowable fill.

MEASUREMENT AND PAYMENT

B. Refer to Section 01 22 00 – "Unit Prices" for unit price procedures.

C. No separate payment will be made for flowable fill under this Section. Include cost in unit prices for work, as specified in Section 01 29 00 Payment Procedures

REFERENCES

D. ASTM C 31 – Making and Curing Concrete Test Specimens in the field.

E. ASTM C 39 – Compressive Strength of Cylindrical Concrete Specimens.

F. ASTM C 40 – Organic Impurities in Fine Aggregates for Concrete.

G. ASTM C 94 - Ready-Mixed Concrete.

H. ASTM C 150 - Portland Cement.

I. ASTM C 192 – Making and Curing Concrete Test Specimens in the Laboratory.

J. ASTM C 260 – Air-Entraining Admixtures for Concrete.

K. ASTM C 494 - Chemical Admixtures for Concrete.

L. ASTM C 618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Concrete.

M. ASTM C 4318 – Liquid Limit, Plastic Limit and Plasticity Index of Soils.

SUBMITTALS

N. Conform to requirements of Section 01 33 00 Submittal Procedures.

O. Submit proposed mix design.

P. Submit a copy of delivery tickets accompanied by batch tickets, providing the information required by ASTM C 94 to the City.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide material conforming to:

1. Cement- ASTM C 150, Type I.
2. Fly Ash – ASTM C 618, Class C, with a minimum CaO content of 20 percent.
3. Water- ASTM C 94.
4. Fine Aggregate – Natural or manufactured fine aggregate, or a combination there of, free from deleterious amounts of salt, alkali, vegetable matter or other objectionable material. The plasticity index shall be 4 or less when tested in accordance with ASTM D 4318. Organic impurities, when tested in accordance with ASTM C 40, shall not show a color darker then the standard color. It is intended that the fine aggregate be fine enough to stay in suspension in the mortar to the extent required for proper flow. The fine aggregate shall conform to the following gradation:

Sieve Size	Percent Passing
3/8 inch	100
No. 200	0-10

5. If flowable mixture cannot be produced, the fine aggregate may not be approved.
6. Admixtures – ASTM C 260 and /or C 494.

MIX DESIGN

B. Mix design shall state the following information:

1. Mix design number or code designation to order the concrete from the supplier.
2. Design strength at 7 days (unless otherwise noted on the Plans).
3. Cement type and brand.
4. Fly ash type and brand.
5. Admixtures type and brand.
6. Proportions of each material used.

C. Minimum strength requirement is 150 psi in 7 days unless otherwise noted on the Plans.

PART 3 - EXECUTION

3.1 BATCHING, MIXING AND TRANSPORTATION

A. Batch, mix and transport flowable fill in accordance with ASTM C 94, except when directed otherwise by the City.

B. Mix flowable fill in quantities required for immediate use. Do not use portions which have developed initial set or which are not in place within 90 minutes after the initial water has been added.

C. Do not mix flowable fill while the air temperature is at or below 35 degrees F. without prior approval of the City Engineer.

PLACEMENT

D. Seal off the area to be repaired.

E. Monitor and control the fluid pressure during placement of flowable fill prior to set. Take appropriate measures to avoid excessive pressure that may damage or displace structures or cause flotation. Cease operations if flowable fill is observed leaking from the repair area. Repair or replace damaged or displaced structures at no additional cost.

CLEAN UP

F. Clean up excess flowable fill discharged from the work area and remove excess flowable fill from pipes at no additional cost.

END OF SECTION

SECTION 31 23 23.53
CEMENT STABILIZED SAND

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cement stabilized sand.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Separate payment will not be made for work performed under this Section. Include cost of such work in Contract unit prices for items listed in bid form requiring cement stabilized sand.
2. Refer to Section 01 29 00 - Payment Procedures for unit price procedures.
3. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

REFERENCES

C. ASTM C 33 - Standard Specification for Concrete Aggregates (Fine Aggregate).

D. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

E. ASTM C 42 - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

F. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

G. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.

H. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

I. ASTM C 150 - Specification for Portland Cement.

J. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.

K. ASTM D 1632 - Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.

L. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-

Cement Cylinders.

M. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

N. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

O. ASTM D 3665 - Standard Practice for Random Sampling of Construction Materials.

P. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

SUBMITTALS

Q. Conform to requirements of Section 01 33 00 - Submittal Procedures.

R. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements.

DESIGN REQUIREMENTS

S. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.

1. Base design on strength specimens molded in accordance with ASTM D 558 at moisture content +/- 2 percent of optimum and within 3 hours of batching.
2. Determine minimum cement content from production data and statistical history. Provide no less than 1.5 sacks of cement per cubic yard.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: Type I Portland cement conforming to ASTM C 150.

B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Section 31 23 23.13- Backfill, and the following requirements:

1. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
2. Deleterious materials:

   a. Clay lumps, ASTM C 142 - less than 0.5 percent.
   b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
   c. Organic impurities, ASTM C 40, color no darker than standard color.

3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.

C. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

MIXING MATERIALS

D. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

MATERIAL QUALIFICATION

E. Determine target cement content of material as follows:

1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.
2. Complete molding of samples within 4 hours after addition of water.
3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
4. Perform cement content tests on each sample.
5. Perform moisture content tests on each sample.
6. Plot average 48-hour strength vs. cement content.
7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).

F. Test raw sand for following properties at point of entry into pug-mill:

1. Gradation.
2. Plasticity index.
3. Organic impurities.
4. Clay lumps and friable particles.
5. Lightweight pieces.
6. Moisture content.
7. Classification.

G. Target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula:

1. f'_c% 1/2 standard deviation.

PART 3 - EXECUTION

3.1 PLACING

A. Place sand-cement mixture in maximum 8-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other

applications. Target moisture content during compaction is 0 to 3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.

B. Do not place or compact sand-cement mixture in standing or free water.

ACCEPTANCE

C. Strength level of material will be considered satisfactory if:

1. The average 48-hour strength is a minimum of 100 psi.
2. Material will be considered deficient when 2-day individual strength test (average of two specimens) is less than 100 psi.

D. Material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test has 2-day strength less than 100 psi.

E. Testing laboratory shall notify Contractor, City Engineer, and material supplier by email of tests indicating results falling below specified strength requirements within 24 hours.

F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given.

G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

H. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.

I. When mixture produces 7-day compressive strength less than 100 psi remove and replace cement-sand mixture, paving and other necessary work at no cost to the Owner.

END OF SECTION

SECTION 31 23 33
EXCAVATION BACKFILL AND COMPACTION FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for trench excavation, and backfill for utilities.

DEFINITIONS

B. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.

C. Embedment Material/Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.

D. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

E. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

F. Pipe Embedment Zone: Portion of trench backfill that consists of bedding, haunching and initial backfill.

G. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

H. Unsuitable Materials:

1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

I. Suitable Material: Suitable soil materials are those meeting specification requirements.

J. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.

K. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom.

L. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.

M. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.

N. Trench Conditions are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.

1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.

    a. Stable Trench with Seepage in Clay Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
    b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.

3. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.

O. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by the Contractor.

P. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.

Q. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing

capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.

R. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.

S. Trench Safety Systems: Includes both protective systems and shoring systems.

T. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cave in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected. Trench Shield must be designed by a licensed Engineer.

U. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements. Shoring system must be designed by a licensed Engineer.

V. Special Shoring: Shoring system meeting special shoring as specified for locations identified on Drawings. Special shoring must be designed by a licensed Engineer.

SCHEDULING

W. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

X. Do not excavate more trench in any day than can be completed (facility installed and trench backfilled) in the same day, unless by written permission of City. City shall be empowered at any time to require the backfilling of open trenches over completed pipe lines if, in their judgment, such action is necessary.

SUBMITTALS

Y. Conform to requirements of Section 01 33 00 - Submittal Procedures.

Z. Submit planned typical method of excavation, backfill placement and compaction including:

1. Trench widths.
2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.

AA. Submit backfill material sources and product quality information in accordance with requirements of Section 31 23 23.13 – Backfill.

BB. Submit trench excavation safety program. If special shoring system is to be used, include designs for special shoring meeting requirements as specified.

CC. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.

DD. Submit 11 inch by 17 inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Owner.

TESTS

EE. Geotechnical testing and analysis of backfill materials for soil classification and compaction testing during construction shall be provided by the Owner and will be performed by an independent, state certified, Licensed Geotechnical Professional Engineer who is approved by Owner. (proctors)

FF. Frequency:

1. Perform compaction testing minimum every 300 LF per lift in unpaved areas and 100 LF in paved areas unless otherwise approved by the Engineer.
2. If ground water is present, at the discretion of the City, compaction testing shall be increased to every 100 LF in unpaved areas.
3. Minimum one (1) compaction test per lift shall be performed for all backfill operations under driveways.
4. Minimum one (1) compaction test per lift shall be performed for all backfill operations with less linear footage than specified to include point repairs.
5. Testing agency shall determine at the time of testing the location of each compaction test within the specified testing length.

    a. At the start of the trenching operation, the Contractor shall demonstrate to the City through the results reported by the accepted testing agency that the compaction density specified can be attained by the compaction equipment and methods the Contractor intends to use. (See Section 2.01 D)
    b. Once the method and equipment has been approved, no substitutions will be permitted without City's approval.
    c. Additional demonstration of the suitability of the compaction equipment and methods will be required whenever there is a significant change in material characteristics or change in compaction equipment or method.
    d. Should testing determine that the required density is not being met, or the material is outside the specified moisture range, the Contractor shall, without additional compensation, re-excavate, rework, and/or recompact the particular layer or section until the required density and/or moisture is attained.

GG. Compaction:

1. Trench backfill within all rights-of-way of improved or paved areas shall be compacted to at least 95 percent of maximum density at a moisture content within 2 percent, or of the optimum moisture in accordance with ASTM D 698.

SPECIAL SHORING DESIGN REQUIREMENTS

HH. Provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a pre-manufactured system approved by Owner to meet project site requirements based on manufacturer's standard design.

II. The requirement for special shoring shall be determined by City Engineer for all excavations within 10-feet of a City owned asset.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment designed for achieving requirements of this Section, approved by Owner.

B. Do not use heavy compaction equipment until adequate cover is attained in order to prevent damage to pipes, conduits, or ducts.

C. Use trench shields or other protective systems or shoring systems, including special shoring systems as specified, which are designed and operated in accordance with all Local, State, and Federal (including OSHA) standards and regulations.

D. Achieve compaction by use of vibrating plates, sheep’s foot, or approved equipment designed for compaction. Use of backhoe bucket by tamping is an unacceptable method for compaction.

MATERIAL CLASSIFICATIONS

E. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Section 31 23 23.13 – Backfill.

F. Concrete Encasement: Concrete used for encasement or caps shall have a minimum compressive strength of 2500 psi.

G. Concrete Backfill: Excavatable as defined by the National Ready Mixed Association as having a compressive strength not exceeding 150 psi.

H. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

A. Installation of pipe shall conform to ASTM standards and the City of Sugar Land design standards.

PREPARATION

B. Maintain barricades and warning lights for streets and intersections affected by Work, and that are considered hazardous to traffic movements as specified in the approved traffic control plan for the project.

C. Obtain required permits for excavation to include a Traffic Control Plan approved by the local governing authority.

D. Perform work to conform to applicable safety standards and regulations, as outlined in current OHSA , state and local regulations

E. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Owner for any repairs or relocations, either temporary or permanent.

F. Remove existing pavements and structures, including sidewalks and driveways, to conform to local (local, state DOT, DPW, etc.) requirements.

G. Install and operate necessary dewatering and surface-water control measures. Provide stable trench to allow installation in accordance with Specifications.

H. Maintain permanent benchmarks, monuments, and other reference points. Unless otherwise directed in writing. It is the responsibility and at the expense of the Contractor/Licensed Surveyor to replace those which are damaged or destroyed in accordance with the requirements of the Owner.

CRITICAL LOCATION INVESTIGATION

I. Coordinate utility locations within the Limits of Disturbance per the standard procedures for the project location (One call system, DPW, Utility Company Coordination, etc.)

J. Prior to excavation verify the location of existing utilities in a manner that complies with local, state and federal regulations. Use extreme caution and care when uncovering these lines.

K. Notify Owner in writing immediately upon identification of obstruction.

L. Notify involved utility companies of date and time that investigation excavation will

occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide City written 48 hours notice prior to field excavation or related work.

PROTECTION

M. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings.

N. Protect and support above-grade and below-grade utilities which are to remain.

O. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.

P. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to City.

Q. Protection of Property and Structures:

1. The Contractor shall be responsible for all damage and assume all expense for direct or indirect injury caused by his work, to above ground facilities or below ground facilities.
2. The Contractor shall, at his own expense, sustain in place and protect from direct or indirect injury all existing facilities in the vicinity of the excavation, whether above or below the ground, or that may appear in the trench.
3. The Contractor shall be responsible for the implementation of protective measures associated with the presence or proximity of pipes, poles, tracks, walls, buildings, property markers, and other structures and property of every kind and description in or over his trenches or in the vicinity of his work whether above or below the surface of the ground.

EXCAVATION

R. Except as otherwise specified or shown on Drawings, install underground utilities in open cut trenches with vertical sides.

S. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.

T. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation.

U. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.

V. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions notify City Engineer immediately.

W. Trench Support:

1. The Contractor shall support the sides and ends of all excavations wherever necessary with braces, sheeting, shoring or stringers, trench boxes, or other acceptable excavation support systems. Timbering shall be installed by workers skilled in such work and shall be arranged so that it may be withdrawn as backfilling proceeds, without injury to the utility or structure constructed or to any roadbed or adjacent structure or property.
2. Perform in accordance with the latest OSHA requirements.
3. Timbering in excavations, trench boxes, or excavation support systems shall be withdrawn as the backfilling is being done.
4. Contractor shall cut off any sheeting left in place 2 feet below finished grade and shall remove the material cut off without compensation.
5. Support of the trench shall be the sole responsibility of the Contractor.
6. Removal or Moving of trench shoring shall be performed so that pipe, and backfill materials, after placement and compaction, are not damaged, disturbed, or degree of compaction reduced. Re-compact after shoring is moved if soil is disturbed.
7. Coordinate and provide safe access at all times to all inspecting and testing activities for City and authorized representatives.

HANDLING EXCAVATED MATERIALS

X. Use only excavated materials, which are suitable as defined in this Section and in accordance with Section 31 23 23.13 – Backfill. Place material suitable for backfilling in stockpiles per the most current OSHA standards.

Y. When required, provide additional backfill material conforming to requirements of Section 31 23 23.13 – Backfill.

Z. Stockpile locations shall be pre-approved by Owner and the City.

AA. Excavated material not used as backfill the same day as excavated shall be removed from the site and stockpiled in an area pre-approved by the Owner.

TRENCH FOUNDATION

BB. Fill unauthorized depressions or irregularities before pipes or appurtenances are installed in the bottom of the trench or tunnel with firmly compacted embankment or other approved material.

CC. Adequately control water that may be present in the excavation. Provide for the disposal of water removed from excavations in such a manner not to cause damage to public or private property or to any portion of the work completed or in progress or cause any impediment to the use of any area by the public.

DD. Do not discharge any flushing or ground water or any material of any nature into existing sanitary sewer system during the construction of the facilities. Discharge water through an approved sediment control device.

EE. Notify City Engineer immediately when unsatisfactory material is encountered on trench bottom. Up to 12 inches of additional undercut may be permitted to achieve suitable trench bottom. If additional undercut does not result in a satisfactory trench bottom, obtain a bedding design prepared by a licensed Geotechnical Engineer.

FF. Perform over excavation, if directed by City Engineer. Removal of material may be required.

GG. Trench dams shall be installed as determined by the City Engineer when ground water is encountered.

PIPE EMBEDMENT, PLACEMENT, AND COMPACTION

HH. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.

II. Place approved embedment including bedding, haunching, and initial backfill as shown on Drawings.

JJ. Manually spread approved embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.

KK. Place geotextile to prevent particle migration from in-situ soil into open-graded modified embedment materials or drainage layers as specified by project design.

LL. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.

MM. Place haunching material around pipe and compact per the City's standard details to provide uniform bearing and side support. Install haunching in a manner that prevents the pipe from moving.

NN. Place electrical conduit, if used, directly on foundation without bedding.

OO. The method of compaction of the embedment zone material shall comply with the pipe manufacture's recommendation. Water jetting is not allowed.

TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

PP. Place approved backfill for pipe or conduits and restore surface as soon as

practicable. Leave only minimum length of trench open as necessary for construction.

MANHOLES, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

QQ. Manholes, junction boxes and other pipeline structures shall have bedding consisting of a minimum of 1 foot compacted cement stabilized sand (CSS). Install CSS horizontally out from the base to the limits of the excavation (minimum 2 feet), and extend to within 2 feet of the top of the manhole. Install CSS to a uniform depth around the entire perimeter of the structure.

DISPOSAL OF EXCESS MATERIAL

RR. Dispose of excess materials in accordance with requirements of contract documents.

END OF SECTION

SECTION 31 24 00
EMBANKMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes construction of embankments with excess excavated material and borrow.

MEASUREMENT AND PAYMENT

B. Payments will be made in place, per cubic yard.
   1. Refer to Section 01 22 00 – "Unit Prices" for unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

REFERENCES

D. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

E. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

F. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Section 31 24 13 "Roadway Excavation" for acceptable excess materials from roadway excavation.

B. Refer to Section 31 23 23.13 "Backfill" for acceptable excess materials from utility excavation and trenching.

C. Refer to Section 31 05 13.13 "Grade Borrow Material" for acceptable borrow materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify borrow and excess excavated materials to be reused are approved.

B. Verify removals and clearing and grubbing operations have been completed.

PREPARATION

C. Backfill test pits, stump holes, small swales and other surface irregularities. Backfill and compact in designated lift depths to requirements for embankment compaction.

D. Excavate and dispose of unsuitable soil and other unsuitable materials which will not consolidate. Backfill and compact to requirements for embankment.

E. Backfill new utilities below future grade.

PROTECTION

F. Protect trees, shrubs, lawns, existing structures, and other features outside of embankment limits.

G. Protect utilities above and below grade, which are to remain.

PLACING EMBANKMENT

H. Do not conduct placement operations during inclement weather or when existing ground or fill materials exceed 3 percent of optimum moisture content. Contractor may manipulate wet material to facilitate drying, by disking or windrowing.

I. Do not place embankment fill until density and moisture content of previously placed material comply with specified requirements.

J. Scarify areas to be filled to minimum depth of 4 inches to bond existing and new materials. Mix with first fill layer.

K. Spread fill material evenly, from dumped piles or windrows, into horizontal layers approximately parallel to finished grade. Break clods and lumps and mix materials by blading, harrowing, disking or other method as approved by Owner. Extend each layer across full width of fill.

L. Each layer shall be homogeneous and contain uniform moisture content before compaction. Mix dissimilar abutting materials to prevent abrupt changes in composition of fill.

M. Layers shall not exceed the following compacted thickness:

1. Areas indicated to be within right-of-way, shall not exceed 8 inches.

N. For steep slopes, cut benches into slope and scarify before placing fill. Place increasingly wider horizontal layers of specified depth to level of each bench.

O. Build embankment layers on back slopes, adjacent to existing roadbeds, to level of old roadbed. Scarify top of old roadbed to minimum depth of 4 inches and recompact with next fill layer.

P. Construct to lines and grades shown on Drawings.

Q. Remove unsuitable material and excess soil not being used for embankment from site.

R. Maintain moisture content of embankment materials to attain required density.

S. Compact to following minimum densities at moisture content of plus/- 2 percent of optimum as determined by ASTM D 698, unless otherwise indicated on Drawings:

1. Minimum density of 95 percent of maximum dry density.

TOLERANCES

T. Top of compacted surface: Plus or - 0.01 foot.

FIELD QUALITY CONTROL

U. Compaction Testing will be performed in accordance with ASTM D 698 or ASTM D 2922 and ASTM D 3017.

V. A minimum of three tests will be taken for each 1000 linear feet per lane of roadway or 500 square yards of embankment per lift.

W. If tests indicate work does not meet specified compaction requirements, recondition, re-compact, and retest at no cost to the Owner.

X. If area that has previously been approved becomes unstable due to drying or neglect to keep moisture conditioned; rework, re-compact, recondition at no cost.

END OF SECTION

SECTION 31 32 13.16
CEMENT TREATED SUBGRADE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for foundation course of portland cement stabilized natural subgrade material.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for Portland cement stabilized subgrade is on a square yard basis compacted in place to proper density. Separate measurement will be made for each different required thickness of subgrade course.

   a. Limits of measurement shall match actual pavement replaced, but no greater than maximum pavement replacement limits shown on Drawings. Limits for measurement will be extended to include installed portland cement stabilized subgrade material that extends 2 foot beyond outside edge of pavement to be replaced, except where proposed pavement section shares common longitudinal or transverse edge with existing pavement section. No payment will be made for portland cement stabilized subgrade in areas beyond these limits.
   b. Limits of measurement and payment shall match pavement replacement limits shown on Drawings, except indicated, or as approved by Owner.

2. Payment for Portland cement is by ton of 2000 pounds dry-weight basis.
3. Refer to Section 01 22 00 “Unit Prices” for unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

REFERENCES

D. ASTM C 150 - Standard Specification for Portland Cement.

E. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil-Cement-Mixtures.

F. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12.44 ft-lbf/ft3).

G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

SUBMITTALS

I. Conform to requirements of Section 01 33 00 - Submittal Procedures.

J. Submit certification that Portland cement complies with these specifications.

PART 2 - PRODUCTS

2.1 WATER

A. Water: Clean, clear and free from oil, acids, alkali, or organic matter.

PORTLAND CEMENT

B. ASTM C 150 Type I; bulk or sacked.

SOIL

C. Provide soil consisting of approved material free from vegetation or other objectionable matter encountered in existing roadbed.

TESTS

D. Tests and analysis of soil materials will be performed in accordance with ASTM D 4318.

E. The percentage of moisture in soil, at time of cement application, will be ± 2 percent of optimum moisture as determined by ASTM D 558.

MIX DESIGN

F. Geotechnical Engineer shall submit a signed and sealed recommendation determining the target cement content and optimum moisture content to produce a stabilized mixture that meets a minimum compressive strength of 200 psi at 48 hours using.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify subgrade lines and grades are correct.

EQUIPMENT

C. Apply Portland cement treatment with machine or combination of machines and auxiliary equipment to produce specified results. Mixing may be accomplished by multiple-pass traveling mixing plant or single-pass traveling mixing plant. Provide sufficient equipment to enable continuous prosecution of work

PREPARATION (STEP 1)

D. Backfill for utilities below future grade.

E. Verify subgrade is firm and able to support, without displacement, construction equipment at specified density. Correct soft or yielding subgrade and stabilize by scarifying and aerating or by adding cement and compacting to uniform stability.

F. Grade, shape, and compact, as required, to allow construction of Portland cement treatment for in-place materials to lines, grades, thickness, and typical cross section shown on Drawings. Remove unsuitable soil or material and replace with acceptable material.

G. Pulverize soil to specified depth so that at completion of moist-mixing, 100 percent by dry weight passes 1-inch sieve, and minimum of 80 percent passes No. 4 sieve, exclusive of gravel or stone retained on these sieves. Pulverize existing bituminous wearing surfaces so that 100 percent will pass 2-inch sieve.

MIXING (STEP 2)

H. Do not place and mix cement when temperature is below 40 degrees F and falling. Place base when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

I. Spread cement uniformly on soil at rate specified by laboratory. When bulk cement spreader is used, position it by string lines or other approved method to ensure uniform distribution of cement. Apply cement only to area where operations can be continuous and completed in daylight, within 1 hour of application. Amount of moisture in soil at time of cement placement shall not exceed quantity that will permit uniform mixture of soil and cement during dry mixing operations. Do not exceed specified optimum moisture content for soil cement mixture.

J. Do not allow equipment other than that used in spreading and mixing, to pass over freshly spread cement until it is mixed with soil.

K. Dry mix cement with soil after cement application. Continue mixing until cement has been sufficiently blended with soil to prevent formation of cement balls when water is applied. Mixture of soil and cement that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.

L. Immediately after dry mixing is complete, uniformly apply water as necessary and incorporate it into mixture. Pressurized equipment must provide adequate supply to ensure continuous application of required amount of water to sections being processed within 3 hours of cement application. Ensure proper moisture distribution at all times. After last increment of water has been added, continue mixing until thorough and uniform mix has been obtained.

M. Ensure percentage of moisture in mixture, based on dry weights, is within ±2 percentage points of specified optimum moisture content prior to compaction. When uncompacted soil cement mixture is wetted by rain indicating that average moisture content exceeds tolerance given at time of final compaction, reconstruct entire section in accordance with this Section at no additional cost to City.

SLURRY PLACEMENT

N. Mix the required quantity of cement with water, as approved.

O. Provide slurry free of objectionable materials and with a uniform consistency that can be easily applied.

P. Agitate slurry continuously.

Q. Apply slurry within 2 hours of adding water and when roadway is at a moisture content drier than optimum.

R. Distribute slurry uniformly by making successive passes over a measured section of roadway until specified cement content is reached.

COMPACTION (STEP 3)

S. Prior to beginning compaction, ensure mixture is in loose condition for its full depth. Uniformly compact the loose mixture to specified density, lines, and grades.

T. After soil and cement mixture is compacted, apply water uniformly as needed and mix thoroughly. Then reshape surface to required lines, grades, and cross section and lightly scarify to loosen imprints left by compacting or shaping equipment.

U. Roll resulting surface with pneumatic-tired roller and "skin" surface with power grader.

1. Thoroughly compact mixture with pneumatic roller, adding small increments of moisture, as needed.
2. When aggregate larger than No. 4 sieve is present in mixture, make one complete coverage of section with flat-wheel roller immediately after skinning

operation.

3. When approved by Owner, surface finishing methods may be varied from this procedure, provided dense uniform surface, free of surface compaction planes, is produced.
4. Maintain moisture content of surface material at its specified optimum during finishing operations.

5. Compact and finish surface within period not to exceed 2 hours, to produce smooth, closely knit surface, free of cracks, ridges, or loose material, conforming to crown, grade, and line shown on Drawings within period not to exceed 2-hours.
6. Compact to a minimum of 95 percent of the maximum density in accordance with ASTM D698.

CONSTRUCTION JOINTS

V. At end of each day's construction, form straight transverse construction joint by cutting back into total width of completed work to form true 2-inch depth vertical face free of loose and shattered material. Construct cement treatment for large wide areas in series of parallel lanes of convenient length and width approved in advance by Owner.

W. Seal asphalt or emulsion alternate.

CURING

X. Moist cure for minimum of 3 calendar days before placing base or surface course, or opening to traffic. When open, restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

Y. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

Z. Place base and surface within 14 days after final mixing and compaction, unless prior approval is obtained from City.

AA. Alternate Sealer: Use of emulsifier is acceptable. Contractor shall submit alternate rate to owner for acceptance.

TOLERANCES

BB. Completed surface: smooth and conforming to typical section and established lines and grades.

CC. Top of compacted surface: ±1/4 inch in cross section or in 16-foot length.

FIELD QUALITY CONTROL

DD. In-place density will be determined in accordance with ASTM D 2922 or ASTM D 698. Minimum of three tests will be taken for each 1000 feet per lane of roadway or 500 square yards of embankment.

PROTECTION

EE. Maintain stabilized subgrade to lines and grades and in good condition until placement of base or surface course.

FF. Repair defects immediately by replacing material to full depth.

END OF SECTION

SECTION 31 32 13.19
LIME SOIL STABILIZATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foundation course of lime stabilized subgrade material.

   a. Application of lime slurry to subgrade.
   b. Mixing, compaction, and curing of lime slurry, water, and subgrade into a stabilized foundation.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Measurement and payment for lime stabilized subgrade is on a square yard basis compacted in place to proper density. Separate measurement will be made for each required thickness of subgrade course.

   a. Limits of measurement shall match actual pavement replaced, but no greater than maximum pavement replacement limits shown on Drawings. Limits for measurement will be extended to include installed lime stabilized subgrade material that extends 2 foot beyond outside edge of pavement to be replaced, except where proposed pavement section shares common longitudinal or transverse edge with existing pavement section. No payment will be made for lime stabilized subgrade in areas beyond these limits.
   b. Limits of measurement and payment shall match pavement replacement limits shown on Drawings, except as noted or as approved by Project Manager.

2. Measurement and payment for lime is by ton of 2000 pounds dry weight basis. Calculate weight of dry solids for lime slurry based on percentage by dry weight solids.
3. Refer to Section 01 22 00 “Unit Prices” for unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

DEFINITIONS

D. Moist Cure: Curing soil and lime to obtain optimum hydration.

E. 1000-Foot Roadway Section: 1000 feet per lane width or approximately 500 square yards of compacted subgrade for other than full-lane-width roadway sections.

REFERENCES

F. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).

G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

I. TxDOT Tex-101-E (Part III) - Preparation of Soil and Flexible Base Material for Testing.

J. TxDOT Tex-140-E - Measuring Thickness of Pavement Layer.

K. TxDOT Tex-600-J - Sampling and Testing Hydrated Lime, Quicklime, and Commercial Lime Slurry.

SUBMITTALS

L. Conform to requirements of Section 01 33 00 - Submittal Procedures.

M. Submit certification that hydrated lime, quicklime, or commercial lime slurry complies with specifications.

N. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

O. Submit lime series test, signed and sealed by Geotechnical Engineer 7 calendar days prior to liming operations.

P. Contractor shall utilize lime slurry application in accordance with TxDOT 260 unless an alternate lime material is approved by the Geotechnical Engineer and the City of Sugar Land. Approval must be in writing.

PART 2 - PRODUCTS

2.1 WATER

A. Use clean, clear water, free from oil, acids, alkali, or vegetation.

LIME

B. Type A - Hydrated Lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide as listed in chemical composition chart.

C. Type B - Commercial Lime Slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.

D. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:

1. Grade DS: Pebble quicklime of gradation suitable for use in preparation of slurry for wet placing. Quicklime shall be in accordance with ASTM C977.

E. Conform to the following requirements:

CHEMICAL COMPOSITION	TYPE		
	A	B	C
Active lime content, % by weight $Ca(OH)_2$+CaO	90.0 min[1]	87.0 min[2]	-
Unhydrated lime content, % by weight CaO	5.0 max	-	87.0 min
Free water content, % by weight H_20	5.0 max	-	-
SIZING Wet Sieve, as % by weight residue retained:			
No. 6	0.2 max	0.2 max[2]	8.0 max[3]
No. 30	4.0 max	4.0 max[2]	-
Dry sieve, as % by weight residue retained:			
1-inch	-	-	0.0
½-inch	-	-	10.0 max

Notes:
1. Maximum 5.0% by weight CaO shall be allowed in determining total active lime content.
2. Maximum solids content of slurry.
3. Total active lime content, as CaO, in material retained on No. 6 sieve shall not exceed 2.0% by weight of original Type C lime.

F. Deliver lime slurry to job site as commercial lime, or prepare at job site by using hydrated lime or quicklime. Provide slurry free of liquids other than water and of consistency that can be handled and uniformly applied without difficulty.

G. Lime containing magnesium hydroxide is prohibited.

SOIL

H. Soil to receive lime treatment may include borrow or existing subgrade material, existing pavement structure, or combination of all three. Where existing pavement or base material is encountered, pulverized or scarify material so that 100 percent of sampled material passes 2inch sieve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade will support imposed loads.

B. Verify subgrade lines and grades.

PREPARATION

C. Complete backfill of utilities prior to stabilization.

D. Cut material to bottom of subgrade using an approved cutting and pulverizing machine meeting following requirements:

1. Cutters accurately provide smooth surface over entire width of cut to plane of secondary grade.
2. Provide cut to depth as specified or shown in the Drawings.

E. Alternatively, scarify or excavate to bottom of stabilized subgrade. Remove material or windrow to expose secondary grade. Obtain uniform stability.

F. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting as directed by Owner.

G. Pulverize existing material so that 100 percent passes a 1-3/4-inch sieve.

LIME SLURRY APPLICATION

H. Apply slurry with distributor truck equipped with an agitator to keep lime and water in consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed within 6 hours of application.

I. Minimum lime content shall be 6 percent of dry unit weight of subgrade as determined by ASTM D 698 or Geotechnical recommendation.

J. Apply lime slurry in accordance with TxDOT 260.

K. Spread lime only on area where first mixing operations can be completed within 6 hours of application.

L. Mix hydrated lime or quicklime with water to form a slurry of the solid content specified. Commercial lime slurry shall have dry solid content as specified. Conform to cautionary requirements as specified.

M. Apply slurry with a distributer truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured sections of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on same working day.

N. Apply so that dry subgrade will contain a minimum lime content of 6 percent by weight of dry subgrade unless otherwise directed as a result of soil testing. Soil and lime should be mixed such that the plastic index is 20 or less with a pH of 12.4.

PRELIMINARY MIXING

O. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain homogeneous friable mixture free of clods and lumps.

P. Shape mixed subgrade to final lines and grades.

Q. Do not mix or place material when temperature is below 40 degrees F. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F.

FINAL MIXING

R. Final Mixing shall begin within 3 to 7 days.

S. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.

T. Add water to bring moisture content of soil mixture to optimum or above.

U. Mix and pulverize until all material passes 13/4-inch sieve; minimum of 85 percent, excluding non-slacking fractions, passes 3/4-inch sieve; and minimum of 60 percent excluding non-slacking fractions passes No. 4 sieve. Test according to TxDOT Tex-101-E, Part III using dry method.

V. Shape mixed subgrade to final lines and grades.

W. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

COMPACTION

X. Aerate or sprinkle to attain optimum moisture content to 3 percent above optimum, as determined by ASTM D 698 on material sample from roadway after final mix with lime.

Y. Start compaction immediately after final mixing.

Z. Spread and compact to where total compacted thickness is greater than equipment manufacturer's recommended range of mixing and compaction.

AA. Compact with approved heavy pneumatic or vibrating rollers, or combination of tamping rollers and light pneumatic rollers. Begin compaction at bottom and continue until entire depth is uniformly compacted.

BB. Do not allow stabilized subgrade to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and re-compacting.

CC. Compact subgrade to minimum density of 95 percent of maximum dry density, according to ASTM D 698, at moisture content of ±2 percent above optimum, unless otherwise indicated on Drawings:

DD. Seal with approved light pneumatic tired rollers. Prevent surface hair line cracking. Rework and re-compact at areas where hairline cracking develops.

CURING

EE. Moist cure for minimum of 3 days before placing base or surface course, or opening to traffic. Subgrade may be opened to traffic after 2 days when adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

FF. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

GG. Place base or surface within 3 to 5 calendar days after final mixing and compaction.

HH. Loss of moisture or stability.

TOLERANCES

II. Completed surface: smooth and conforming to typical section and established lines and grades.

JJ. Top of compacted surface: + or - 1/4 inch in cross section or in 16-foot length.

KK. Depth of lime stabilization shall be + or - 1/2 inch of specified depth for each 1000 foot roadway section.

FIELD QUALITY CONTROL

LL. Test soils, lime, and mixtures as follows:

1. Tests and analysis of soil materials will be performed in accordance with ASTM D 4318, using the wet preparation method.
2. Sampling and testing of lime slurry shall be in accordance with TxDOT Tex-600-J, except using a lime slurry cup.
3. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.
4. Moisture-density relationship will be established on material sampled from roadway, after stabilization with lime and final mixing, in accordance with ASTM 698, Moist preparation Method.

MM. In-place depth will be evaluated for each 1000-foot roadway section and determined in accordance with TxDOT Tex-140-E in hand excavated holes. For each 1000-foot section, 3 phenolphthalein tests will be performed. Average stabilization depth for 1000-foot section will be based on average depth for three tests.

NN. Perform compaction testing in accordance with ASTM D 2922. Three tests will be performed for each 1000-foot roadway section.

OO. Pulverization analysis will be performed as required on material sampled during mixing of each production area. Three tests will be performed per 1000-foot roadway section or a minimum of once daily.

REWORK OF FAILED SECTIONS

PP. Rework sections that do not meet specified thickness.

QQ. Rework sections that paving did not begin within specified the time allotted.

RR. Rework sections in conformance with TxDOT Item 260.

PROTECTION

SS. Maintain stabilized subgrade to lines and grades and in good condition until placement of base or surface course. Protect asphalt membrane from being picked up by traffic.

TT. Repair defects immediately by replacing material to full depth.

END OF SECTION

SECTION 31 34 19.16
GEOTEXTILE SOIL REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the furnishing of materials and placement of geotextile soil reinforcement as indicated on the Drawings or directed by the Owner.

PRICE AND PAYMENT PROCEDURES

B. Measurement and Payment:

1. Method of Measurement: By the square yard as indicated in contract documents, including seams, overlaps, and wastage.
2. Basis of Payment: By the square yard as indicated in contract documents installed.

SUBMITTALS

C. Product Data: For each type of product indicated.

1. Catalog cuts.
2. Samples of material selected.
3. Product test reports.

QUALITY ASSURANCE

D. Installer Qualifications: A firm that is acceptable to manufacturer for installation specified materials.

E. Pre-installation Conference: Conduct conference at Project site.

DELIVERY, STORAGE, AND HANDLING

F. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.

G. Products shall be wrapped with material to protect from damage due to shipment, water, sunlight, and contaminants.

H. Elevate products off of ground and adequately cover to protect from the following:

1. Site construction damage.
2. Extended exposure to ultraviolet radiation.
3. Precipitation.
4. Temperatures in excess of 160 degrees F.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Synthetic thermoplastic fiber material woven or non-woven to form a mat of uniform quality.
2. Fabric fibers may be either continuous or discontinuous and oriented in either a random or an aligned pattern throughout the fabric.
3. The fabric shall be mildew resistant, rot proof and shall be satisfactory for use in a wet soil and aggregate environment.
4. The fabric shall contain ultraviolet stabilizers and shall have non-raveling edges.

B. Physical Requirements:

1. Fabric shall meet requirements of the following table when sampled and tested in accordance with methods indicated:

TABLE 1: FILTER FABRIC REQUIREMENTS

Original Physical Properties	Test Method	Requirements
Fabric weight (mass), on an ambient temperature air-dried tension free sample, expressed in oz/ sq. yd (grams/ square meter)	TxDOT Tex-616-J*	Underdrains/Slope Stabilization 4.0 (135) minimum
		Gabions and Revet Mattresses 6.0 (200) minimum
Water flow rate by falling head method, 7.9 inches (20 cm) to 3.9 inches (10 cm) on 2 inch (50 mm) ID cylinder with 1 inch (25 mm) diameter orifice, with flow rate expressed in gal/sq.ft/minute (liters/square meter/minute).	TxDOT Tex-616-J*	80 (3,260) minimum

Breaking load in either machine or cross-machine direction, expressed in pounds (newtons)	ASTM D-1682 grab method G**	100 (445) minimum
Equivalent opening size for US Standard (SI) sieves.	CW-02215	70 to 100 (212 to 150μm)
"Apparent elongation" at breaking load in either machine or cross-machine direction, expressed as percent	ASTM D-1682 grab method G**	100 maximum

*TxDoT Tex-616-J, "Testing of Construction Fibers
**ASTM D 1682 grab method G, "Test Methods for Breaking Load and Elongation of Textile Fabrics"* as modified by TxDoT Test Method Tex-616-J
***CW-02215, US Army Corps of Engineers, Civil Works Construction Guide Specification "Plastic Filter Fabric".

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare surface to receive materials as indicated on Drawings.

INSTALLATION

B. Install in accordance with manufacturer’s written instructions.

C. When lapping is required, it shall be in accordance with the manufacturer's recommendations.

D. Backfilling around the Filter Fabric shall be done in such a manner that the Filter Fabric material will not be damaged during the placement.

END OF SECTION

SECTION 31 36 19
GABIONS AND REVET MATTRESSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section furnishing, assembling, filling, and tying rock-filled wire mesh compartmented gabions and revet mattresses

MEASUREMENT AND PAYMENT

B. Measurement of acceptable "Gabions and Revet Mattresses", complete in place, will be made on the basis of volume determined by the actual length, width and height.

C. The Gabion and revet mattress quantities, measured as described above, will be paid for at the unit bid prices per cubic yard of the various types indicated. The price shall include full compensation for furnishing, hauling and placing all materials, including filter fabric, wire containers, connectors, reinforcement stones and backfill; for all labor, tools, equipment and incidentals needed to complete the work.

D. Excavation and all subgrade preparation required for shaping the foundation for the wire containers shall be included in the unit bid price for "Gabions and Revet Mattresses".

PART 2 - PRODUCTS

2.1 MATERIALS

A. Construct gabions and revet mattresses of galvanized steel wire with polyvinyl-chloride (PVC) flexible coating.

1. Ggabions and revet mattresses shall be of the construction and sizes as specified and as indicted on Drawings.
2. Furnish gabions in the specified dimensions within a tolerance of ± 5 percent.
3. Furnish revet mattresses in the specified dimensions within a tolerance of ± 5 percent for the length and width and ± 10 percent for the height.
4. For each individual gabion or revet mattress, use the same mesh style for the base, front, ends, back, diaphragms and lid panels.
5. Each gabion or revet mattress shall be manufactured and divided into cells of equal length, no greater than 3 feet (0.9 meter), by diaphragm panels.

6. Gabion and Revet Mattress Wire:

a. Gabion wire shall be galvanized steel, Class 3 or A coating, soft temper conforming to ASTM A 641, and shall specifically meet the requirements given below for gabions (12 gage wire) and/or revet mattresses (13.5 wire gage) as indicated on Drawings.

b. PVC coating of the wire may be fuse-bonded or extruded onto the wire. Galvanization of welded wire shall be performed either before or after welding.

c. Table 1: Requirements – Mesh Wire for Gabions and Revet Mattress Units

Characteristic	Gabions	Revet Mattresses
Wire Gage	12 gage	13.5 gage
Maximum Tensile Strength (ASTM 641)	70,000 psi (483 mPa)	75,000 psi (517 mPa)
Nominal Wire Diameter (ASTM A 641)	0.106 inch (2.7 mm)	0.0866 inch (2.2 mm)
Minimum Diameter (ASTM A 641, Table 3)	0.102 inch (2.6 mm)	0.0826 inch (2.9 mm)
Galvanizing, Zinc (ASTM A 641, Table 1)	0.80 oz/ft^2 (245 gr/m^2)	0.70 oz/ft^2 (215 gr/m^2)

7. Gabion Mesh

a. Woven Mesh

1) Woven mesh shall be of a uniform non-raveling, double twist hexagonal pattern nominally of dimensions 3.25 inches by 4.5 inches (83 mm by 114 mm). Selvedge wire shall be 10 gage (nominal diameter of 3.4 mm).

8. Welded Mesh

a. Mesh opening shall be nominally 3 inches by 3 inches (75 mm by 75 mm). Strength of welds shall meet the following requirements when tested in accordance with section 13.4 of ASTM A-974:

b. Table 2: Minimum Weld Strength Requirements

Type of Structure	Wire Size (Diameter)	Minimum Average Weld Shear Strength
	Gage (mm)	English Units (SI Units)
Gabions	12 (2.7)	472 lbf (2.10 kN)
Revet Mattress	13.5 (2.2)	292 lbf (1.30 kN)

B. Manufacturing:

1. Twisted wire mesh gabions shall be manufactured in conformance with ASTM A-975, while welded wire mesh gabions shall be manufactured in conformance with ASTM A-974.

C. Revet Mattresses:

1. Woven Mesh: Woven mesh shall be of a uniform non-raveling, double twist hexagonal pattern, nominally of dimensions 2.5” x 3.25” (64 mm by 83 mm). Selvedge wire shall be 12 gage (nominal diameter of 2.7 mm).

D. Welded Mesh:

1. Mesh opening shall be nominally 1.5” x 3.0” (38 mm by 76 mm). Strength of welds shall meet the requirements listed in Table 2 for 13.5 gage (2.2 mm) wire, when tested in accordance with section 13.4 of ASTM A-974:
2. Twisted wire mesh revet mattresses shall be manufactured in conformance with ASTM A-975, while welded wire mesh revet mattresses shall be manufactured in conformance with ASTM A-974.

E. PVC Coating:

1. All wire used in fabrication of the gabions, revet mattresses and wiring operations during construction shall, after zinc coating, have a fuse-bonded or extruded coating of PVC. The coating shall be gray in color. The thickness shall be nominally 0.020 inch (0.5 mm), and shall not be less than 0.015 inch (0.38 mm) in thickness. It shall be capable of resisting deleterious effects of natural weather exposure, and immersion in salt water.
2. For PVC-coated welded wire fabric panel, cutting of the panels shall not be allowed closer than 1/4 inch ± 1/8 inch (6 mm ± 3.18 mm) after fabrication in order to prevent exposure near the welds.

F. Initial Properties:

1. Woven Mesh: The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-975:
2. Specific Gravity: The specific gravity as determined in accordance with ASTM D-792 shall be between 1.3 to 1.35.
3. Durometer Hardness:The hardness as determined in accordance with ASTM D-2240 shall be between 50 to 60, Shore D.
4. Tensile Strength:The tensile strength when tested in accordance with ASTM D-412 shall not be less than 2985 psi (20.6 mPa).
5. Modulus of Elasticity at 100% Elongation:

    a. The Modulus of Elasticity when determined in accordance with ASTM D-412 shall not be less than 2700 psi (18.6 mPa).

6. Resistance to Abrasion:

    a. The percentage loss in weight (mass) during abrasion testing in accordance with ASTM D-1242 shall be less than 12%.

7. Brittleness Temperature:

    a. The brittleness temperature shall not be higher than 15^0F (–9.0^0C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 15^0F (8^0C) below the minimum temperature at which the gabion will be handled or filled.

G. Welded Mesh:

1. The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-974:
2. Specific Gravity:

    a. The specific gravity as determined in accordance with ASTM D-792 shall be between 1.20 and 1.40.

3. Durometer Hardness:

    a. The hardness as determined in accordance with ASTM D-2240 shall not be less than 75, Shore A.

4. Tensile Strength:

    a. The tensile strength when tested in accordance with ASTM D-638 shall not be less than 2275 psi (15.7 mPa).

5. Modulus of Elasticity:

    a. The Modulus of Elasticity when determined in accordance with ASTM D-638 shall not be less than 1980 psi (13.7 mPa).

6. Resistance to Abrasion:

   a. The percentage loss in weight (mass) shall be less than 12 % during abrasion testing in accordance with ASTM D-1242, Method B, at 200 cycles, CSI-A abrader tape, 80 grit.

7. Brittleness Temperature:

   a. The brittleness temperature shall not be higher than 15^0F (–9.0^0C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 15^0F (8^0C) below the minimum temperature at which the gabion will be handled or filled.

8. Adhesion:

   a. The PVC coating on the wire shall adhere to the wire such that the coating breaks rather than separates from the wire, when tested in accordance with the PVC Adhesion Test described in Section 13.3 of ASTM A-974.

9. Mandrel Bend:

   a. The PVC-coated wire, when subjected to a single 360^0 bend at 0^0F (-18^0C) around a mandrel ten times the diameter of the wire, shall not exhibit breaks or cracks in the PVC coating.

H. Performance Tests:

1. The PVC coating shall have the demonstrated ability to withstand the specified exposure testing.

   a. Exposure to Salt Spray: The PVC shall show no effect after 3000 hours of salt spray exposure in accordance with ASTM Test Method B-117.
   b. Exposure to Ultraviolet Rays: The PVC shall show no effect of exposure to ultraviolet light with test exposure of 3000 hours, using apparatus Type E and 145^oF (63^oC), when tested in accordance with ASTM Practice D-1499 and G-23.

I. Properties After Exposure Tests:

1. After conclusion of the salt spray and exposure to ultraviolet light tests, the PVC shall not show cracks, blisters or splits, nor any noticeable change in color. In addition the PVC coating shall not show cracks or breaks after the wires are twisted in the fabrication of the mesh, nor shall there be any moisture intrusion under the PVC coating as a result of the test.
2. After completion of the exposure tests the following criteria shall also be met:

   a. Woven Mesh:

      1) The Specific Gravity shall not change more than 6% of its initial

value.

2) The Durometer Hardness shall not change more than 10% of its initial value.
3) The Tensile Strength shall not change more than 25% of its initial value.
4) The Resistance to Abrasion shall not change more than 10% of its initial value.

b. Welded Mesh:

1) The Specific Gravity shall not change more than 6% of its initial value.
2) The Modulus of Elasticity shall not change more than 25% of its initial value.
3) The Tensile Strength shall not change more than 25% of its initial value.
4) The Resistance to Abrasion shall not change more than 10% of its initial value.

J. Salt Spray Resistance for Fastener:

1. The fasteners for twisted mesh wire gabions and revet mattresses shall be subjected to Salt Spray Test of Test Method B-117 for a period of not less than 48 $\pm$ 1 hour cycle length. After testing the fasteners, the selvedge, or mesh wire confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends.
2. Stone
3. Gabion Basket Stones

a. Stone fill shall be durable and of suitable quality to ensure permanence in the structure. The stone used to fill the gabion baskets shall be a clean, sound, and durable rock meeting the following requirements. It shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410-A). The loss of material experienced during five cycles of magnesium sulfate exposure conducted in accordance with TxDOT Test Method Tex-411-A for Rock RipRap shall not exceed 18 percent. The stone shall be well graded to produce a dense fill, angular in texture, while meeting the following gradation requirements:

b. Table 3: Gabion Stone Gradation Requirements

Sieve Size US (SI)	Percent by Weight (Mass) % Passing Each Individual Sieve
8 Inch (200 mm)	100
4 Inch (100 mm)	0 - 5

3 Inch (75 mm)	0

c. The minimum unit weight (unit mass) of a rock-filled gabion shall be 120 pcf [1.92 megagrams (mg) per cubic meter]. Verification of unit weight (mass) shall be performed when ordered by the Engineer, by constructing a test gabion with materials supplied for construction with the same effort and method intended for production gabions.

K. Revet Mattress Stone:

1. The stone used to fill the revet mattresses shall be as specified for gabions except that it shall have a maximum dimension of 5 inches (125mm) and a minimum dimension of 3 inches (75 mm). The majority of the stone shall be in the 3 to 4 inch (75 to 100 mm) range; cubical or rounded in shape. A tolerance of 5% shall be allowed on the upper and lower dimensions of the rock.
2. Connections

L. Wire

1. Lacing wire and connecting wire shall be 13.5 gage [0.087 inch (2.20 mm)] PVC coated galvanized steel, Class 3, soft temper, conforming to ASTM A-641. During testing, any separation of 2 inches (50 mm) or more between connecting wires shall be considered as a failure.

M. Spiral Binder for Welded Wire Mesh

1. Spiral binders shall consist of 0.106 inch (2.7 mm) PVC coated wire for the gabion and 0.087 inch (2.2 mm) PVC coated wire for the revet mattresses. Spiral binders shall have a 3.0 inch (75 mm) maximum separation between continuous successive loops (3 inch or 75mm pitch).
2. The binder shall be made of galvanized steel, Class 3, soft temper, conforming to ASTM A-641.

N. Alternate Fasteners for Twisted Woven Mesh

1. Alternate fasteners, acceptable for use by the intended gabion basket manufacturer, may be submitted to the Engineer for consideration and approval prior to construction. The fasteners may consist of split ring or interlocking fasteners. Alternate fasteners systems shall produce a joint that meets the requirements of ASTM A-975, Section 7, Table 2.

O. Fastener System

1. The Contractor shall provide a complete description of the fastener system, including the number of fasteners required for all vertical and horizontal connections for single- and multiple-basket joinings, as well as the number and size wires the fastener is capable of properly joining. The Contractor shall provide a description of a properly installed fastener, including test reports, drawings and/or photographs. Properly formed fasteners shall meet the requirements of ASTM A-974 for welded wire mesh or ASTM A-975 for twisted

woven mesh.

a. Each interlocking fastener shall be locked and closed.
b. Each overlapping ring fastener shall be closed and the free ends shall overlap an average of 1 inch (25 mm).
c. Spiral binders shall be screwed into position such that they pass through each mesh opening along the joint. In order to prevent unraveling, both ends of the spiral shall be crimped back around itself.
d. Wire fasteners shall not be used to join more wires, or larger wires, than tested and approved for the application.

2. Panel to Panel Joint Strength

a. The minimum strength of the joined panels shall be as specified in Section 7.3 of ASTM A-974 for Welded wire panels or Section 7.3 of ASTM A-975 for twisted woven mesh.

P. Miscellaneous

1. Aggregate bedding, geotextiles or other materials shall conform to the requirements established on the Drawings.

Q. Certificate of Compliance

1. The Contractor shall submit Certificates of Compliance for all materials proposed for use to the Engineer for review and approval one week prior to construction.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Twisted wire mesh Gabon's and revet mattresses shall be supplied in the forms allowed in ASTM A-975, while welded wire mesh Gabon's and revet mattresses shall be supplied in a form allowed in ASTM A-974.

B. The Gabon/revet mattress manufacturer/supplier will be required to have a qualified representative on site at the start of gabion/revet mattress construction. The Contractor shall submit work experience documentation of the representative for review/approval by the Engineer or designated representative. The representative shall be available for consultation as needed throughout the gabion construction.

C. Gabions and revet mattresses shall be constructed to the lines and grades shown on the Drawings. Individual or groups of gabions or revet mattresses, which deviate from line and grade, shall, at the direction of the Engineer or designated representative, be removed and replaced at no cost to the owner. Gabions or revet mattresses, which are constructed with bulges, and/or underfilled, loosely filled, or otherwise lacking a neat and compact appearance shall, at the direction of the Engineer or designated representative, be repaired/replaced at no cost to the owner. Underfilling of gabion/revet mattress corners to facilitate insertion of spirals shall not be permitted.

FOUNDATION PREPARATION

D. The foundation shall be excavated to the extent shown on the Drawings or as directed by the Engineer or designated representative. All loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. The depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to a density at least equal to that of the adjacent foundation. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free draining materials.

E. Any buried debris protruding from the foundation that will impede the proper installation and detrimentally impact the final appearance of the gabion, shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to gabion or revet mattress placement, the prepared foundation surface shall be inspected and approved by the Engineer and no material shall be placed thereon until that area has been approved.

F. Placement of filter material and/or filter fabric shall be as shown on the Drawings or directed by the Engineer.

GABION/REVET MATTRESS BASKET ASSEMBLY

G. No work shall take place using PVC coated materials unless both the ambient air temperature and the temperature of the PVC materials are at least 15°F (80C) above the brittleness temperature of the PVC materials.

H. Assembly of gabions and revet mattresses shall consist of shaping and tying each individual basket. Baskets shall be assembled by connecting all untied edges including diaphragms with lacing wire, spirals or approved fasteners. The connections for the completed assemblies shall conform to the requirements of Section 7 of ASTM specifications A-974 (welded wire) and Section 7.3 and Table 2 of A-975 (double twisted).

I. Assembly of baskets, connection of baskets together and lid closures shall be accomplished in accordance with one of the following approved procedures:

1. Lacing Wire:

a. Using lacing wire of appropriate length, secure one end of the wire onto the basket corner by looping and twisting the lacing wire together. Proceed along the joint by tying with double loops every other mesh opening at intervals not more than 6 inches (150 mm) apart, while pulling the basket elements tightly together. Secure the other end of the lacing wire again by looping and twisting the wire around itself.

J. Spiral Binders for Welded Wire Mesh:

1. Spiral binders, meeting the minimum acceptance criteria of article 594S.2 (6) c) shall be screwed into position such that they pass through each mesh opening

along the joint. To prevent unraveling, each end of the spiral binder shall be crimped back against itself.

K. Alternate Fasteners for Twisted Woven Mesh:

1. Interlocking fasteners meeting the minimum acceptance criteria of article 594S.2 (6) c), shall be installed with, as a minimum, one interlocking fastener in every other opening.
2. Ring fasteners meeting the minimum acceptance criteria of 594S.2 (6)c), shall be installed with, as a minimum, one split ring fastener in every opening, having a minimum 1 inch (25 mm) total overlap and securing only the number and diameter of wires for which tested.
3. Placing of gabions and revet mattresses shall consist of installing baskets to the lines and grades shown on the Drawings. Gabions and revet mattresses shall be securely fastened to each adjoining unit along the vertical and top reinforced edges of all contact surfaces. Overlying rows of baskets shall be staggered appropriately. Empty sections stacked on a filled line of gabions and revet mattresses shall be securely fastened to the bottom unit along the front, back and ends.
4. Prior to the placement of rock, the baskets used in the front vertical exposed faces of retaining walls shall be aligned. To facilitate alignment, tension may be applied to empty units at the direction of the Engineer or designated representative.

L. Filling of Gabions and Revet Mattresses

1. The gabions and revet mattresses may be filled by machine, in maximum lifts of 12 inches (300 mm). The machine work shall be supplemented with handwork to avoid bulges and provide a compact mass with a minimum of voids. Care will be exercised so as not to damage the gabion/revet mattress elements or wire coating by limiting height of drop during filling to 3.0 feet (0.9 meter) for Gabions and 1.5 feet (0.5 meter) for revet mattresses. Undue deformation or bulging of the mesh shall be corrected prior to further stone filling. Where specified on the Drawings, select large stone shall be hand placed on vertical outside faces to achieve a desired neat appearance.
2. During placement, the depth of stone in any cell shall not exceed the depth in an adjoining cell by more than one foot (300 mm). Stone smaller than the mesh opening found against vertical faces shall be removed.
3. Two connecting wires in each direction for end units and two parallel connecting wires perpendicular to the exposed face for exposed face units shall be installed at every 12 inch (300 mm) lift. The connecting wires shall loop around two mesh openings, and the ends of wires shall be securely twisted with a minimum of three twists after looping. Prefabricated connecting wire may be used in lieu of connecting wire.
4. Connecting wires associated with 18-inch (450 mm) gabions shall be installed when and as specified on the Drawings or as recommended by the gabion/revet mattress manufacturer.
5. The gabion or revet mattress unit shall be overfilled by 1 1/2 to 2 inches (37.5 to 50 mm) and the lid shall be bent and stretched until it meets the perimeter edges of the front and end panels. The stretching shall be accomplished using an

approved lid closing tool in order to prevent damage to the PVC coating. Crow bars or similar single point leverage devices will not be allowed. The lid shall then be securely tied with lacing wire, spirals or approved fasteners to the fronts, ends and diaphragms. Excessive deformation of the lid panel to facilitate closing of a bulging gabion or revet mattress will not be permitted.

6. All backfill shall be placed and compacted in sequence with the filling of the baskets; however, care shall be exercised in compacting the fill behind a single row of baskets since excessive compaction effort can displace the gabions/revet mattresses from the desired alignment.
7. Gabion or revet mattress units may be cut or shaped to fit odd length or odd shaped areas. They shall be cut at least 6" to 8" (150 mm to 200 mm) larger than the opening to allow sufficient material for overlap and lacing. All edges or faces formed in this manner shall be adjusted to present a finished and pleasing appearance.
8. At all times, care shall be taken to turn all loose and projecting ends of wire into the gabion units to prevent injury.

WORKMANSHIP

M. Wire of proper grade and quality, when fabricated and installed in the manner herein required, shall result in a strong, serviceable mesh-type product having substantially uniform openings. It shall be fabricated and finished in a workmanlike manner, as determined by visual inspection, and shall conform to this specification.

END OF SECTION

SECTION 31 64 10
CAISSONS FOR LIFT STATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Constructing external walls of lift station wet well structures by caisson method, including base slab and excavation cell partitions. Valve/pump chamber to be constructed by open cut.
2. If method of construction is not specified, Contractor may select caisson method as an alternate to open-cut method for wet well construction.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. No separate payment will be made for lift station construction using caisson method. Include cost for caisson construction in lump sum for lift station.
2. No separate measurement will be made for payment of concrete in wet well caisson except listed in an approved schedule of values.
3. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

DEFINITIONS

D. Caisson: External walls of concrete structure, together with excavation cell partition walls, erected at-grade or in starter pit and sunk by gravity to final position through excavation inside structure under dry or wet conditions. Complete caisson includes structural base slab. Caisson walls provide ground support during construction and for permanent installation.

E. Dry Construction: Contractor operates sufficient external ground water control system to maintain ground water level and piezometric head safely below excavation bottom within caisson.

F. Wet Construction: External hydrostatic ground water pressure is counteracted by water or slurry within caisson.

REFERENCE STANDARDS

G. ASTM D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3 (600 kN-m/m3)).

SUBMITTALS

H. Conform to requirements of Section 01 33 00 Submittal Procedures.

I. Submit drawings and design calculations prepared by Contractor's Engineer.

J. Show modifications proposed to lift station structure design required for caisson construction.

K. Submit wall design including water jet, bentonite and grout pipes, and injection ports, and dimensions of annular space for bentonite lubrication. Show increased wall thickness for dead weight when required to sink caisson. Show height of each concrete placement lift and construction joint locations.

L. Submit safety plan to meet OSHA requirements. These procedures will not be subject to approval by City Engineer and are for record purposes only. Address in plan, as minimum but not limited to the following:

1. Protection against caisson instability, soil instability, and ground water inflow.
2. Safety for caisson access and exit, including ladders, stairs, walkways, and hoists.
3. Protection against equipment operations, and for lifting and hoisting equipment and material.
4. Support of surcharge weights.
5. Ventilation systems.
6. Monitoring for hazardous gases.
7. Protection against flooding of caisson and inflow into sewers when connected to caisson structure.
8. Protection of workers and public, including traffic barriers, accidental or unauthorized entry, and falling objects.
9. Safety supervising responsibilities.

M. Building and Structures Assessment: Submit for review prior to construction, Building and Structures Assessment Plan. Provide preconstruction and post-construction assessment reports for buildings and structures located within distance equal to depth of caisson but at least 50 feet in plan from proposed caisson perimeter. Include photographs or video of existing damage to structures in vicinity of caisson in assessment reports.

N. Caisson Survey: Submit Caisson Survey identifying required modifications to complete lift station and to comply with specified tolerances.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Concrete is to be in accordance with Section 03 31 00 Structural Concrete.

REINFORCEMENT

A. Reinforcement is to be in accordance with Section 03 21 00 Reinforcing Steel.

EMBEDDED ITEMS

A. Embedded items are to be in accordance with Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment.

BACKFILL

B. Select material is to be in accordance with Section 31 23 33.16 Excavation and Backfill for Structures.

C. Cement stabilized sand is to be in accordance with Section 31 23 23.53 Cement Stabilized Sand.

GROUT

A. Use grout conforming to Section 31 73 00 Tunnel Grouting.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. Perform site preparation for site clearing and for grading of site to required elevation. Provide for site drainage.

B. Relocate and protect utilities to remain that may be affected by caisson construction area, including starter pit.

C. Install security fencing around caisson construction areas to prevent accidental or unauthorized entry.

D. Provide for control of ground water and surface water according to Section 01 57 10 Temporary Control of Groundwater and Surface Water.

E. Compact disturbed soils to 95 percent of maximum density as determined by ASTM D

698. Compact soil at moisture content sufficient to develop required density.

CAISSON WALL CONSTRUCTION

F. Place concrete as specified in Section 03 31 00 Structural Concrete.

G. Inspect concrete surfaces after form removal and repair defects before wall section is sunk into ground.

CAISSON CLEAN UP AND INSPECTION

H. Clean interior of caisson after seal slab has been poured. Remove soil, mud, slurries, spilled grout or concrete, or other materials not part of structure from caisson and clean surfaces.

B. Inspect caisson for possible structural damage or damage to embedded items occurring during excavation and caisson sinking. Notify and allow City Engineer to witness caisson inspection. Repair and replace damage before proceeding with construction.

CAISSON CONSTRUCTION TOLERANCES

I. Maximum acceptable deviation of caisson from vertical is 1 inch in 5 feet.

J. Maximum acceptable horizontal deviation from design location of center of caisson at ground surface level is 12 inches.

K. Install elevation of base of caisson structure equal to or lower than elevation shown in Drawings. Show top of caisson structure elevation on Drawings.

L. Provide block-outs with allowance for pipe entry deviations of plus or - 1.5 inches vertically and plus or - 6 inches horizontally, plus caisson construction tolerances.

M. Tolerances defined above are only acceptable provided that Contractor can adjust sewer connections, structural, mechanical and electrical components to resolve deviation from plumpness and horizontal or vertical location as approved by City Engineer. Adjustments must be made without adversely affecting operation or maintenance of lift station.

N. Monitor caisson installation to verify that no settlement or heave is observed for 10 consecutive days starting not later than 50 days after structural completion.

BACKFILL

O. Remove starter pit shoring to depth of at least 8 feet below ground surface and for at least 5 feet from pipes and tunnels penetrating shoring. Remove shoring concurrent with backfilling operations. Perform shoring removal and backfilling so that stability of pit is maintained.

P. Compact backfill material in accordance with Section 31 23 10 Structural Excavation and Backfill.

MONITORING

Q. Settlement: Install series of settlement monitoring points on ground and structures within area of potential influence due to soil movements at caisson, before start of caisson or starter pit construction.

1. As minimum, equally space 4 monitoring points around caisson at distance of 15 feet and 4 more at distance 30 feet from caisson for total of 8 monitoring points.
2. Survey monitoring point elevations before start of caisson excavation and weekly thereafter until structure has been completed and dewatering terminated.

R. Caisson:

1. Determine plumbness of caisson at least once each shift at two locations, 90 degrees apart, during caisson sinking operations until caisson is secured by grout and base slab hardened.
2. As soon as caisson has been secured, install 3 benchmarks, 120 degrees apart, on top concrete placement for settlement monitoring of installed caisson. Transfer benchmarks to higher elevation on structure as required due to continued lift station construction. Continue weekly monitoring of settlement points until 60 days after completed construction of structure.
3. Install and monitor borehole heave points in caisson for dry construction as defined on Drawings. Survey heave points before excavation starts and upon retrieval when final excavation bottom has been reached.
4. Submit monitoring results to City Engineer weekly.

CAISSON SURVEY

S. When caisson has been secured, seal slab poured, and, in case of wet construction, when fluid has been pumped out, survey installed caisson for compliance with tolerances defined. Include in Survey:

1. Location of center of caisson at ground level.
2. Elevation of top and bottom of caisson and structural slab connection.
3. Elevation and locations of penetrations and embedded items and other support points for lift station installation completion.
4. Deviation from plumb from caisson top to structural slab at two locations 90 degrees apart.

FIELD QUALITY CONTROL

T. Perform field inspection and testing in accordance with Section 03 31 00 Structural Concrete and Section 01 45 00 Quality Control.

DISPOSAL OF EXCESS MATERIAL

U. Remove excavated material from job site in accordance with Section 01 74 13 Progress Cleaning.

END OF SECTION

SECTION 32 01 11.01
ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes requirements for the elimination of pavement markings and raised pavement markers.

1.02 MEASUREMENT AND PAYMENT

A. Measurement

1. This item will be measured by each word, symbol, or shape eliminated; by the linear foot of marking eliminated; or by any other unit shown on the plans.

B. Payment:

1. The work performed and materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid for “Eliminating Existing Pavement Markings and Markers” of the type and width as applicable. This price is full compensation for the elimination method used and equipment, materials, tools, labor, and incidentals. Removal of raised pavement markers will not be paid for directly and will be subsidiary to the pertinent bid items.

   This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified. Additional measurements or calculations will be made if adjustments of quantities are required due to an increase or decrease that exceeds 5%.

2. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Use potable water when water is required.

B. Use approved patching materials for repairing damaged surfaces. Surfaces must be returned to original condition and be approved by Owner.

2.02 EQUIPMENT

A. Equipment shall be power driven and of sufficient capacity to remove pavement markings.

B. Air compression equipment shall utilize moisture and oil traps/vacuums of sufficient capacity to remove contaminants from the blasting air and prevent deposition of moisture, oil, or other contaminants on pavement surface.

C. Furnish and maintain equipment in good working condition.

PART 3 - EXECUTION

3.01 REMOVAL OF EXISTING MARKINGS

Eliminate existing pavement markings and markers on both concrete and asphaltic surfaces such that color and texture contrast of the pavement surface will be held to a minimum. Repair damage to asphaltic surfaces, such that that spalling, shelling, etc., greater than 1/4 inch in depth resulting from the removal of pavement markings and markers. Use any mechanical method except grinding. Flail milling is acceptable in the removal of markings on asphalt and concrete surfaces.

A. Collect and dispose of markers or accumulated waste in accordance with federal, state, and local regulations. Work areas should be clean and returned to original condition at the end of each work day.

END OF SECTION

SECTION 32 01 11.02
PAVEMENT SURFACE PREPARATION FOR MARKINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes requirements for the preparation of surface areas before placement of pavement markings.

1.02 MEASUREMENT AND PAYMENT

A. Measurement

1. This item will be measured by each word, symbol, or shape; by the linear foot of marking; or by any other unit shown on the plans or contract. Each stripe will be measured separately.

2. Surface Preparation of raised pavement markers will not be measured for directly and will be subsidiary to the pertinent raised pavement marker bid items.

B. Payment:

1. The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pavement Surface Preparation for Markings" of the type and width as applicable. This price is full compensation for the preparation method used, equipment, materials, tools, labor, and incidentals.

   Surface preparation of raised pavement markers will not be paid for directly and will be subsidiary to the pertinent pavement marker bid items.

   Surface preparation for pavement markings will not be paid for directly <u>if elimination bid items are used to replace a marking</u>. Surface preparation will be subsidiary to the pertinent elimination bid items.

   If plans are provided, the quantity to be paid is the quantity shown in the proposal unless modified. Additional measurements or calculations will be made if adjustments of quantities are required due to an increase or decrease that exceeds 5%.

2. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Use potable water when water is required.

B. Use a compressor that is capable of generating compressed air at a minimum of 150 cfm and 100 psi using 5/16-in. or larger hosing when preparing surface with air blasting.

C. Use a commercial abrasive blasting medium capable of producing the specified surface cleanliness.

D. Use approved patching materials for repairing damaged surfaces. Surfaces must be returned to original condition and be approved by Owner.

2.02 EQUIPMENT

A. Equipment shall be power driven and of sufficient capacity to remove pavement markings.

B. Air compression equipment shall utilize moisture and oil traps/vacuums of sufficient capacity to remove contaminants from the blasting air and prevent deposition of moisture, oil, or other contaminants on pavement surface.

C. Furnish and maintain equipment in good working condition.

PART 3 - EXECUTION

3.01 PREPARATION OF PAVEMENT SURFACE

A. Prepare pavement surface of sufficient area for the pavement markings specified by plans or by City inspector.

B. Use any mechanical method except grinding. Flail milling is acceptable in the surface preparation of markings on asphalt and concrete surfaces. Air blast pavement surface after the surface preparation and just prior to placing the stripe.

C. Repair damage to asphaltic surfaces, such that spalling, shelling, etc., greater than 1/4 inch in depth resulting from the removal of pavement markings and markers.

D. New Portland Cement Concrete
   1. The curing compounds must be completely removed from Portland Cement surfaces prior to the application of LS65 hybridized epoxy. High pressure water-blasting, flail milling, and/or shot blasting are the recommended methods for removing curing compounds.

E. New Asphalt
   1. LS65 hybridized epoxy can be applied directly to new asphalt surfaces as soon as the asphalt has cooled and can support the weight of application equipment. The asphalt surface must be free of excess asphalt emulsions and oils to ensure proper adhesion of the markings.

F. Chip and Slurry Seal Coated Surfaces
   1. Slurry seal coats must be completely cured prior to the application of LS65 hybridized epoxy. Chip seal surfaces must be free of loose aggregate. A reasonable waiting period to allow vehicles to wear off loose aggregate is recommended.

G. Restriping Existing Pavement Markings
   1. Surface preparation for the replacement existing pavement markings and markers on both concrete and asphaltic surfaces will be governed by “Section 32 01 11.01 Eliminating Existing Pavement Markings And Markers”.

H. Collect and dispose of accumulated waste in accordance with federal, state, and local regulations. Work areas should be clean and returned to original condition at the end of each work day.

END OF SECTION

SECTION 32 01 29
PAVEMENT REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repairing and replacing streets, highways, and other pavements that have been cut, broken, or damaged due to utility excavation.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for pavement repair and replacement for utility projects is on a square yard basis and includes surface and base materials as required per street cut ordinance.
2. Measurement for utility projects: Match actual pavement replaced but no greater than maximum pavement replacement limits in accordance with the street cut ordinance or otherwise shown on drawings.
3. Refer to Section 01 29 00 - Measurement and Payment for other unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this section is included in total Stipulated Price.

PART 2 - PRODUCTS PART 3 - EXECUTION

3.1 PREPARATION

A. Notify City prior to commencement of excavation in pavement for which a Right of Way use permit has been obtained. Follow directions contained in the permit.

B. Saw cut pavement 24 inches wider than width of trench needed to install utilities unless otherwise indicated on Drawings.

C. When removing pavement to existing deformed metal strip (i.e. dummy joint), saw cut pavement minimum full depth on opposite side of deformed metal strip. Place saw joint far enough behind deformed metal strip to obtain continuously straight joint. Remove damaged portion of deformed metal strip as required to provide proper joint. Saw cut and remove metal strip before placement of new concrete pavement.

D. Protect edges of existing pavement to remain from damage during removals, utility placement, backfill, and paving operations. Damaged pavement edges shall be repaired full depth as directed by City of Sugar Land. For concrete pavement, protect undisturbed subgrade that is to remain to support replacement slab.

E. Dowel existing pavement where no reinforcement is found or is broken due to construction activities. Unless otherwise directed by the City, provide No. 4 bars 24 inches long, drilled and embedded 12 inches into center of existing slab with 'PO-ROC' epoxy grout or approved equal. Space dowels to match new pavement reinforcement spacing, but not to exceed 24” spacing.

F. Provide transitional paving and earthwork as required to tie proposed pavement to existing pavement when unable to dowel new pavement into existing pavement.

INSTALLATION

G. Parking Areas, Service Drives, Driveways, and Sidewalks: Replace with material equal to or better than existing or as indicated on Drawings.

H. Street Pavements and Curbs, Curbs and Gutters: Replace subgrade, base, and surface course with like materials or as indicated on Drawings. Curbs and curbs and gutters shall match existing.

I. For concrete pavement, install size and length of reinforcing steel and pavement thickness indicated on Drawings. Place types and spacing of joints to match existing or as indicated on Drawings.

J. Where existing pavement consists of concrete pavement with asphaltic surfacing, resurface with minimum 2 inch depth asphaltic pavement.

K. Repair state highway and county crossings in accordance with TxDOT permit or county requirements as appropriate and within 1 week after utility work is installed.

PROTECTION

L. Maintain pavement in good condition until completion of Work.

M. Replace pavement damaged by Contractor's operations at no cost to City.

END OF SECTION

SECTION 32 01 90
OPERATION AND MAINTENANCE OF PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and all applicable specification sections, apply to this section.

WORK COVERED

B. Furnish all labor, materials and equipment as necessary to provide a landscape maintenance program in strict accordance with the Specifications and Drawings.

RELATED WORK IN OTHER SECTIONS

C. Examine all section for work related to this section.

REQUIREMENTS OF REGULATORY AGENCIES

D. Perform Work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all permits required by local authorities.

CONTRACTOR RESPONSIBILITIES

E. Begin maintenance immediately upon starting any portion of the Work of this contract.

F. Contractor's Maintenance Period shall continue as few as 90 days, or as specified in contract, beyond Substantial Completion of all Work in this contract.

G. Trees, Shrubs and Groundcovers: The Contractor's maintenance of new planting shall consist of watering, cultivating, fertilizing, weeding, mulching, re-staking, tightening and repairing of guys, resetting plants to proper grades or upright position, restoration of the planting saucer, and furnishing and applying such sprays and invigorants as are necessary to keep the plantings free of insects and disease and in thriving condition.

H. Irrigation System: Maintenance of irrigation system shall consist of monitoring and adjustment of the duration and frequency of the watering schedule, adjustment of heads for coverage and elevation, repair of leaks in both mains and lateral lines and all other work required to establish a complete working irrigation system.

I. Turf: Maintenance of new turf shall consist of mowing, watering, weeding, repair of all

erosion and reseeding as necessary to establish a uniform stand of specified grasses.

J. Trash Pick-up: Pick up trash on site and empty trash receptacles at each site visit.

PROTECTION

K. Protect planting areas and lawns at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection fences, barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by Owner at no additional cost to Owner.

FINAL ACCEPTANCE

L. Work under this section will be accepted by the City Engineer upon satisfactory completion of all work, including maintenance, replacement of plant materials and lawns under the Warranty Period. Upon final Acceptance, the City will assume responsibility for maintenance of the Work.

MAINTENANCE INSTRUCTIONS

M. At the completion of work, furnish two (2) copies of written maintenance instructions to Owner and one (1) copy to Landscape Architect for maintenance and care of all planting throughout the year.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials required for installed items shall match those already in use.

B. Topdress Fertilizer: Commercial fertilizer with guaranteed analysis per Landscape Architect requirement/specification as required for application use.

REQUIRED EQUIPMENT

C. Contractor shall have available for their use the following maintenance equipment:

1. Lawn Mowers
2. Gasoline Powered Edgers
3. Trash Collection Equipment
4. Line Trimmers
5. Miscellaneous Hand Tools, Rakes, Brooms, Etc.
6. Blowers
7. Other as needed.

PART 3 - EXECUTION

3.1 WATERING

A. It shall be the responsibility of the Contractor to assure that the correct watering of plant materials is being accomplished through the following irrigation techniques:

B. Regular deep watering to all new trees until there are definite signs that the trees have established themselves, new growth is apparent, and no trees are experiencing stress conditions.

C. Frequent watering to the lawn areas to insure against drying. This may be accomplished as above, by the automatic sprinkler system, hand watering or portable sprinklers. Contractor shall monitor settings of automatic sprinkler controls and recommend necessary adjustments according to climatic changes.

D. Contractor shall be responsible for watering areas of proposed improvement that do not have irrigation systems at no additional cost to owner.

E. Contractor shall be responsible for damages to irrigation system caused by maintenance operations.

MAINTENANCE OF TURF AREAS

F. Mowing turf areas shall be accomplished with sharp, properly adjusted mowers of the correct size for the various areas. Maintain grassed areas by watering, fertilizing, weeding, and trimming.

G. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.

H. For areas seeded in fall, continue maintenance through the following spring until acceptable turf is established.

I. Restore bare or thin areas by topdressing with mix of 50 percent sharp sand and 50 percent sphagnum peat moss. Apply mixture 1/4 to 1/2 inch thick.

J. Reseed small, sparse grass areas. When sparse areas exceed 20 percent of planted area, reseed by hydromulch.

K. Mowing frequency shall be as per the Landscape Maintenance Program. Blade heights shall be set according to the following schedule.

1. 1-1/2 inches Initial Mowing
2. 1-1/2 inches April – November
3. 2 inches December – March

L. In the event of a prolonged rainy period and a surge of leaf growth is anticipated, the mower height may be readjusted to prevent "scalping" or skinning of lawn on preceding cuts.

M. Turf shall be edged evenly at all walks, headers and other structures as per the schedule. Use an edger, not a line trimmer.

N. Until the establishment of the turf, the Contractor will be responsible for replacing soils that have eroded onto the paved areas. Residual soils on paving will be removed and if not mingled with objectionable materials may be re-used in eroded areas. Repair areas damaged by erosion by regrading, rolling and replanting

O. Immediately upon observing any turf spreading into shrub or groundcover areas, the Contractor shall initiate a program of removal and maintain this program throughout the maintenance period.

P. Any turf appearing in paved areas shall receive an application of soil sterilant according to manufacturer's direction. The sterilant shall be approved and will not be detrimental structurally to paved areas.

Q. Special effort shall be given to the control to fire ants infesting the site. After control is accomplished, the ant mounds shall be lowered and tamped to the existing grade.

R. Apply top dress fertilizer 30 days after grassing.

MAINTENANCE OF TREES AND SHRUBS

S. Contractor shall adjust and tighten as required all tree staking and guying. Removal as directed by Owner's Representative.

T. Remove weeds within the mulched area around each tree and in each shrub bed as often as required. Under no circumstances shall weeds and grass within planted areas be allowed to attain more than 4 inches growth.

U. Contractor shall be continuously alert for signs of insect presence or damage or the presence or damage from plant fungi. Upon locating such evidence, the Contractor shall report it to the Owner's Representative and take action as directed.

MAINTENANCE OF IRRIGATION SYSTEM

V. Irrigation System: Maintenance of irrigation system shall consist of monitoring and adjustment of the duration and frequency of the watering schedule, adjustment of heads for coverage and elevation, repair of leaks in both mains and lateral lines and all other work required establishing a complete working irrigation system.

TRASH COLLECTION

W. Removal of debris from the site unrelated to horticultural maintenance (paper, bottles, cans, "Pirate" signs, etc.) shall be the responsibility of the Contractor. Contractor shall pick up trash and empty trash receptacles at each site visit. Frequency as per Landscape Maintenance Program.

DE-WATERING

X. Contractor shall de-water by pumping or siphoning as often as necessary to remove excess moisture from soil in planting areas and tree balls. De-watering to occur during scheduled visits as required.

SCHEDULES

Y. The execution items of part 3 in this specification shall be performed as a minimum per the following schedule as applicable for the maintenance period:

MONTH	MINIMUM # OF VISITS PER MONTH
January	2
February	2
March	4
April	4
May	5
June	4
July	5
August	5
September	5
October	3
November	2
December	2

Z. Topdress Fertilizer: Thirty (30) days after seeding

AA. Mulching, Weeding, Weed Control, Guying and Staking Adjustment: As required each visit.

BB. Meeting: Contractor shall meet once each month and at the end of the maintenance period with the Owner's on-site maintenance personnel. Contractor shall review irrigation system schedule and operation and other pertinent and helpful maintenance information at each meeting.

CC. Notify City Engineer 10 days before end of maintenance period for inspection.

END OF SECTION

SECTION 32 01 90.13
FERTILIZING

PART 1 - GENERAL

1.1 SUMMARY

A. Description:

1. This item shall govern the provision and distribution of fertilizer over the areas indicated on the Drawings and in accordance with these specifications and TxDOT 166.
2. This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

SUBMITTALS

B. The submittal requirements for this specification item shall include:

1. Type of soil(s) at the site.
2. Type(s) of re-vegetation (seeding, sodding, etc).
3. Type(s) of fertilizer.
4. Rate(s) of application of fertilizer.
5. Chemical analysis of the fertilizer(s).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fertilizer used on site shall be delivered in bags or containers, which are clearly labeled and show the analysis. The figures in the analysis shall represent the percent of nitrogen, phosphoric acid and potash nutrients, respectively, as determined by the methods of the Association of Official Agricultural Chemists. The fertilizer may be subject to testing by the State Chemist in accordance with the Texas Fertilizer Law. A pelleted or granulated fertilizer shall be used. Fifty percent or greater of the Nitrogen required shall be in the form of Nitrate Nitrogen ($N0_3$). The remaining Nitrogen required may be in the form of Urea Nitrogen ($CO(NH_2)_2$).

B. The total amount of nutrients furnished and applied per acre (hectare: 1 hectare equals 2.471 acres) shall equal or exceed that specified for each nutrient.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. The fertilizer type and rate of application should be based on chemical tests of representative soil samples taken after completion of construction and ground work.

B. Pelleted or granulated fertilizer shall be applied uniformly into the soil to a depth of 4 inches (100 mm) over the area specified on the Drawings to be fertilized and in the manner directed for the particular item of work. The fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected. Distribution of the fertilizer for the particular item of work shall meet the approval of the Engineer or Designated Representative.

C. The fertilizer may also be applied with the hydromulch.

END OF SECTION

SECTION 32 10 14.53
TRAFFIC SIGN ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for Small Traffic Sign Assemblies which include Sign Fabrication, Sign Assembly Installation, and Sign Assembly Removal. For the purpose of this specification, a sign assembly consists of the signs, sign supports, foundations, and associated hardware.

1. **Sign Fabrication**: Furnish material and fabricate traffic signs per specification.

2. **Sign Assembly Installation**: Install sign support, foundations, small signs, and hardware per specification.

3. **Sign Assembly Removal:** Remove existing traffic sign assemblies per specification.

B. All materials, sheeting, and mounting hardware shall conform to the City of Sugar Land specifications specified in this document. The manufacturer's recommendations will govern if any details are left out of this specification.

C. All traffic sign assemblies shall conform to the current version of the Texas Manual on Uniform Traffic Control Devices (TMUTCD), the latest Standard Highway Sign Designs for Texas (SHSD) manual, and the City of Sugar Land's Engineering Construction Details and Specifications.

D. No substitutions will be accepted without written approval by the City Traffic Engineer.

1.02 MEASUREMENT AND PAYMENT

A. Measurement

1. **Sign Fabrication:** This Item will be measured as each sign fabricated per bid items and this specification. Bid items show dimensions and TMUTCD sign designations. This specification gives details on the materials that should be used for all signs.

2. **Sign Assembly Installation**: This Item will be measured as each bid item used to install each sign support and sign and per this specification.

3. **Sign Assembly Removal:** Bid item will be measured by each sign assembly removed complete in place. Sign assembly includes all signs, poles, hardware, and foundation per requirements as specified in the Removal section.

B. Payment:

1. The work performed and materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit bid price of the bid item specified for “Sign Fabrication”, “Sign Assembly Installation”, and “Sign Assembly Removal”.

2. **Sign Fabrication:** This price is for the full compensation for providing all specified material required for sign fabrication and associated labor, tools, equipment, and incidentals necessary to complete the work.

3. **Sign Assembly Installation:** This price is for the full compensation for providing specified material necessary to install sign assembly as needed and associated labor, tools, equipment, and incidentals necessary to complete the work.

4. **Sign Assembly Removal**: This price is for the full compensation for removing an existing complete sign assembly as described by specification, providing backfill, and all other materials, labor, tools, equipment, and incidentals necessary to complete the work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sign Blanks

1. Furnish aluminum sign blanks to the sizes and shapes shown on the plans, bid items, or as instructed by the City Traffic Engineer. Sign blanks must also be free of buckles, warps, burrs, dents, cockles, or other defects.

2. For all City of Sugar Land traffic signs (except street name signs), use 0.08-inch thick aluminum sign blanks.

3. For standard street name signs (D3-1), use 9-inch tall extruded aluminum sign blanks.

4. Complete the fabrication of sign blanks, including the cutting and drilling or punching of holes, before cleaning and degreasing. After cleaning and degreasing, ensure the substrate does not come into contact with grease, oil, or other contaminants before the application of the reflective sheeting.

B. Sign Sheeting

1. Retro reflectorize the sign faces with flat surface reflective sheeting. Use 3M™ Diamond Grade™ DG³ Reflective Sheeting. Use retro reflective sheeting from the same manufacturer for the entire sign face background. Ensure that the sign legend, symbols, borders, and the background exhibit uniform color, appearance, and retro reflectivity when viewed both day and night.

2. Use 3M™ or Avery™ black vinyl sign sheeting. Use 3M™ or Avery™ EZ-film with sign sheeting involving colors other than black. The EZ-film and sheeting must be supplied from the same manufacturer.

3. 3M™ silk screen pre-cut signs can be used for the fabrication of stop signs (R1-1) and all way plaques (R1-3P).

4. Street Name signs (D3-1) shall use white lettering with blue background (standard colors).

C. Sign Messages

1. Fabricate sign messages to the sizes, types, and colors shown on the plans, bid items, or required by the TMUTCD, SHSD, or this specification. Use sign message material from the same manufacturer for the entire message of a sign.

2. Street name sign plate fonts shall be Helvetica Bold, Medium Style. Refer to COSL Construction Details for the minimum and maximum size limits of street name signs.

3. For the standard street name sign (D3-1), uppercase letters will be 6 inches in height and lowercase letters will be 4-1/2 inches in height. See COSL Construction Details for more details on typical spacing requirements for street name signs.

4. For overhead mast arm street name sign, uppercase letters will be 9 inches in height and lowercase letters will be 6 inches in height.

5. Ensure that the screened messages have clean, sharp edges and exhibit uniform color and retro reflectivity. Prevent runs, sags, and voids.

6. Furnish direct-applied route markers and other attachments within the parent sign face unless otherwise specified on the plans or bid item sheets.

D. Hardware

1. Use galvanized steel for the sign poles.

2. Use dichromate sealed aluminum materials for the sign clamps (2-3/8”).
   a. Use a minimum of two clamps when mounting a sign to a pole.
   b. Use dichromate sealed aluminum materials for the bolts, nuts, and lock washers on the rear clamp mount.
   c. Use stainless steel materials for the bolts, nuts, and flat washers on the sign face.

3. Use dichromate sealed aluminum pole caps, crosses, and wing brackets made for extruded street name sign blanks.

4. For sign poles, use 16-gauge poles, 12 feet in length, and 2-3/8 inches in diameter. This applies to all pole mounted traffic signs.

5. For mounted signs with less than or equal to 14 square feet in face area and located on roadways with a 40 mph or higher posted speed limit, use the Poz-Lock, Wedge Anchor system for the foundation base.

6. For mounted signs with more than 14 square feet in face area and located on roadways with a 40 mph or higher posted speed limit, use the 10-gauge breakaway slip base system as specified in the Triangular Slipbase System designs; as shown in the TxDOT Detail Sheets SMD (SLIP-1)-08, SMD (SLIP-2)-08, and SMD (SLIP-3)-08.

7. Furnish and fabricate frames and/or sign poles, provide if needed wind beams and stiffeners; furnish bolts, rivets, screws, fasteners, clamps, brackets, and sign support connections. All work performed shall be in conformance with the manufacturer's recommendation.

PART 3 - EXECUTION

3.01 REMOVAL OF EXISTING SIGNS

A. Remove signs and abandoned concrete foundations at finish grade unless otherwise shown on the plans, bid items, or as instructed by the City Traffic Engineer. Cut off and remove steel protruding from the remaining concrete. Backfill the remaining hole with material equal in composition and density to the surrounding area. Replace any surfacing with like material to equivalent condition.

3.02 SURFACE PREPARATION

A. Follow manufacturer's written instructions on surface preparation prior to installing components.

3.03 FOUNDATION REQUIREMENTS

A. For city streets with concrete curb sections, locate sign poles at a minimum distance of two (2) feet from the back of the curb. All sign assembly locations shall comply with TMUTCD.

B. For the Wedge Anchor System, a 6-inch diameter by 18-inch deep hole will be prepared. The wedge anchor tubular socket will be driven 24 inches into the ground with 3 inches of the socket left above ground level. Space around the socket will be filled with approximately 2-cubic feet of concrete.

C. For the Triangular Slipbase System, installation will be prepared using an auger to drill into the ground 33 inches and provide 12-inch to 14-inch diameter hole. The tubular socket will be driven 40 inches into the ground with 3 inches of the socket left above ground level. Space around the socket will be filled with approximately 3-cubic feet of concrete per TxDOT detail sheets provided under the "Hardware" section.

3.02 WARRANTY

A. Whole Sign Assembly

1. Contractor must provide a one-year written material warranty for sign materials and labor craftsmanship.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Portland cement concrete paving.
B. All workmanship and materials shall be in conformance with TxDOT 360 unless otherwise directed by the Engineer.
C. All traffic controls shall be in compliance with the latest TMUTCD.

1.2 MEASUREMENT AND PAYMENT

C. Unit Prices:

1. Payment for concrete paving is on a square yard basis.
2. Payment for concrete paving, high early strength, is on a square yard basis.
3. Payment for pavement repair or pavement replacement for utility projects is on a square yard basis and shall include base materials.
4. Refer to Section 01 22 00 “Unit Prices” for Unit Price Procedures.

REFERENCES

D. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

E. ASTM A185 – Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

F. ASTM A497 – Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.

G. ASTM A615 – Standard Specification for Deformed and Plain Billet – Steel Bars for Concrete Reinforcement.

H. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

I. ASTM C 33 – Standard Specification for Concrete Aggregates.

J. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

K. ASTM C 40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

L. ASTM C 42 – Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

M. ASTM C 78 – Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading).

N. ASTM C 94 – Standard Specification for Ready-Mixed Concrete.

O. ASTM C 131 – Standard Test Method for Resistance to Degradation of Small-Size coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

P. ASTM C 136 – Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

Q. ASTM C 138 – Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

R. ASTM C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete.

S. ASTM C 150 – Standard Specification for Portland Cement.

T. ASTM C 174 – Standard Test Method for measuring Thickness of Concrete Elements Using Drilled Concrete Cores.

U. ASTM C 231 – Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.

V. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete.

W. ASTM C 494 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.

X. TxDOT Tex-203-F – Sand Equivalent Test.

Y. TxDOT Tex-406-A – Material Finer than 75 (No. 200) Sieve In Mineral Aggregates (Decantation Test for Cement Aggregates).

ACTION SUBMITTALS

Z. Product Data: For each type of product indicated.

AA. Samples: For each exposed product and for each color and texture specified.

BB. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
2. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver.

DELIVERY, STORAGE, AND HANDLING

CC. Do not mix different classes of aggregate without written permission of Project Manager.

DD. Class of aggregate used may be changed with written permission of Project Manager.

EE. Reject segregated aggregate. Before using aggregate with particles that have been separated by size, mix them uniformly to grading requirements.

FF. Reject aggregates mixed with dirt, weeds, or foreign matter.

GG. Do not dispose of or store aggregate in roadbed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement:

1. Sample and test cement to verify compliance with Standards of ASTM C 150, Type I or Type III.
2. Bulk cement which meets referenced standards may be used when handling method is approved by Owner. When using bulk cement, provide satisfactory weighing devices.
3. Fly ash which meets standards of ASTM C 618 may be used as mineral fill when approved by Owner.

B. Water: Conform to requirements for water in ASTM C 94.

C. Coarse Aggregate: Crushed stone, gravel, or a combination which is clean, hard, and durable, conforms to requirements of ASTM C 33, and abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).

D. Fine Aggregate: Sand, manufactured sands, or combination, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Conform fine aggregate for concrete to requirements of ASTM C 33 with graduation within limits in accordance with ASTM C 136.

1. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Text (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.

E. Mineral Filler: Type “C” or Type “F” fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts exceeding 25 percent by weight of cementitious material

in mix design. Cement content may be reduced when strength requirements can be met.

F. Air Entraining Admixture: Furnish in conformance with ASTM C 260.

G. Water Reducer: Furnish in accordance with requirements of ASTM C 494.

H. Reinforcing Steel: Provide new billet steel manufactured by open hearth process and in conformance with ASTM A 615, Grade 60 with a minimum yield strength of 60,000 psi.

2.2 EQUIPMENT

I. Conform to requirements of ASTM C94.

2.3 MIXING

J. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C78. Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in Accordance with ASTM C 39. Determine and measure batch quantity of each ingredient, including water for batch designs, and concrete produced for work.

K. Mix design to produce concrete which will have flexural strength of 500 psi at 7 days and 600 psi at 28 days. Minimum compressive strength shall be 3500 pounds per square inch for 7 days and 3500 pounds per square inch at 28 days when tested in accordance with ASTM C 39. Slump of concrete shall be at least 2 inches but no more than 5 inches when tested in accordance with ASTM C 143.

1. Concrete pavement, including curbs, curb and gutter, and saw tooth curb shall contain at least 5-1/2 sacks (94 pounds) of cement per cubic yard with not more than 6.5 gallons of water per sack of cement (water-cement ratio maximum0.57). Determine cement content in accordance with ASTM C 138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.
2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.
3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4-1/2 percent plus or -1-1/2 percent. Determine air content by testing in accordance with ASTM C 231.
4. Use retardant when temperature exceeds 90 degrees F. Proportion as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.

L. Use high early strength concrete pavement as indicated on Drawings. Design in accordance with the following:

1. Concrete Mix: Strength greater than or equal to 3500 psi at 72 hours.
2. Cement: Minimum 7 sacks of cement per cubic yard of concrete.
3. Water-cement ratio maximum 0.45. Slump of concrete shall be a maximum 5 inches, when tested in accordance with ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted base is ready to support imposed loads and meets compaction requirements.

B. Verify lines and grades are correct.

3.2 PREPARATION

C. Properly prepare, shape, and compact each section of subgrade before placing forms, reinforcing steel, or concrete.

D. Remove subgrade that does not support loaded form. Replace and compact subrade to required density.

3.3 EQUIPMENT

E. Alternate equipment and methods may be used as approved by Project Manager.

1. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.

F. Subgrade Planer and Template:

1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so it will remain on form, and have strength and rigidity that under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of sub-base.
2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1 foot intervals. Adjust rods to gauge cross sections of slab bottom when template is resting on side forms.

G. Machine Finisher: Provide power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires when it operates on concrete pavement.

H. Hand Finishing:

1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.
2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.

I. Vibrators: Furnish mechanically-operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation. Dragging the vibrator and/or walking the concrete are prohibited.

J. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment.

1. Equip traveling paver with longitudinal trans angular finishing float adjustable to crown and grade. Use float long enough to extend across pavement to side forms or edge of slab.
2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.
3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace pavement in which tie bars assume final position other than that shown on Drawings.

3.4 FORMS

K. Side Forms: Use metal forms of approved shape and section. Preferred depth of form is equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness when not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Bottom flange of form shall be same size as thickness of pavement. Aluminum forms are not allowed. Forms shall be approved by Project Manager. Length of form sections shall not be less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200 foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than 8 inches

for form 8 inches or more in height. Forms shall be free from warp, bends, or kinks, and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street or intersections and driveways, wood forms of good grade and quality shall be used.

L. Form Setting:

1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and during entire operation of placing, compacting, and finishing of concrete, do not deviate from grade and alignment of more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by Project Manager.
2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. Do not use adjacent slabs for forms until concrete has aged at least 7 days.

3.5 REINFORCING STEEL AND JOINT ASSEMBLIES

M. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt, or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.

N. Position pavement joint assemblies at required locations and elevations and rigidly secure in center line of pavement as shown.

O. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.

P. Secure in required position to prevent displacement during placing and finishing of concrete.

Q. Drill dowels 12” into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.

R. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from placement by more than 1/4 inch.

3.6 FIBROUS REINFORCING

S. DO NOT use fibrous reinforcing to replace structural, load-bearing, or moment-reinforcing steel.

3.7 PLACEMENT

T. In threatening weather which in the opinion of the Engineer may result in conditions which will adversely affect the quality of the concrete to be placed the Engineer may order postponement of the work.

U. Place concrete when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Do not place concrete when temperature is below 40 degrees F and falling.

V. Place concrete within 90 minutes after initial water has been added. Remove and dispose of concrete not placed within this period.

W. Concrete slump during placement shall be 1 to 5 inches, except when using traveling-form paver. Slump shall be 2 inches.

X. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10 feet long.

Y. Take special care in placing and spading concrete against forms at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

Z. Concrete shall not be placed when the concrete temperature is 95 degrees Fahrenheit or greater.

3.8 COMPACTION

AA. Consolidate concrete using mechanical vibrators as specified. Extend vibratory unit across pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse, or longitudinal joints.

BB. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints, and in areas not covered by mechanically controlled vibrators.

3.9 FINISHING

CC. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.

1. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement sections shown on Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

DD. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.

EE. After completion of straightedge operation, make first pass of transverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep broom clean and free from encrusted mortar during use.

3.10 TOLERANCES

FF. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10 foot straightedge parallel to center of roadway to bridge depressions and touch high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10 foot straightedge shall not exceed 1/8 inch. With Engineer approval grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

3.11 FIELD QUALITY CONTROL

GG. Compressive Strength Test Specimens: Make four test specimens for compressive strength test in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Test two specimens at 3 days or at number of hours as directed by Project Manager for high early strength concrete. Test remaining two specimens at 28 days. Test specimens in accordance with ASTM C 39. Minimum compressive strength shall be 3500 pounds per square inch for first two specimens and 3500 pounds per square inch at 28 days.

HH. When compressive test indicates failure, make yield test in accordance with ASTM C

138 for cement content per cubic yard of concrete. When cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.

II. Minimum of one 4 inch core shall be taken at random locations per 375 feet per 12 feet lane or 500 square yards of pavement to measure in-place depth. Measure depth in accordance with ASTM C 174. Each core may be tested for 28 day compressive strength according to ASTM C 42. 28 day compressive strength of each core tested shall be a minimum of 3500 pounds per square inch.

JJ. Fill cores and density test sections with new concrete paving or non shrink grout.

3.12 NONCONFORMING PAVEMENT

KK. Remove and replace areas of pavement found deficient in thickness or that fails compressive strength tests, with concrete of thickness shown on Drawings.

3.13 PAVEMENT LEAVEOUTS

LL. Pavement leaveouts as necessary to maintain and provide for local traffic shall be provided at location and indicated on the plans or as directed by the owner. The extent and location of each leaveout required and a suitable crossover connection to provide for traffic movements shall be determined in the field by the owner. Left or right-turn lanes and median openings shall not be considered as pavement leaveouts.

3.14 PAVEMENT TESTING AND EVALUATION

MM. TESTING OF MATERIALS. Samples of all materials for test shall be made at the same expense of the owner, unless otherwise specified in the special provisions or in the plans. In the event the initial sampling and testing does not comply with the specifications, all subsequent testing of the material in order to determine if the material is acceptable shall be at the contractor's expense at the same rate charged by the commercial laboratories. All testing shall be in accordance with the applicable ASTM standards and concrete testing technician must me ACI certified, or equivalent.

NN. PAVEMENT THICKNESS TESTS. Upon completion of the work and before final acceptance and final payment shall be made, pavement thickness test shall be made by the owner. The number of tests and locations shall be at the discretion of the owner, unless otherwise specified in the special provisions or on the plans. The cost for the initial pavement is revealed during normal testing operations, subsequent tests necessary to isolate the deficiency shall be at the contractor's expense. The cost of additional coring test shall be at the same rate charged by commercial laboratories.

Where the average thickness of the pavement in the area found to be deficient in thickness by more than 0.20-in. (5mm), but not more than 0.50-in. (12.5mm), payment shall be made at an adjusted price as specified in table 3.14 Concrete Pavement Deficiency.

Table 3.14 Concrete Pavement Deficiency

Deficiency in Thickness Determined by Cores		**Proportional Part of Contract Price**
Inches	**mm**	**Allowed**
0.00 – 0.20	**0.0 – 5.0**	**80 Percent**
0.21 – 0.30	**5.3 – 7.5**	**60 Percent**
0.31 – 0.40	**7.8 – 10.0**	**40 Percent**
0.41 – 0.50	**10.3 – 12.5**	**20 Percent**

Any area of pavement found to be deficient in thickness by no more than 0.50-in. or 1/10th of the plan thickness, whichever is greater, shall be evaluated by the owner. If, in the judgment of the owner, the area of such deficiency should not be removed and replaced, there shall be no payment for the area retained. If in the judgment of the owner, the area of such deficiency warrants removal, the area shall be removed and replaced, at the contractor's entire expense, with concrete of the thickness shown on the plans. Any area of pavement found deficient in thickness by more than 0.50-in. or more than 1/10th of the plan thickness, whichever is greater, shall be removed and replaced, at the contractor's entire expense, with concrete of the thickness shown on the plans.

No additional payment over the contract unit price shall be made for any pavement of a thickness exceeding that required by the plans.

3.14 PAVEMENT STRENGTH TEST

1. FOR STANDARD CLASSES OF CONCRETE. During the progress of the work, the contractor shall cast test cylinders, in accordance with ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field, to maintain a check on the compressive strengths of the concrete being placed. In accordance with ASTM C31 and ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete, four test cylinders shall be taken from a representative portion of the concrete being placed for every 150-cubic yards of concrete pavement placed, but in no case shall less than 2 sets of cylinders be taken from any one day's placement. After the cylinders have been cast, they shall remain on the job site and then transported, moist cured, and tested by the owner in accordance with ASTM C31 and ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. In each set, one of the cylinders shall be tested at 7-days, two cylinders shall be tested at 28-days.If the 28-day test results indicate deficient strength, the contractor may, at its option and expense, core the pavement in question at locations chosen by the Engineer and have the cores tested by an approved laboratory, in accordance with ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete and ACI 318 protocol, except all cores must meet 100% of the minimum specified strength, to override the results of the cylinder tests.

The contractor shall be responsible for the proper storage, maintenance, and any required curing of concrete test samples made by the owner. The contractor shall provide and maintain curing facilities for the purpose of curing concrete test specimens on site in accordance with ASTM C31. The cost of all materials used in test specimens and the cost of storing, maintaining and of providing and maintaining curing facilities will not be paid for as a separate contract pay item, and the costs thereof shall be considered incidental to the contract pay items provided. Cylinders and/or cores must meet minimum specified strength. Pavement not meeting the minimum specified strength shall be subject to the money penalties or removal and replacement at the contractor's expense as shown in Table 3.15.1 Standard Class Concrete Deficiency Penalties.

Table 3.15.1 Standard Class Concrete Deficiency Penalties.

Percent Deficient	**Percent of Contract Price Allowed**
Greater Than 0% - Not More Than 5%	95%
Greater Than 5% - Not More Than 10%	90%
Greater Than 10% - Not More Than 15%	80%
Greater Than 15%	60% or removed and replaced at the entire cost and expense of the contractor as directed by owner

2. FOR PERFORMANCE CLASSES OF CONCRETE. During the progress of the work, the contractor shall cast test cylinders, in accordance with ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens, to maintain a check on compressive strengths of the concrete being placed.
   In accordance with ASTM C31 and ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete, four test cylinders shall be taken from a representative portion of the concrete being placed for every 150-cubic yards of concrete pavement placed, but in no case shall less than 2 sets of cylinders be taken from any one day's placement. After the cylinders have been cast, they shall remain on the job site and then transported, moist cured, and tested by the owner in accordance with ASTM C31 and ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   In each set, one of the cylinders shall be tested at 7-days, two cylinders shall be tested at 28 days, and one cylinder shall be held or tested at 56 days, if necessary.
   If the 28 day test results indicate deficient strength, the contractor may, at its option and expense, core the pavement in question and have the cores tested by an approved laboratory, in accordance with ASTM C42 Standard Test Method for obtaining and Testing Drilled Cores and Sawed Beams of concrete and ACI 318 protocol, to override the results of the cylinder tests.
   The Contractor shall be responsible for the proper storage, maintenance, and any required curing of concrete test samples made by the owner. The contractor shall provide and maintain curing facilities for the purpose of curing concrete test specimens on site in accordance with ASTM C31. The cost of all materials used in test specimens and the cost of storing, maintaining and of providing and maintaining curing facilities will not be paid for as a separate contract item, and

the costs thereof shall be considered incidental to the contract pay items provided.
Cylinders and/or cores must meet the specified strength in accordance with ACI 318 protocol. Pavement not meeting the specified strength shall be subject to the money penalties or removal and replacement at the contractors expense as shown in table 3.15.2 Performance Class Concrete Deficiency Penalties.

Table 3.15.2 Performance Class Concrete Deficiency Penalties

Percent Deficient	**Percent of Contract Price Allowed**
Greater Than 0% - Not More Than 5%	95-percent
Greater Than 5% - Not More Than 10%	90-percent
Greater Than 10% - Not More Than 15%	80-percent
Greater Than 15%	60-percent or removed and replaced at the entire cost and expense of the contractor as directed by the owner

The amount of penalty shall be deducted from payment due to contractor; such penalty deducted is to defray the cost of extra maintenance.

3.15 PAVEMENT MARKINGS

OO. Restore pavement markings to match those existing in accordance with City of Sugar Land standard specifications and details, and Owner's requirements.

3.16 PROTECTION

PP. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricaded pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old. Pavement may be open to light weight (no trucks) traffic earlier provided Contractor pays for testing and additional specimens once 7 day specified strength is obtained. Pavement may be opened when high early strength concrete is used meeting specified 72 hour strength.

QQ. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by Project Manager.

RR. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by traffic. Opening of pavement to traffic shall not relieve responsibility for Work.

SS. Maintain concrete paving in good condition until completion of Work.

TT. Repair defects by replacing concrete to full depth.

END OF SECTION

SECTION 32 15 40
CRUSHED STONE SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for labor, materials, equipment and appliances necessary to install and complete decomposed granite pathways in accordance with Contract Documents.

B. Work shall include, but not necessarily be limited to, compaction of subgrade, installation of edge treatment, and installation of decomposed granite.

RELATED WORK OF OTHER SECTIONS

C. Coordinate work of this Section with work of other Sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other Sections.

QUALITY ASSURANCE

D. The Contractor is responsible for correction of work which does not conform to the specified requirements, including strength, tolerances and colors. Correct deficient materials as directed by the Owner.

E. Installer: a firm with a minimum of (3) three years of experience in the successful installation of similar work in similar quantities. Firm must provide Owner a list of jobs completed which can be inspected by Owner or Owner's Representative. A minimum of 2 of these completed jobs must be located in the area similar to this job.

SUBMITTALS

F. Product Data: Submit manufacturer's product data with application and installation instructions for all materials and items.

1. Optimum moisture-density characteristics for decomposed red granite and red road base sources.
2. Proposed trail/path construction sequence and equipment.
3. Field density test results for in-place compacted red granite gravel and red road base.

G. Samples:

1. Decomposed granite of size and color specified.
2. Sample of red road base material or approved equivalent.

WARRANTY

H. Warrant the work specified herein for 1 year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

I. Defects shall include, but shall not be limited to settling.

PRODUCT HANDLING

J. Material shall be delivered and stockpiled at job site at a location agreed by Landscape Architect and Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Decomposed Granite: The decomposed granite shall be color approved by Owner.

B. Edge Treatment: As indicated on Drawings.

C. Weed Barrier: Woven soil separator/weed barrier to be installed on the path system shall be Pro 5 Weed Barrier as available through San Jacinto Environmental Supply, 2221 A West 34th Street, Houston, TX 77018, 713-957-0909 or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Review related drawings and stake out on the ground areas to receive decomposed granite and obtain approval of the Owner before excavation work is begun.

B. In order to minimize conflict, locate all existing utilities prior to beginning work.

PROTECTION

C. Prior to commencement of this work, all required erosion controls and tree protection measures indicated on the Drawings shall be in place.

D. Areas within the construction limits shall be cleared of all obstructions, abandoned structures, and other items as defined above. All vegetation, except trees or shrubs indicated for preservation, shall also be removed. Trees and shrubs, which are

scheduled for preservation, shall be carefully trimmed as directed by the engineer or designated representative and shall be protected from scarring, barking or other injuries during construction operations in accordance with Standard Specification Item No. 610S, " Preservation of Trees and Other Vegetation". All exposed cuts over 2 inches (50 millimeters) in diameter, exposed ends of pruned limbs or scarred bark shall be treated with an approved asphalt material within 24 hours of the pruning or injury.

E. Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings and/or specified in the Contract Documents. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

INSTALLATION

F. Base:

1. Excavate for granite material where designated on the drawing only.
2. Compact subgrade to 95 percent maximum density.

G. Decomposed Granite:

1. Decomposed granite shall be clean and free of foreign materials before installation.
2. Installation should start from one end and proceed forward over the undisturbed laying course.
3. Work shall be level and true to line and grade; shall be installed properly to coincide and align with adjacent work and elevations. All edges must be retained as per Detail.
4. All decomposed granite shall be rolled and compacted to a 4 inch depth. Minimum cross slope shall be 1-1/2 percent.
5. Decomposed granite trail shall drain sufficiently so as not to cause ponding or puddling on trail.
6. Weed Barrier shall be installed below all decomposed granite surfaces. Type to be approved by City through the submittal process.

END OF SECTION

SECTION 32 17 23.01
REFLECTORIZED PAINT PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SUMMARY

A. This item includes reflectorized paint pavement markings for traffic control.

1.02 MEASUREMENT AND PAYMENT

A. Measurement

1. This item will be measured by each word, symbol, or shape; by the linear foot of marking; or by any other unit shown on the plans. Each stripe will be measured separately.

B. Payment:

1. The work performed and materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid for “Reflectorized Paint Pavement Markings” of the type and width as applicable. This price is full compensation for the pavement cleaning and preparation, materials, tools, labor, and incidentals in conformance with the manufacturer’s recommendation. Pavement cleaning and preparation will not be paid for directly and will be subsidiary to the pertinent bid items.

   This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified. Additional measurements or calculations will be made if adjustments of quantities are required due to an increase or decrease that exceeds 5%.

2. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Furnish in accordance with DMS-8200,

C. Furnish Type III drop-on glass beads or other beads specified on the plans conforming to DMS-8290, “Glass Traffic Beads.”

D. Use clearly marked containers that indicate color, mass, material type, manufacturer, and batch number.

E. Equipment - Use equipment that:
   1. Is maintained in satisfactory condition.
   2. Meets or exceeds the requirements of the National Board of Fire Underwriters and the RRC for this application.
   3. Uses an automatic bead dispenser attached to the pavement marking equipment.
   4. Can provide continuous mixing and agitation of the pavement marking material.
   5. Can place at least 40,000 ft. of 4-in. solid or broken markings per day at the specified thickness.
   6. Can place linear markings up to 8 in. wide in a single pass.
   7. Can place markings other than solid or broken lines.
   8. Can place a center-line and no-passing barrier-line configuration consisting of 1 broken line with 2 solid lines at the same time to the alignment, spacing, and thickness shown on the plans, for 3-line application.
   9. Can place white line from both sides.
   10. Can place lines with clean edges, uniform cross section and thickness, and reasonably square ends.
   11. Can place skip lines between 10 and 10-1/2 ft., an approximate stripe-to-gap ratio of 1 to 3, and a stripe-gap cycle between 39-1/2 ft. and 40-1/2 ft., automatically.
   12. Can place beads uniformly and almost instantly on the marking as the marking is being applied.
   13. Can place beads uniformly during the application of all lines (each line must have an equivalent bead yield rate and embedment).

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Follow manufacturer’s written instructions for proper cleaning and preparation of pavement surfaces to receive pavement marking or as shown below if information not provided by manufacturer.

B. Remove old pavement markings, loose material, and other contaminants deleterious to adhesion of new pavement markings to be placed. On Portland concrete pavement, minimize over blasting to prevent damage to pavement surface. Small particles of tightly adhering existing pavement markings may remain when complete removal will result in pavement surface damage.

C. Prepare pavement surface of sufficient area for pavement markings as indicated on Drawings. Remove contamination and loose material. Avoid damaging pavement surface. When existing pavement markings are present, remove loose and flaking

material. Approved pavement surface preparation methods are sweeping, air blasting, flail milling, and blast cleaning unless otherwise specified on Drawings.

D. For concrete surfaces, air blast after removal of contamination or existing material and just prior to placing stripe. Perform air blasting with compressor that is capable of generating compressed air at a minimum of 150cfm and 100 psi using 5/16-in or larger hosing for the air blast.

3.02 APPLICATION

A. Place pavement markings in proper alignment with guidelines established on roadway. Do not deviate from alignment established greater than two inches. Do not deviate in alignment of marking being placed greater than one inch per 200 feet of marking and do not deviate abruptly.

B. Install in widths or shapes as shown on Drawings.

C. Applied markings shall have uniform mil thickness and glass bead distribution across the width of the line. The markings shall have crisp distinct edges and clean cutoff at the end of each line.

D. Apply on surfaces with a minimum surface temperature of 50°F.

E. Apply at least 20 gal. per mile on concrete and asphalt surfaces and at least 22 gal. per mile on surface treatments for a solid 4-in. line. Adjust application rates proportionally for other widths.

3.03 WARRANTY

A. All labor and materials, including removal and preparation, shall be covered by warranty for a period of twelve (12) months commencing on the final acceptance date with respect to material, workmanship, and performance of the product. Contractor shall bear all expenses connected with the removal and reapplication of pavement markings during the warranty period.

B. Contractor shall upon notification immediately replace all pavement markings and raised markers to the extent noted by the City Inspector. Contractors will completely remove arrow, word, and linear sections of pavement markings and markers. Contractors will not partially patch these markings that leads to a color contrast and loss of retro-reflectivity within the same markings. Contractors will remove all glass beads from the roadway section before leaving the site. No partially patched markings or partially replaced markers will be accepted.

C. Any guarantee work is to be completed within 15 days after receipt of notice of material deficiencies.

END OF SECTION

SECTION 32 17 23.02
REFLECTORIZED PAVEMENT MARKERS, TRAFFIC BUTTONS AND JIGGLE BARS

PART 1 - GENERAL

1.01 SUMMARY

A. This item includes reflectorized pavement markers, buttons and jiggle bars for traffic control as shown on the plans or specified in contract.

1.02 MEASUREMENT AND PAYMENT

A. Measurement

1. This item will be measured by each reflectorized pavement marker, traffic button or jiggle bar.

B. Payment:

1. The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reflectorized Pavement Marker", "Traffic Button" or "Jiggle Bar" of the type shown on the plans or specified in contract. *This price is full compensation for removing existing markers, pavement cleaning and preparation*, materials, tools, labor, and incidentals in conformance with the manufacturer's recommendation.

   Removal, pavement cleaning, and preparation will not be paid for directly and will be subsidiary to the pertinent pavement marker bid items.

   ONLY *standalone markers which represent linear markings that will be replaced by striping will be measured by the linear foot and subsidiary to the pertinent elimination bid items. EXAMPLE: 4 buttons spaced evenly representing a 15' four inch stripe will be 15' of four inch elimination.*

   If plans are provided, the quantity to be paid is the quantity shown in the proposal unless modified. Additional measurements or calculations will be made if adjustments of quantities are required due to an increase or decrease that exceeds 5%.

2. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. The items furnished must be on the Texas Department of Transportation Approved Products List for reflectorized pavement markers, traffic buttons, jiggle bars, and epoxy adhesives. No substitutions are acceptable.

C. Self-adhesive markers are only allowed for temporary construction application. Epoxy adhesives must be used for all permanent construction.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION AND PLACEMENT OF MARKERS

A. Follow manufacturer's written instructions for proper cleaning and preparation of pavement surfaces.

3.02 INSTALLATION

A. Establish pavement marking guides to mark the lateral location of reflectorized pavement markers, traffic buttons, or jiggle bars as shown on the plans and as directed. Do not make permanent marks on the roadway for the guides.

B. Place pavement markers, traffic buttons or jiggle bars in proper alignment with the guides.

C. Remove reflectorized pavement markers, traffic buttons, or jiggle bars placed out of alignment or sequence at Contractor's expense.

D. Use the manufacturer's recommended epoxy adhesive for placement of reflectorized pavement markers, traffic button, or jiggle bars unless otherwise shown on the plans. If no manufacturer's recommendation is given use TXDOT approved epoxy adhesive.Apply adhesives in sufficient quantity to:

   a. ensure that 100% of the bonding area of reflectorized pavement markers, traffic buttons, or jiggle bars is in contact with the adhesive, and
   b. ensure that reflectorized pavement markers, traffic buttons, or jiggle bars except for plowable markers, are seated on a continuous layer of adhesive and not in contact with the pavement surface.

E. Apply adhesives in accordance with manufacturer's recommendations unless otherwise required by this Article.

F. Machine-mix epoxy adhesive.

G. Furnish reflectorized pavement markers, traffic buttons, or jiggle bars free of rust, scale, dirt, oil, grease, moisture, and contaminants that might adversely affect the adhesive bond.

H. Place reflectorized pavement markers, traffic buttons, or jiggle bars immediately after the adhesive is applied and ensure proper bonding. Do not use adhesives or any other material that impairs the functional retro-reflectivity of the reflectorized pavement marker.

END OF SECTION

SECTION 32 17 23.04
THERMOPLASTIC PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SUMMARY

A. This item includes thermoplastic pavement markings and sealers for crosswalks, stop lines, lane lines, and other types of traffic control markings (except retroreflectorized curb markings).

B. All pavement markings shall be Ennis-Flint PAVEMARK alkyd spray/extrude thermoplastic markings applied in conformance with this specification. Provide Ennis-Flint marking materials in accordance to the Type 1 marking materials listed in TxDOT's 2014 Standard Specification for Construction Item 666 and the TxDOT Approved Material Products List for "Thermoplastic Pavement Markings."

C. The manufacturer's recommendations will govern if any details are left out of this specification.

D. No substitutions are acceptable without written approval by the City.

1.02 MEASUREMENT AND PAYMENT

A. Measurement

1. This item will be measured by each word, symbol, or shape; by the linear foot of markings and sealant; or by any other unit shown on the plans. Each stripe will be measured separately.

B. Payment:

1. The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Thermoplastic Pavement Markings" of the type and width as applicable. This price is full compensation for the pavement cleaning and preparation, materials, tools, labor, and incidentals in conformance with the manufacturer's recommendation.

   Elimination of existing pavement markings will be paid under "Section 32 01 11.01 Eliminating Existing Pavement Markings and Markers" which includes surface preparation.

   Surface preparation for thermoplastic pavement markings will be paid under "Section 32 01 11.02 Pavement Surface Preparation for Markings" ONLY when existing markings are not being replaced.

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified. Additional measurements or calculations will be made if adjustments of quantities are required due to an increase or decrease that exceeds 5%.

2. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Spherical glass beads shall be used as reflective media.
   1. The glass spheres shall be colorless, clean, transparent and free of excessive bubbles.
   2. Type 2 beads may be used in lieu of the Type 1 beads only with the City's approval under special circumstances.
   3. The surface of the spheres shall not exhibit any scarring or scratching.
   4. The contractor shall furnish certifications which shall include or have attached specific results of tests performed for roundness, refractive index, flow characteristics and gradation. The certifications shall show the quantity and lot number.

C. Use clearly marked containers that indicate color, mass, material type, manufacturer, and batch number.

D. Equipment - Use equipment that:
   1. Is maintained in satisfactory condition.
   2. Meets or exceeds the requirements of the National Board of Fire Underwriters and the RRC for this application.
   3. Uses an automatic bead dispenser attached to the pavement marking equipment.
   4. Can provide continuous mixing and agitation of the pavement marking material.
   5. Can place at least 40,000 ft. of 4-in. solid or broken markings per day at the specified thickness.
   6. Can place linear markings up to 8 in. wide in a single pass.
   7. Can place markings other than solid or broken lines.
   8. Can place a center-line and no-passing barrier-line configuration consisting of 1 broken line with 2 solid lines at the same time to the alignment, spacing, and thickness shown on the plans, for 3-line application.
   9. Can place white line from both sides.
   10. Can place lines with clean edges, uniform cross section and thickness, and reasonably square ends.

11. Can place skip lines between 10 and 10-1/2 ft., an approximate stripe-to-gap ratio of 1 to 3, and a stripe-gap cycle between 39-1/2 ft. and 40-1/2 ft., automatically.
12. Can place beads uniformly and almost instantly on the marking as the marking is being applied.
13. Can place beads uniformly during the application of all lines (each line must have an equivalent bead yield rate and embedment).

E. Provide a hand-held thermometer capable of measuring the temperature of the thermoplastic marking material.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Follow manufacturer's written instructions for proper cleaning and preparation of pavement surfaces to receive pavement marking or as shown below if information not provided by manufacturer.

B. Remove old pavement markings, loose material, and other contaminants deleterious to adhesion of new pavement markings to be placed. On Portland concrete pavement, minimize over blasting to prevent damage to pavement surface. Small particles of tightly adhering existing pavement markings may remain when complete removal will result in pavement surface damage.

C. Prepare pavement surface of sufficient area for pavement markings as indicated on Drawings. Remove contamination and loose material. Avoid damaging pavement surface. When existing pavement markings are present, remove loose and flaking material. Approved pavement surface preparation methods are sweeping, air blasting, and blast cleaning unless otherwise specified on Drawings.

D. For concrete surfaces, air blast after removal of contamination or existing material and just prior to placing stripe. Perform air blasting with compressor that is capable of generating compressed air at a minimum of 150cfm and 100 psi using 5/16-in or larger hosing for the air blast.

3.02 APPLICATION

A. Place pavement sealers prior to placing thermoplastic pavement markings. The pavement sealer is either an acrylic or epoxy sealer as recommended by the manufacturer or shown on Drawings.

B. Place pavement markings that:

1. Meet the minimum retroreflectivity requirements as shown on Drawings.

2. Are installed in widths or shapes as specified by the City Inspector.

3. Are in proper alignment with guidelines established on roadway. Do not deviate from alignment established greater than two inches. Do not deviate in alignment of marking being placed greater than one inch per 200 feet of marking and do not deviate abruptly.

4. Are applied with a minimum thickness of 90 mils and glass bead distribution across the width of the line. The markings shall have crisp distinct edges and clean cutoff at the end of each line.

5. Are free of blisters and moisture bubbles; with no more than 5% by area of holes or voids.

6. Are only applied on road surfaces with a 50°F or higher atmospheric and surface temperatures. Do not apply if ambient temperatures are near or below the dew point.

7. Are pre-heated to a temperature between 400º and 450º F; not below or above these temperature limits.

8. Cannot be applied to new concrete and asphalt surfaces until the surface is allowed to cure for a minimum 14 days.

9. Are only applied to pavement surfaces that are clean, dry, and free of oils, grease, antifreeze, sand, aggregate, and any chipped or pealed existing pavement markings.

3.03 WARRANTY

A. All labor and materials, including removal and preparation, shall be covered by warranty for a period of twelve months commencing on the final acceptance date with respect to material, workmanship, and performance of the product. Contractor shall bear all expenses connected with the removal and reapplication of pavement markings during the warranty period.

B. Contractor shall upon notification immediately replace all pavement markings and raised markers to the extent noted by the City Inspector. Contractors will completely remove arrow, word, and linear sections of pavement markings and markers. Contractors will not partially patch these markings that leads to a color contrast and loss of retro-reflectivity within the same markings. Contractors will remove all glass beads from the roadway section before leaving the site. No partially patched markings or partially replaced markers will be accepted.

C. Any guarantee work is to be completed within 15 days after receipt of notice of material deficiencies.

END OF SECTION

SECTION 32 32 13.26
LIME/FLY ASH STABILIZED SUBGRADE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Foundation course of lime/fly ash stabilized subgrade material.

1. Application of lime slurry and fly ash to subgrade
2. Mixing, compaction, and curing of lime, slurry, fly ash, water and subgrade into a stabilized foundation

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Measurement and payment for lime/fly ash stabilized subgrade is on a square yard basis compacted in place to proper density. Separate measurement will be made for each required thickness of subgrade course.

   a. Limits of measurement shall match actual pavement replaced, but no greater than the maximum pavement replacement limits shown on Drawings. Limits for measurement will be extended to include installed lime/fly ash stabilized subgrade material that extends 2 foot beyond outside edge of pavement to be replaced, except where proposed pavement section shares a common longitudinal or transverse edge with existing pavement section. No payment will be made for lime/fly ash stabilized subgrade in areas beyond these limits.
   b. Limits of measurement and payment shall match pavement replacement limits shown on Drawings.

2. Payment for hydrated lime and quicklime is by ton of 2000 pounds dry-weight basis
3. Payment for commercial lime slurry is by ton of 2000 pounds of lime calculated on percentage by weight of dry solids for grade of slurry
4. Payment for fly ash is on unit price basis per ton
5. Refer to Section 01 22 00 - Measurement and Payment for unit price procedures

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

DEFINITIONS

D. Moist Cure: Curing soil lime/fly ash material to obtain optimum hydration.

E. Foot Roadway Section: Approximately 500 square yards of compacted subgrade for other than full-lane-width roadway sections.

REFERENCES

F. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for use as Mineral Admixture in Portland Cement Concrete.

SUBMITTALS

G. Conform to requirements of Section 01 33 00 - Submittal Procedures.

H. Submit certification that fly ash, hydrated lime, quicklime, or commercial lime slurry complies with these specifications.

I. Submit weight tickets, certified by supplier, with each bulk delivery of materials to work site.

DELIVERY, STORAGE, AND HANDLING

J. Conform to requirements of Section 31 32 13.19 – Lime Soil Stabilized.

K. Quicklime can be dangerous; exercise extreme caution if used for Work. Become informed about recommended precautions in handling, storage and use of quicklime.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Water: clean, clear and free from oil, acids, alkali, or vegetable matter.

B. Conform to requirements of Section 31 32 13.19 - Lime Stabilized Subgrade for Type A hydrated lime, Type C quicklime, and Type B commercial lime slurry.

C. Fly ash: Residue or ash remaining after burning finely pulverized coal at high temperatures conforming to requirements of ASTM C 618, Type ‘C” or “F” and following:

1. Minimum CaO content of 20 percent
2. Loss on ignition not to exceed 3 percent
3. Contain no lignite ash

D. Asphaltic Seal Cure: Conform to requirements of Section 02336 - Lime Stabilized Subgrade.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Include fly ash in percentage amounts in lime or lime slurry as established from geotechnical evaluation for application, mixing, and compaction.

B. Apply lime/fly ash as single mix, single pass over lower PI soils.

C. Conduct operations to minimize elapsed time between mixing and compacting lime/fly ash stabilized subgrade in order to take advantage of rapid initial set characteristics. Complete compaction within 2 hours of commencing compaction and not more than 6 hours after adding and mixing last stabilizing agent.

QUALITY CONTROL

D. Soil will be sampled to establish percent of fly ash and hydrated lime, quicklime, or lime slurry to be applied to subgrade material.

E. Gradations-

F. Depths – 0” to 1”

END OF SECTION

SECTION 32 80 00
IRRIGATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings, valves, sprinkler heads, and accessories.

B. Control system.

MEASUREMENT AND PAYMENT

C. Unit Prices.

1. Payment for landscape irrigation will be made under this Section on lump sum basis.
2. Payment for capped irrigation sleeve, for connection to future system expansion, is on linear foot basis.
3. Refer to Section 01 22 00- Measurement and Payment.

D. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

REFERENCES

E. ANSI/ASTM D 2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

F. ASTM D 2241 - Standard Specification for (Poly Vinyl Chloride) (PVC) Pressure - Rated Pipe (SDR Series).

G. City of Sugar Land Development Code

H. Texas Commission on Environmental Quality (TCEQ)

SYSTEM DESCRIPTION

I. Electric solenoid controlled underground irrigation system.

J. Source Power: 120 volt

SUBMITTALS

K. Conform to requirements of Section 01 33 00 - Submittal Procedures.

QUALIFICATIONS

L. Manufacturer: Company specializing in performing work of this section with minimum three years documented experience.

REGULATORY REQUIREMENTS

M. Conform to applicable code for piping and component requirements.

N. Texas Commission on Environmental Quality (TCEQ) Rules

O. City of Sugar Land Development Code

COORDINATION

P. Coordinate work with site landscape grading and delivery of plant life.

EXTRA MATERIALS

Q. Furnish extra components in accordance with requirements:

1. Two sprinkler heads of each type and size.
2. Two valve box keys.
3. Two wrenches for each type head core and for removing and installing each type head.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Pipe shall be continuously and permanently imprinted with manufacturer's name, size, schedules, type, and working pressure.

B. PVC Pipe ASTM D 2241; 200 psi pressure rated upstream from controls, 160 psi downstream; solvent welded sockets rubber gasket joints.

C. Fittings: Type and style of connection to match pipe.

D. Solvent Cement: ANSI/ASTM D 2564 for PVC pipe and fittings.

E. Sleeve material: 4 inch schedule 40 PVC.

OUTLETS

F. Subject to compliance with requirements provide the following or comparable product as approved in writing by Landscape Architect:

1. Rainbird Model 1804.
2. Rainbird Model 1812.
3. Hunter Model PGP.

G. Rotary type sprinkler head: Pop-up type with screens; fully adjustable for flow and pressure; size as indicated; with letter or symbol designating degree of arc and arrow indicating center of spray pattern.

H. Spray Type Sprinkler Head: Pop-up head with full circle, half circle, third circle, quarter circle, and square pattern.

VALVES

I. Subject to compliance with requirements provide the following or comparable product as approved in writing by Landscape Architect:

1. Rainbird Model PEB Series

J. Gate Valves: Bronze construction, non-rising stem, and sized to line.

K. Backflow Preventers: FEBCO 765 Bronze body construction, or pressure vacuum breaker type.

L. Valve Box and Cover: rectangular 10 inches by 4 inches or 9 inches round.

CONTROLLER

M. Subject to compliance with requirements provide the following or comparable product as approved in writing by Engineer:

1. Rainbird Model RC1260C

N. Valves: Electric solenoid wiring including required fittings and accessories.

O. Wire conductors: color coded.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions in accordance with requirements.

B. Verify location of existing utilities.

C. Verify that required utilities are available, in proper location, and ready for use.

PREPARATION

D. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures.

E. Layout and stake locations of system components.

F. Review layout requirements with other affected work.

G. Coordinate locations of sleeves under paving to accommodate system.

TRENCHING

H. Trench and filling as required.

I. Trench size:

1. Minimum cover over installed supply piping: 18 inches.
2. Minimum cover over installed branch piping: 12 inches.
3. Minimum cover over installed outlet piping: 12 inches.
4. Minimum cover over installed sleeves: 18 inches.

J. Trench to accommodate grade changes.

K. Maintain trenches free of debris, material, or obstructions that may damage pipe.

L. Do not leave trenches open overnight.

INSTALLATION

M. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.

N. Connect to utilities.

O. Set outlets and box covers at finish grade elevations.

P. Install control wiring as required. Provide 10-inch expansion coil at each valve to which controls are connected, and at 100 foot intervals. Bury wire beside pipe. Mark valves with neoprene valve markers containing locking device. Set valve markers in 160 psi PVC pipe risers exiting from top of valve to finish grade.

Q. After piping is installed, but before outlets are installed and filling commences, open valves and flush system with full head of water.

R. Coordinate pipe installation with conduit installation.

FIELD QUALITY CONTROL

S. Field inspection and testing will be performed.

T. Prior to filling, test system for leakage for whole system to maintain 100 psi pressure for one hour.

FILLING

U. Cover with 3 inches of sand over piping; fill trench and compact to subgrade elevation. Protect piping from displacement.

ADJUSTING

V. Adjust control system to achieve time cycles required.

W. Change and adjust head types for full water coverage as directed.

DEMONSTRATION AND TRAINING

X. Instruct personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration.

END OF SECTION

SECTION 32 91 00
PLANTING PREPARATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section specifies the-requirements for providing planting materials and their installation as indicated and scheduled.

UNIT PRICES

B. No separate payment will be made for trees and shrubs. Include payment in lump sum with price breakdown in the Schedule of Values.

C. Refer to Section 01 22 00 - Measurement and Payment, and Section 01 29 73 - Schedule of Values.

REFERENCES

D. ANSI Z60.1 - American Standard for Nursery Stock.

E. American National Standards Institute (ANSI) A300 Standards for Tree Care Operations

SUBMITTALS

F. Work Schedule: Contractor shall submit a work schedule for all planting work prior to purchase and installation of plant material.

G. Certification:

1. Submit certification from supplier that each type of tree and shrub conforms to reference standards.
2. Submit, for Owner's Representative's review and approval, manufacturer's or vendor's certified analysis of soil amendments. Submit other data substantiating that materials comply with specified and indicated requirements.
3. Fertilizer certification shall be submitted for Owner's Representative's review and approval as to the chemical analysis of the fertilizer, a listing of the elements contained therein and their percentages.

H. Soils and compost materials shall be approved at their source prior to delivery.

I. Submit samples of topsoil, bark mulch, enriched bark mulch and compost.

J. For unpackaged materials, submit analysis by recognized laboratory made in accordance with methods established by Association of Official Agriculture Chemists, when applicable.

DELIVERY, HANDLING AND STORAGE OF MATERIALS

K. Packaged Materials: Deliver packaged materials in fully labeled original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

L. Plants:

1. Ship trees with Certificates of Inspection as required by governing authorities. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.

Do not drop stock during delivery.

2. Materials shall not be pruned prior to installation unless otherwise approved by Owner's Representative in writing. Do not bend or bind-tie trees and shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery.
3. Deliver plants after preparation for planting has been completed and plant immediately. If planting is delayed more than 7 hours after delivery, set plants in shade, protect from weather and mechanical damage. Keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture, and water as needed.
4. Do not remove container grown stock from containers before time of planting and water immediately after delivery and prior to planting.
5. Provide a storage platform for balled-and-burlapped root balls over 24 inches in diameter.
6. Store plants on the site as directed.
7. Spray with antitranspirant at time of delivery in warm season months. Apply at rates in accordance with manufacturer's recommendations.

SUBSTITUTIONS

M. Substitution of larger size or better grade than specified will be allowed, but with no increase in cost. Substitution of an alternate species may be accepted upon written approval from the City Engineer. If specified planting material is not obtainable, submit proof of non-availability together with proposal for use of equivalent material. Contractor shall submit proposal in a timely manner as to not impact project completion or installation of other work.

WARRANTY

N. Contractor shall furnish written warranty of trees, shrubs, groundcover and turf for

12 months after date of final acceptance, against defects including death and unsatisfactory growth, loss of shape due to improper pruning or maintenance, except for defects resulting from neglect by Owner or abuse or damage by others. Plumb leaning trees during warranty period.

O. Remove and replace trees, shrubs and groundcover found to be dead or in unhealthy condition during warranty period. Replace trees, shrubs and groundcover which are in doubtful condition at end of warranty period. However, if in the opinion of Owner, such doubtful material may survive, Contractor shall extend the warranty period for a full growing season. Owner will determine which items are in doubtful condition.

P. Periodically inspect plants for proper watering and spraying during warranty period.

Q. Damage caused by natural hazards such as hail, high wind, or storms is not covered by the warranty.

R. Plant materials which die due to insects or diseases are included in the warranty.

S. Existing plant material required to be moved on the site will be protected under the warranty.

T. Another inspection will be conducted by Owner, at end of extended warranty period to determine acceptance or rejection.

SOIL ANALYSIS

U. Submit for approval an analysis of soils obtained from off-site sources prior to delivery.

V. Analysis of existing soil is not required.

QUALITY ASSURANCE

W. Submit inspection certificates as required by law with the invoice for each shipment or order of stock. Submit certificates to the City Engineer in ample time to be reviewed to meet installation schedule.

X. Installer: Installation of planting work shall be performed by a single firm specializing in landscape and planting work. Contractor shall be licensed by the Texas Association of Nurserymen, shall possess an agricultural certificate, shall be a licensed pest applicator, and shall have not less than 5 years of experience in this type of work.

PROTECTION

Y. Take reasonable precautions to prevent damage to existing structures and plants. Refer to Section 01 56 39 – Tree and Plant Protection. Keep the area free of hazards.

Z. Protect trees which may be subject to damage.

AA. During planting, protect installed plants and lawns from damage. If heavy equipment or materials must be moved across lawns, use planks or pontoons to protect the turf. Similarly, protect walks across which heavy equipment must pass.

BB. Plant frost-tender trees only after danger of frost is past or sufficiently before frost season to allow for establishment before first frost. Do not plant in frozen ground.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Refer to Section 32 91 19.13 – Topsoil.

FERTILIZER

B. Granular fertilizer shall be a commercial fertilizer, uniform in composition, free flowing, and suitable for application with approved equipment. Fertilizer which has been exposed to high humidity and moisture, has become caked or otherwise damaged making it unsuitable for use, will not be acceptable. Application shall be Osmocote 13.13.13 + Iron by Sierra Chemical, 1-800-492-8255, 1001 Yosemite Dr., Milpitas, CA 95035, or approved equal. Broadcast and rototill fertilizer at the rate of 3 lbs. actual nitrogen per 1000 square feet into prepared planting soil.

C. Agriform 20-10-5 Planting Tablets shall be evenly placed in planting pits at the following rate:

Material	No. of Tablets
1 gallon/4" pots	1/2 (or granular fertilizer)
5 gallon	1
15 gallon	2
30 gallon	3
65 gallon	5

CONSTRUCTION MATERIALS

D. Tree Guys:

1. Guy Wires: Use 10-gage galvanized annealed iron wire.
2. Hose: 2-ply, fiber-reinforced.

E. Stakes:

1. For use in identifying tree and shrub locations.
2. Use 1 x 2 pine, or equivalent, 18 inches long.
3. Use waterproof marker for identification.
4. Use tree stakes that are of sound and durable quality capable of withstanding aboveground and underground conditions either T-post or treated lodge poles.

F. Sharp Sand:

1. Sand shall be thoroughly washed, coarse grade sharp, construction or brick sand, free of clay balls, weeds, and grass. So-called cushion sand, blow sand, or creek silt is not acceptable for substitution where sharp sand is specified.

G. Bark Mulch for top dressing: Organic mulch free from deleterious materials and suitable for top dressing of trees, shrubs or plants. Mulch shall be composted, well rotted, shredded hardwood mulch, black or dark brown in color. Enriched Bark Mulch for bed prep shall be as above with additional organic of peat and/or manure.

H. Prepared Backfill Mix: Shall be 1/3 topsoil, 1/3 sharp sand, and 1/3 enriched bark mulch or approved commercially available soil mix. Add fertilizer as per specifications.

SPRAYS

I. Sterilization:

1. Use approved solution of Dyclomec 4G or equal for areas to be planted.
2. Use Pramitol or equal for areas to be paved

J. Herbicides:

1. Use an approved systemic non-selective, post emergent herbicide on specified areas to kill vegetation.
2. Use Confront or equal for general control of broadleaf weeds in lawns.
3. Use Preemerg, Eptam, Dryclomec, or equal for ground cover.
4. Use an approved pre-emergent to control seed germination in specified areas.

K. Root Stimulant. Use approved root stimulant on newly planted trees, shrubs, vines and ground cover areas. Root Stimulator: Shall be Hi-Yield Root Stimulator 5-12-3, by Voluntary Purchasing group, P.O. Box 460, Bonham, TX 75418, 214-583-5501, or approved equal. Spreader sticker as needed.

L. Fire Ant Control: Durzban or 1 % Diazanon Granular as manufactured by Green Light Projects Co., San Antonio, TX 78217 or Logic by PBI Gordon, Kansas City, MO or approved equal.

M. Insecticide: Lindane with Adjuvant distributed by Esco Distributors, 514 W. 25th Street, Houston, TX 77008 713-864-7771 or approved equal.

PLANT CHARACTERISTICS

N. Provide healthy, vigorous, specimen plants which are true to type and name, and typical of their species or variety. Plants shall have a normal, well-developed branch structure, with a vigorous root system, and shall be generally sound and healthy. Use plants which are free from defects, including:

1. Disfiguring knots

2. Sun scald
3. Injuries
4. Bark abrasions
5. Plant diseases
6. Insect eggs
7. Borers
8. Infestations.

O. Select well-formed plants balanced between height and spread typical of the species or variety with branches in normal position. Heading back plants to meet size limits is not permitted.

P. Unless otherwise specified, plants shall be nursery grown in a recognized nursery and at least twice transplanted. Use plants which have been growing under similar climatic conditions to those of the project for at least 2 years prior to the date of the contract. Recently stepped-up plants are not acceptable. Balled-and-burlapped plants or bare root plants shall be freshly dug; heeled-in or cold storage plants will not be accepted.

Q. Balled, bare root and container-grown plants will conform to the definitions given in the American Standards for Nursery Stock.

R. No tree shall be accepted which has had leaders cut or damaged, or which has a thin, weak trunk or poorly formed tops.

S. Inspection: Notify Owner's Representative at least 2 weeks prior to installation, of location where materials that have been selected for planting may be inspected, either at place of growth or the site prior to planting. Plant material will be inspected for compliance with requirements for genus, species, variety, size and quality. Owner's Representative retains right to further inspect trees for size and conditions of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Contractor shall remove rejected trees immediately from site and replace with specified materials. Plant material not installed in accordance with Contract Documents will be rejected.

T. Regardless of sample selection, a plant may be rejected at the site by the City Engineer.

NURSERY STOCK

U. Deciduous Trees:

1. Provide trees which are straight and symmetrical and have a persistently preferred main leader. The crown must be in good overall proportion to the entire height of the tree. Where a clump is specified, a plant having a minimum of three stems originating from a common base at the ground line shall be furnished.
2. Measure trees by average caliper of trunk.
3. For trees up to 4 inches in diameter, measure caliper 6 inches above ground.
4. For trunks larger than 4 inches, measure caliper 12 inches above ground.

B. Evergreen Trees:

1. Form of the top will be typical of the species and not unnaturally sheared or color-treated.
2. Measure by average caliper.
3. For trees up to 4 inches in diameter, measure caliper 6 inches above ground.
4. For trunks larger than 4 inches, measure caliper 12 inches above ground.

C. Vines and Ground Cover. Provide plants which are container-grown for sufficient time to ensure adequate root growth to hold the soil in place and retain the original shape when removed from the container.

HYDROMULCH

V. Provide hydromulch seeding as noted in Section 32 92 13 - Hydromulch Seeding.

PART 3 - EXECUTION

3.1 WORK CONDITIONS

A. Work Scheduling: Proceed with and complete planting work in a timely manner, working within seasonal limitations for each kind of planting work required.

B. Weather Restrictions. Stop work during inclement weather such as drought, high winds, excessive rain, extreme heat, cold or freezing temperatures, or as directed by the City Engineer. Obtain authorization before resuming work.

C. Plant trees, shrubs and groundcover after final grades are established and prior to planting of lawns, unless otherwise directed by Owner's Representative in writing. If planting occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

D. Utilities: Refer to engineering drawings and coordinate with Utility Contractor for location of utilities. Contractor shall be responsible for damage to existing utilities and structures.

E. Security: The Owner will not assume any responsibility for security of any materials, equipment, etc. during construction of the project until project acceptance.

F. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions beyond the scope of this contract, or obstructions, notify Owner's Representative of such conditions, immediately and before planting.

G. Pollution Control: Control dust caused by planting operations. Dampen surfaces as necessary. Comply with pollution control regulations of governing authorities.

H. Traffic Control: Contractor must obtain a right of way permit from the City's Public Works Department and comply with all TUMCD and TxDOT rules.

SITE PREPARATION

I. Existing Trees:

1. Protection: Protect tops, trunks and roots of trees to remain on the site. Before starting work, box, fence or otherwise protect trees subject to construction damage. Remove boxing when directed. Do not stockpile materials or heavy equipment within the branch spread of trees.
2. Removal. Remove trees marked for removal. Do not remove any tree without proper authorization. Stumps within 36 inches of final grade must be removed.
3. Pruning and Surgery. Cut and trim trees only as directed; do not cut any tree without proper authorization. Trim existing trees of dead or diseased limbs. Cut limbs close to the trunk.

J. Grading Around Trees. As required, fill or grade within the branch spread of trees to remain, observing the following requirements.

1. For trenching beneath trees, tunnel under the tree roots with careful hand digging. Where possible, avoid cutting or injuring roots.
2. Do not raise or lower the grade around an existing tree in any way, unless so directed.

K. Placing Topsoil.

1. Disk, drag, harrow, or handrake subgrade. Scarify the subgrade to a depth of 1-1/2 inches. Before placing topsoil, rake the subsoil surface clear of stones, wood, rubbish and other debris. Place no topsoil until the subgrade preparation has been approved.
2. Spread, rake, and compact topsoil to form a layer with a minimum depth of 4 inches in lawn areas and 6 inches in shrub areas. Place topsoil to conform to finished gradients as shown on the grading plan.
3. Remove spilled topsoil from curbs, gutters, and paved areas and dispose of excess topsoil in accordance with requirements.

L. Fertilizer. Evenly broadcast and work fertilizer into soil at the following rates:

1. Ground Cover, Shrub, and Tree Areas: 1-1/2 N pounds per 1000 square feet.

PLANTING

M. Layout: Before proceeding with planting operations, notify the City Engineer, or his designee, 3 working days in advance to coordinate a site visit. Set stakes to locate plants or place 5-gallon and larger sized plants in their permanent locations and acquire approval from the City Engineer. Do not place plants or stakes in planter areas until soil has been placed and accepted.

N. Excavation for Trees and Large Shrubs:

1. Excavate pits with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage.
2. Make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus 3" allowance for setting of ball on a layer of compacted backfill.
3. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.

O. Planting Trees and Large Shrubs:

1. Set stock on layer of compacted planting soil mixture, plumb and in center of pit at same elevation as adjacent finished planting grades. This must be done just prior to backfill to prevent air drying of rootball. Place fertilizer tablets evenly spaced in hole at specified rate. Immediately place additional backfill mix around base and sides of ball and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Dish top of backfill to allow for mulching.
2. Prune, thin out, and shape shrubs in accordance with standard horticultural practice. Prune shrubs to retain natural character. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
3. When balled-and-burlapped plants are being set, loosen burlap, ropes, and wire from the tops and the sides of the ball before backfilling with soil. Do not remove burlap from beneath the ball.

P. Excavation for Shrubs in Beds

1. Excavate entire planting beds to a depth of 8 inches planting beds to have vertical sides.
2. Dispose of subsoil removed from planting beds excavations. Do not mix with planting soil or use as backfill.
3. Till bottom of planter 2"-4", leave bottom of planter un-compacted. Backfill with 8" of prepared backfill mix.

Q. Planting of Shrubs in Beds

1. Set stock on layer planting soil mixture, plumb and at the same elevation as adjacent finished planting grades. Place fertilizer tablets paced in planting bed at specified rate. Place additional backfill mix around base and sides of ball and work each layer to settle backfill and eliminate voids and air pockets. Water entire beds thoroughly, adjust plant if settling occurs.

2. Provide steel edging.

R. Treat entire areas of planting and tree root balls with:

1. Broadcast application of fire ant insecticide at manufacturer's recommended rate.
2. Broadcast application of pre-emergent herbicide at manufacturer's recommended

rate (except seasonal beds).

S. Mulching: Immediately after planting has been completed, mulch tree wells, bed trenches, and plant beds. Provide not less than 4" thickness of hardwood mulch, work into top of backfill, and finish level with adjacent finish grades. Cover entire root ball.

T. Backfilling Around Trees and Shrubs:

1. Backfilling each plant hole with a planting soil mixture for planted areas as follows: 60 percent soil, 20 percent humus, and 20 percent sand.
2. Construct a minimum 4-inch-high soil berm to form a watering basin around newly planted trees and shrubs. On all slopes except minor ones, form soil into an adequate dam or shoulder on the downhill side to catch and hold water and prevent erosion. Properly regrade the slope on the uphill side.

U. Guying, Staking, and Wrapping: Support trees immediately after planting by the use of guys or stakes.

1. Guy each tree with 3 guys equally spaced around the tree. Where possible, attach each guy to the tree trunk at major branch crotches of the tree at least 4 feet above ground height. Encase guy wires in fiber-reinforced rubber hose to prevent cutting into the bark. Place encased guy wire around the trunk in a single loop. Stretch the guy at a 60-degree angle to a notched stake driven completely into the ground. Wire should be equally taut to prevent the tree from swaying in wind. Mark each wire 3 feet above the ground with a 12-inch streamer of plastic white surveyors tape.
2. Use 3 stakes for trees with a trunk 3- to 4-inch caliper; two for trunks with less than 3-inch caliper. Space stakes equally about each tree and drive vertically into the ground 2-1/2 to 3 feet. Avoid injuring ball or roots. Attach strands of wire around the trunk at the meeting of the primary branches and to each stake. Encase the wire around the trunks with fiber-reinforced rubber hose to prevent cutting into the bark.

CLEANING AND MAINTENANCE

V. Cleaning:

1. During planting, remove excess and waste materials regularly. As work in an area is completed, thoroughly clean the area. Stockpile, haul from site, and legally dispose of waste materials and debris. Accumulation will not be permitted. Maintain haul and disposal routes clear, clean, and free of debris. On-site burning of combustible cleared materials will not be permitted.
2. Any paved areas where products are placed must be cleaned periodically to prevent damage or the accumulation of debris. Sweep site and remove trash at end of each workday as necessary.
3. Existing grass areas damaged by planting operations must be cleaned, and returned to the condition prior to start of planting work.
4. Upon completion of construction and before final acceptance, remove temporary facilities, tools, equipment, surplus materials, and debris. Clean and wash paved areas. Provide site clean and free of materials and suitable for use as intended.

SUBSTANTIAL COMPLETION AND FINAL ACCEPTANCE

W. Substantial Completion notice for planting work will be issued by Owner's Representative only for entire planting and landscape work.

X. Substantial Completion notice will be issued only after Owner and Owner's Representative inspect and approve all required planted materials and grassed areas.

Y. Final acceptance will be determined after the maintenance period and when all plant materials are alive and healthy and grass areas are established. Owner will make an inspection to determine acceptability.

Z. Final acceptance notice will be issued only after Owner and Owner's Representative inspect and approve all planting work as in accordance with the Contract Documents.

MACHIINE MOVED TREES

AA. Scope of Work:

1. Scope of Work includes pruning, digging, transporting and planting, sanding in, chemical treatment, weed and grass control, mulching and miscellaneous for tree size and species as shown on drawings.
2. Trees will be tagged in the field by the Contractor(s) and approved by Landscape Architect as required.
3. Trees will be moved with minimum 80" blade machine.
4. Trees will be dug, transported and planted, pruned, sanded, mulched, root stimulated and sprayed for borers, and treated for weed and grass control by tree contractor(s). (See plan for details.)
5. Contractor will stake location of trees on site and obtain approval of Owner prior to moving trees.
6. Contractor will be responsible for locating underground utilities.
7. Contractor will be responsible for watering and maintaining the trees during the project until the project is complete and through the maintenance period.

BB. Pruning:

1. Before digging, or within 48 hours after transplanting, Oaks will be Class IV pruned as defined in the American National Standards Institute (ANSI) A300 Standards for Tree Care Operations. Approximately 20% of the mass shall be removed.

CC. Crossing branches and branches that detract from the tree shall be removed first.

DD. The majority of the mass shall be removed from the outer canopy of the tree.

EE. All major interior branches shall be left intact, except those damaged during the pruning process.

END OF SECTION

SECTION 32 91 19.13
TOPSOIL PLACEMENT AND GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. No separate payment will be made for topsoil under this Section. Include payment in Hydromulch Seeding - Section 32 92 13 or Sodding – Section 32 92 23.
2. Refer to Section 01 22 00 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having following characteristics:

1. pH value of between 5.5 and 6.5
2. Liquid limit: 50 or less
3. Plasticity index: 20 or less
4. Gradation: maximum of 10 percent passing No. 200 sieve

B. Topsoil shall be free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.

C. Obtain topsoil from naturally well-drained areas where topsoil occurs at minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by City Engineer.

B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

TOPSOIL EXCAVATION

C. Conform to excavation and stockpiling requirements of Section 31 24 13 – Roadway Embankment.

PLACEMENT

D. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.

E. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Section 31 23 33.16 – Excavation and Backfill for Utilities.

F. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on Drawings.

G. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01 74 13 – Progress Cleaning.

H. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in and recompact areas of settlement.

PROTECTION

I. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION

SECTION 32 92 13
HYDRO-MULCH SEEDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, material, equipment and incidentals necessary to prepare the ground, furnish and install fertilizer and hydro-mulching seed or a mixture of seed of the kind specified in areas disturbed by the construction operations.

1.2 ACTION SUBMITTALS

B. Product Data: For each type of product indicated.
C. Seeding shall be in conformance with TxDOT 164 unless otherwise directed by the Engineer.

1.3 INFORMATIONAL SUBMITTALS

D. Certification of seed.

1. Certification of each seed mixture.

E. Product certificates.

1.4 QUALITY ASSURANCE

F. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

G. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.

1. The soil-testing laboratory shall oversee soil sampling.
2. Report suitability of tested soil for turf growth.

   a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
   b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

DELIVERY, STORAGE, AND HANDLING

H. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Seed used must carry a Texas Testing Seed label showing purity and germination, name, type of seed, and that the seed meets all requirements of the Texas Seed Law. Seed furnished shall be of the previous season's crop and the date of analysis shown on each tag shall be within nine (9) months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers.

2.2 SEED

B. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's “Journal of Seed Technology; Rules for Testing Seeds” for purity and germination tolerances.

C. The specified seed shall equal or exceed the following percentages of purity and germination:

Common Name	Purity	Germination
Common Bermuda Grass	95%	90%
Rye *(October through December Only)*	N/A	

2.3 MULCHES

D. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

E. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

F. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

G. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

2.4 FERTILIZERS

H. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

I. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

J. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

K. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.5 PESTICIDES

L. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. After the areas disturbed by construction operations have been backfilled and completed to the original pre-construction lines and grades shown on the plans and as provided for in other items of this contract, perform hydro-mulch seeding in accordance with the requirements hereinafter described.

3.2 INSTALLATION

B. Cultivation:

1. Cultivate areas to be seeded to a depth of at least 4". Cultivate the seedbed sufficiently to reduce the soil to a state of good tilth when the soil particles on the surface are small enough and lie closely enough together to prevent the seed from being covered too deep for optimum germination. Cultivation of seedbed will not be required in loose sand where depth of sand is 4" or more. Maintain the cross-section previously established throughout the process of cultivation and any necessary reshaping shall be done prior to any planting of seed.

C. Planting Season and Application Rates:

1. Perform planting between the dates specified for each type except when specifically authorized in writing. The seeds planted per acre shall be of the type specified with the mixture, rate, and planting dates as follows:
2. Common Bermuda Grass - hulled, eighty (80) pounds per acre - April through August or a combination of
3. Common Bermuda Grass - unhulled, fourty (40) pounds per acre and Gulf Coast Annual Rye - unhulled, fourty (40) pounds per acre - September through March.
4. Apply fertilizer uniformly at the average rate of four hundred (400) pounds per acre.

D. Hydro-Mulch (Cellulose Fiber) Seeding:

1. Uniformly distribute the fertilizer, seed or seed mixture, in the quantity specified over the areas to be seeded. Mechanical equipment shall be such that all varieties of seed as well as fertilizer may be distributed at the same time, provided that each component is uniformly applied at the specified rate. When seed and fertilizer are to be distributed as a water slurry, apply the mixture to that area to be seeded within 30 minutes after all components are placed in the equipment. Upon completion of planting the seed, spread cellulose fiber mulch uniformly over the area at the following rates:

    a. Sandy soils with 3:1 slope or less – min. 2000 lbs/acre
    b. Sandy soils with greater then 3:1 slope – min. 2300 lbs/acre
    c. Clay soils with 3:1 slope or less - min. 2500 lbs/acre
    d. Clay soils with greater then 3:1 slope - min. 3000 lbs/acre

2. The rates are given in dry weight of mulch per acre. A mulching machine, approved by the Owner’s Representative, shall be equipped to eject the thoroughly wet mulch material at a uniform rate to provide the mulch coverage specified.

3.3 MAINTENANCE

E. Water the planted area at such times as necessary for a period of one (1) year after final acceptance of the project by the Owner. Fertilize and reseed any area which fails

to survive for a period of one (1) year from the date the project is accepted by the Owner.

END OF SECTION

SECTION 32 92 13
HYDRO-MULCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes seeding, fertilizing, mulching, and maintenance of areas indicated on Drawings.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for hydro mulch seeding is on an acre basis.
2. Refer to Section 01 22 00 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

C. Conform to requirements of Section 01 33 00 - Submittal Procedures.

D. Submit certification from supplier that each type of seed conforms to these specifications and requirements of Texas Seed Law. Certification shall accompany seed delivery.

E. Submit certificate stating that fertilizer complies with these specifications and requirements of Texas Fertilizer Law.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Conform to material requirements of Section 32 91 19.13 - Topsoil.

B. Seed: Conform to U.S. Department of Agriculture rules and regulations of Federal Seed Act and Texas Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet following requirements:

1. Rye: Fresh, clean, Italian rye grass seed (lollium multi-florum), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.

2. Bermuda: Extra-fancy, treated, lawn type common bermuda (Cynodon dactylon). Deliver in original, unopened container showing weight, analysis, name of vendor, and germination test results.
3. Wet, moldy, or otherwise damaged seed will not be accepted.
4. Seed requirements, application rates, and planting dates are:

    a. TYPE APPLICATION RATE POUNDS/A PLANTING DATE
    b. Hulled Common Bermuda Grass 98/88 Unhulled Common Bermuda Grass 98/88 40 40 Jan 1 to Mar 31
    c. Hulled Common Bermuda Grass 98/88 40 Apr 1 to Sep 30
    d. Hulled Common Bermuda Grass 98/88 Unhulled Common Bermuda Grass 98/88 Annual Rye Grass (Gulf) 40 40 30 Oct 1 to Dec 31

C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted.

D. Fertilizer shall contain minimum percentages of following elements:

E. Nitrogen: 10 Percent

F. Phosphoric Acid: 20 Percent

G. Potash: 10 Percent

H. Mulch:

1. Virgin wood cellulose fibers from whole wood chips having minimum of 20 percent fibers 0.42 inches in length and 0.01 inches in diameter. Use of on-site vegetative debris may be acceptable if it meets these standards. Approval from City Engineer is required prior to application.
2. Cellulose fibers manufactured from recycled newspaper and meeting same fiber content and size as for cellulose fibers from wood chips.
3. Dye mulch green for coverage verification purposes.

I. Soil Stabilizer: "Terra Tack 1" or approved equal.

J. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Place and compact topsoil in accordance with requirements of Section 32 91 19.13-Topsoil.

B. Dispose of Objectionable and Waste Materials in accordance with Section 01 74 13 – Progress Cleaning.

3.2 APPLICATION

C. Seed: Apply uniformly at rates given in Paragraph 2.01 B (4) for type of seed and planting date.

D. Fertilizer: Apply uniformly at rate of 500 pounds per acre.

E. Mulch: Apply uniformly at rate of 50 pounds per 1000 square feet.

F. Soil Stabilizer: Apply uniformly at rate of 40 pounds per acre.

G. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.

H. Sod: Lay single row of sod along perimeter where top soil and pavement intersect. Apply in conformance to Section 32 92 23 - Sodding.

I. Suspend operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain City Engineer approval before resuming operations.

END OF SECTION

SECTION 32 93 00
PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.
2. Planting soils.

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

G. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

H. Root Flare: Also called “trunk flare.” The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

J. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of

organic matter and soil organisms.

K. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

B. Samples of mineral mulch.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Maintenance Instructions: Recommended procedures for maintenance of plants during a calendar year.

1.5 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.

1. The soil-testing laboratory shall oversee soil sampling.
2. Report suitability of tested soil for plant growth.

a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

D. Pre-installation Conference: Conduct conference at specified project location.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root

system moist until planting.

B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

C. Handle planting stock by root-ball.

D. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
   b. Structural failures including plantings falling or blowing over.

2. Warranty Periods from Date of Substantial Completion:

   a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
   b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
   c. Annuals: Three months.

1.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period for Trees and Shrubs: To be determined by contract.
2. Maintenance Period for Ground Cover and Other Plants: To be determined by contract.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Root-Ball Depth: Furnish trees and shrubs with root-balls measured from top of root-ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

C. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent

water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch, 3/4-inch, and 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens /m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 to 4 percent nitrogen and 10 to 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5, 10 and 21 gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.5 PLANTING SOILS

A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 2 percent organic material content; existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process; existing, in-place surface soil; imported topsoil or manufactured topsoil from off-site sources; do not obtain from agricultural land, bogs or marshes. Verify suitability of soil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Ratio of Loose Compost to Topsoil by Volume: to be specified in scope.
2. Ratio of Loose Sphagnum to Muck Peat to Topsoil by Volume: to be specified in scope.
3. Ratio of Loose Wood Derivatives to Topsoil by Volume: to be specified in scope.
4. Weight of Lime per 1000 Sq. Ft.: to be specified in scope.
5. Weight of Sulfur, Iron Sulfate, and Aluminum Sulfate per 1000 Sq. Ft.: to be specified in scope.
6. Weight of Agricultural Gypsum per 1000 Sq. Ft.: to be specified in scope.
7. Volume of Sand Plus 10 Percent Diatomaceous Earth and Zeolites per 1000 Sq. Ft.: to be specified in the scope.
8. Weight of Bonemeal per 1000 Sq. Ft.: to be specified in the scope.
9. Weight of Superphosphate per 1000 Sq. Ft.: to be specified in the scope.
10. Weight of Commercial Fertilizer per 1000 Sq. Ft.: to be specified in the scope.
11. Weight of Slow-Release Fertilizer per 1000 Sq. Ft.: to be specified in the scope.

2.6 MULCHES

A. Organic Mulch: Shredded hardwood, Ground or shredded bark, Wood and bark chips, Pine straw, Salt hay or threshed straw, Pine needles, Peanut, pecan, and cocoa-bean shells.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

C. Mineral Mulch: Rounded riverbed gravel or smooth-faced stone; Crushed stone or

gravel; Marble chips; Granite chips.

1. Size Range: 1-1/2 inches maximum, 3/4 inch minimum.
2. Color: Uniform tan-beige color range acceptable to Architect or Readily available natural gravel color range.

2.7 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd..

2.8 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply superphosphate fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
3. Spread planting soil to a depth of 6 inches, but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.2 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root-ball and assist in drainage away from center. Do not further disturb base. Ensure that root-ball will sit

on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter.
2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than depth of the root-ball, measured from the root flare to the bottom of the root-ball.

B. Subsoil and topsoil removed from excavations may be used as planting soil.

3.3 TREE, SHRUB, AND VINE PLANTING

A. Before planting, verify that root flare is visible at top of root-ball according to ANSI Z60.1.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set stock plumb and in center of planting pit or trench with root flare a minimum of 1 to 2 inches above adjacent finish grades.

1. Use planting soil for backfill.
2. Balled and Burlapped: After placing some backfill around root-ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root-balls and from sides, but do not remove from under root-balls. Remove pallets, if any, before setting. Do not use planting stock if root-ball is cracked or broken before or during planting operation.
3. Balled and Potted and Container-Grown: Carefully remove root-ball from container without damaging root-ball or plant.
4. Fabric Bag-Grown Stock: Carefully remove root-ball from fabric bag without damaging root-ball or plant. Do not use planting stock if root-ball is cracked or broken before or during planting operation.
5. Backfill around root-ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
6. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root-ball about 1 inch from root tips; do not place tablets in bottom of the hole.
7. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Bare-Root Stock: Set and support bare-root stock in center of planting pit or trench with root flare 2 inches above adjacent finish grade.

1. Use planting soil for backfill.
2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are

completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.

3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.
4. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root-ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root-ball.

3.4 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

3.5 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines 12 inches apart, or as indicated by project manager, in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and approved tree like shrubs in Turf Areas: Apply organic mineral mulch ring of 3-inch average thickness, with a minimum of 12 inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
2. Use organic or mineral mulch in Planting Areas: Apply a minimum of 2-inch average thickness of mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.7 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use practices to minimize the use of pesticides and reduce hazards.

D. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION

DIVISION 33

SECTION 33 05 01.01
STEEL PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and fittings for water lines for aerial crossings, aboveground piping, and encasement sleeves. Do not bury steel pipe, unless it is large diameter water line.
2. Specifications identify requirements for small-diameter pipe less than or equal to 20 inches.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. No payment will be made for steel pipe and fittings under this Section.
2. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

D. AASHTO - Standard Specifications for Highway Bridges.

E. ASME B 16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.

F. ASTM A 36 - Standard Specification for Carbon Structural Steel.

G. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

H. ASTM A 105 - Standard Specification for Carbon Steel Pipe Forgings for Piping Applications

I. ASTM A 106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

J. ASTM A 135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.

K. ASTM A 139 - Standard Specification for Electric-Fusion (ARC) - Welded Steel Pipe (NPS 4 and Over).

L. ASTM A 1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

M. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

N. AWWA C 200 - Standard for Steel Water Pipe 6 in. and Larger.

O. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

P. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.

Q. AWWA C 210 - Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

R. AWWA M 11 – Steel Pipe – A Guide for Design and Installation.

S. SSPC Good Painting Practice, Volume 1.

T. SSPC SP 1 - Surface Preparation Specification No. 1 Solvent Cleaning.

U. SSPC SP 5 - Joint Surface Preparation Standard White Blast Cleaning.

V. SSPC SP 6 - Surface Preparation Specification No. 6 Commercial Blast Cleaning.

W. SSPC SP 10 - Surface Preparation Specification No. 10 Near-White Blast Cleaning.

X. SSPC VIS 1 - Visual Standard for Abrasive Blast Cleaned Steel.

1.4 SUBMITTALS

Y. Conform to requirements of Section 01 33 00 Submittal Procedures.

Z. For aerial crossings and above ground piping, include lay schedule of new pipe and fittings indicating alignment and grade, laying dimensions, lining and coating systems, proposed welding procedures, fabrication, fitting, flange, and special details. Show station numbers for pipe and fittings corresponding to Drawings.

AA. Submit manufacturer's certifications that pipe and fittings are new and unused.

BB. Submit manufacturer's certifications that pipe and fittings have been hydrostatically tested at factory in accordance with AWWA C 200.

CC. Submit manufacturer's affidavits that coatings and linings comply with applicable requirements of this Section and:

1. Apply polyurethane coatings in strict accordance with manufacturer's recommendations. Allow to cure at temperature 5 degrees above dew point.
2. Linings were applied and allowed to cure at temperature above 32 F.

DD. Submit certification from NACE Certified Coatings Inspector, having Level III certification for coatings and linings, that steel pipe furnished on project was properly inspected and defective coatings detected were properly repaired.

1.5 QUALITY ASSURANCE

EE. Prior to start of work, provide proof of certification of qualification for welders employed for type of work, procedures and positions involved. Provide welder qualifications in accordance with AWWA C 206.

FF. Shop-applied coatings and linings; provide services of an independent coating and lining inspection service or testing laboratory with qualified coating inspectors. Perform inspection by NACE trained inspectors under supervision of NACE Level III Certified Coatings Inspector verifying compliance with same requirements specified.

GG. Coatings: Measure temperature and dew point of ambient air before applying coatings. Inspect physical dimensions and overall condition of coatings. Inspect for visible surface defects, thickness, and adhesion of coating to surface and between layers.

HH. Final Inspection:

1. Before shipment, inspect each finished pipe, fitting, special and accessory for markings, metal thickness, coating thickness, lining thickness (if shop applied), joint dimensions, and roundness.
2. Inspect for coating placement and defects. Test exterior coating for holidays.

   a. Inspect linings for thickness, pitting, scarring, and adhesion.

II. Ensure workmen engaged in manufacturing are qualified and experienced in performance of their specific duties.

PART 2 - PRODUCTS

2.1 STEEL PIPE

A. Manufacture pipe with nominal diameter 20 inches and less but more than 2 inches to conform to ASTM A106 or A 53 Grade B, standard weight.

B. Provide steel pipe and encasement sleeves designed and manufactured in conformance with AWWA C 200 and AWWA M 11 except as modified herein. Steel to be minimum of ASTM A 36, ASTM A 1011 Grade 36, ASTM A 53 Grade B, ASTM A

135 Grade B, or ASTM A139 Grade B.

C. Minimum Allowable Steel-Wall Thickness:

CARRIER PIPE			
Nom. Pipe Size (in)	Min. Wall		Approx. Wt. Per LF Uncoated (lb)
	O.D. (in)	Thick (in)	
4	4.50	0.250	11.35
6	6.625	0.280	18.97
8	8.625	0.322	28.55
10	10.75	0.365	40.48
12	12.75	0.375	49.56
16	16.00	0.375	62.58
20	20.00	0.375	78.60

1. Notes Carrier Pipe:

   a. Review pipe and fitting design for conditions exceeding those specified.
   b. Provide pipe with wall thickness of no less than listed in table above.

MINIMUM DIAMETER CASING PIPE (ENCASEMENT SLEEVES)		
Corresp. Casing	Min. Wall	Approx. Wt. Per

Pipe Size (in)	O.D. (in)	Thick (in)	LF Uncoated (lb)
8	8.625	0.219	19.64
10	10.75	0.219	24.60
12	12.75	0.219	29.28
16	16.00	0.219	36.86
18	18.00	0.250	47.39
20	20.00	0.250	52.73
24	24.00	0.250	63.41

2. Notes for Casing Pipe:

   a. Provide casing pipe with wall thickness of no less than listed in table above.
   b. Casing pipe: AWWA C 200 new uncoated welded steel.
   c. Verify casing diameter required with dimensions of casing spacer.

D. Provide pipe sections in lengths of no less than 16 feet except as required for special sections, and no greater than 40 feet.

E. Provide short sections of steel pipe no less than 4 feet in length unless indicated on Drawings or specifically permitted by City Engineer.

F. Fittings: Factory forged for sizes 4 inches through 20 inches; long radius bends; beveled ends for field butt welding; wall thickness equal to or greater than pipe to which fitting is to be welded unless otherwise shown on Drawings.

G. Joints:

   1. Standard field joint for steel pipe and encasement sleeve: AWWA C 206. Singlewelded, butt joint.
   2. Provide mechanically coupled or flanged joints for valves and fittings, as shown on Drawings. Flanges: AWWA C 207, Class D; same diameter and drilling as Class 125 cast iron flanges ASME B 16.1. Maintain electrically isolated flanged joints between steel and cast iron by using epoxy-coated bolts, nuts, washers and insulating type gasket.

3. Elbows to be standard weight seamless elbows per ASTM A106, Grade A or B.
4. Flanges for pipe 20 inches in diameter and smaller shall be ANSI 150 lb. flat face, slip on or weld neck flanges, meeting ASTM A105 requirements. Where flanges are to join to valves with raised face flanges, use ANSI 150 lb. raised flange.
5. Provide same coating for exposed portions of nuts and bolts as flanges which they secure.

H. Fabricate flanges with over-size bolt holes, with flanges drilled in pairs, to accommodate insulating sleeves.

INTERNAL LINING SYSTEMS FOR STEEL PIPE, ALL INSTALLATIONS

I. Supply steel pipe with epoxy lining, capable of conveying water at temperatures not greater than 140 degrees F. Provide linings conforming to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61 and certification to be from organization accredited by ANSI. Unless otherwise noted, coat exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, etc., with epoxy lining, as specified.

J. Epoxy Lining AWWA C 210, White, or approved equal for shop and field joint applied, except as modified in this Section. Provide material from same manufacturer. For Pipe larger than 2 inches in diameter protect interior surface with liquid two-part chemically cured epoxy primer specified for interior surfaces.

Surface Preparation 2.0 to 3.0 mils surface profile	SSPC-5 (64) White Blast Clean
Prime Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - Buff, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - Buff, or approved equal
Finish Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - White, or equal

1. Total allowable dry film thickness for system:

   a. Minimum: 12.0 mils.
   b. Maximum: 18.0 mils.
   c. Minimum field adhesion: 700 psi.

2. Dry film thicknesses for approved alternate products in accordance with product manufacturer's recommendations.

3. Lining system may consist of three or more coats of same approved alternate epoxy lining without use of separate primer.

EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUNDAND IN VAULTS (EXPOSED)

K. Provide 3-coat-epoxy/polyurethane coating system as designated below. Provide material from same manufacturer.

Surface Preparation 2.0 to 3.0 mils surface profile	SSPC SP 10 Near White Blast Clean
Prime Coat 4.0 to 6.0 mils DFT	Inhibitive Epoxy Primer, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	Chemical Resistant Epoxy, or approved equal
Finish Coat 1.5 to 2.5 mils DFT	Polyurethane, or approved equal Barr Blue color as approved by City Engineer

L. Total Allowable Dry Film Thickness (DFT) for System:
1. Minimum: 9.5 mils.
2. Maximum: 12.5 mils.

M. Clean bare pipe free from mud, mill lacquer, oil, grease, or other contaminant. Inspect and clean surfaces according to SSPC-SP-1 to remove oil, grease, and loosely adhering deposits prior to blast cleaning. Remove visible oil and grease spots by solvent wiping. Use only approved safety solvents which do not leave residue. Use preheating to remove oil, grease, mill scale, water, and ice provided pipe is preheated in uniform manner to avoid distortion.

N. Remove surface imperfections such as slivers, scabs, burrs, weld spatter, and gouges, presence of metallic defects may be cause for rejection of pipe.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Comply with the following:

1. Bedding and Backfilling: Conform to requirements of Section 31 23 33.16 Excavation and Backfill for Utilities.
2. For pipes with coating: Do not roll or drag pipe on ground, move pipe in such a manner as not to damage pipe or coating. Carefully inspect pipe for abrasions and repair damaged coating before pipe is installed.

B. Static Electricity:

1. Properly ground steel pipeline during construction as necessary to prevent build-up of static electricity.
2. Electrically test where required after installation is complete.

EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVE GROUND AND IN VAULTS (EXPOSED) AND EPOXY INTERNAL LINING SYSTEM.

C. Safety: Paints, coatings, and linings specified in this Section are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for personnel involved in painting, coating, and lining operations.

D. Workmanship:

1. Application: By qualified and experienced workers who are knowledgeable in surface preparation and application of high-performance industrial coatings.
2. Paint Application Procedures: SSPC Good Painting Practices, Volume 1.

E. Surface Preparation:

1. Prepare surfaces for painting by using abrasive blasting.
2. Schedule cleaning and painting so that detrimental amounts of dust or other contaminants do not fall on wet, newly-painted surfaces. Protect surfaces not intended to be painted from effects of cleaning and painting operations.
3. Prior to blasting, clean surfaces to be coated or lined of grease, oil and dirt by steaming or detergent cleaning in accordance with SSPC SP 1.
4. Metal and Weld Preparation: Remove surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to 1/4-inch minimum radius.
5. Abrasive Material:

    a. Blast only as much steel as can be coated same day of blasting.
    b. Use sharp, angular, properly graded abrasive capable of producing depth of profile specified herein. Transport abrasive to job site in moisture-proof bags or airtight bulk containers. Copper slag abrasives are not acceptable.
    c. After abrasive blast cleaning, verify surface profile with replica tape such as Tes-Tex Coarse or Extra Coarse Press-O-Film Tape, or approved equal. Furnish tapes to Project Manager.

d. Do not blast if metal surface may become wet before priming commences, or when metal surface is less than 5 degrees F above dew point.

6. Evaluate degree of cleanliness for surface preparation with use of SSPC Pictorial Surface reparation Standards for Painting Steel Surfaces, SSPC-Vis 1.
7. Remove dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air. Test cleanliness by placing ¾-inch by-4 inch piece of clear Scotch type tape on blasted surface, then removing and placing tape on 3x5 white index card. Reclean areas exhibiting dust or residue.

F. Coating and Lining Application:

1. Environmental Conditions: Do not apply coatings or linings when metal temperature is less than 50 degrees F; when ambient temperature is less than 5 degrees F above dew point; when expected weather conditions are such that ambient temperature will drop below 40 degrees F within 6 hours after application; or when relative humidity is above 85 percent. Measure relative humidity and dew point by use of sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. Provide dehumidifiers for field-applied coatings and linings to maintain proper humidity levels.
2. Application Procedures:

   a. Apply in accordance with manufacturer's recommendations and requirements of this Section. Provide finish free of runs, sags, curtains, pinholes, orange peel, fish eyes, excessive over spray, or delaminations.
   b. Thin materials only with manufacturers recommended thinners. Thin only amount required to adjust viscosity for temperature variations, proper atomization and flow-out. Mix material components using mechanical mixers.
   c. Discard catalyzed materials remaining at end of day.

3. Thoroughly dry pipe before primer is applied. Apply primer immediately after cleaning surface. Apply succeeding coats before contamination of undersurface occurs.
4. Cure a minimum of 24 hours at 77 degrees F before successive coats are applied. During curing process, provide force air ventilation in volume sufficient to maintain solvent vapor levels below published threshold limit value. Apply successive coats within recoat threshold time as recommended by coating or lining manufacturer on printed technical data sheets or through written communications. Brush blast joints of pipe which have been shop primed and are to receive intermediate and finish coats in field prior to application of additional coats. After interior coatings are applied, provide forced air ventilation in sufficient volume and for sufficient length of time to ensure proper curing before filling pipe with water.

G. Testing of Coatings and Linings:

1. Inspect pipe for holidays and damage to coating:

   a. If test indicates no holidays and coating is damaged, remove damaged

layers of coating and repair in accordance with coating manufacturer's recommendations.

2. Perform holiday test in accordance with NACE Standard Recommended Practice, RPO 188-90, Discontinuity (Holiday) Testing of Protective Coatings.
3. Begin testing of completed coating after coating has sufficiently cured, usually one to 5 days. Consult coating manufacturer for specific curing schedule.
4. Perform adhesion test on pipe in accordance with ASTM D 4541.
5. For coating thickness of 20 mils or less, test with wet sponge low-voltage holiday detector. For coating thickness in excess of 20 mils, test with high-voltage holiday detector. Perform electrical holiday test with 60-cycle current audio detector. Select test voltage as suggested in table below.

MINIMUM VOLTAGES FOR HIGH VOLTAGE SPARK TESTING

Total Dry Film Thickness (mils)	Suggested Inspection (V)
20 to 40	3,000
41 to 55	4,000
56 to 80	6,000

JOINTS AND JOINTING

H. Welded Joints:

1. Conform to requirements of Section 33 11 13 Public Water Utility Distribution Piping.
2. Field weld to be full penetration butt welded joints for steel pipe and encasement sleeves for entire circumference.
3. Contractor will employ an independent certified testing laboratory to perform weld acceptance tests on welded joints. Testing Laboratory will test by X-ray methods for butt welds, for 100 percent of joint welds. City Engineer has final decision as to suitability of welds tested.

I. Flanged Joints: Conform to requirements of Section 33 11 13 Water Lines.

J. Joint Grouting and Testing: Conform to requirements of Section 33 11 13 Public Water Utility Distribution Piping.

COATINGS AND LININGS INSPECTION RESPONSIBILITIES

K. Contractor is responsible for quality control of coatings and linings applications and testing and inspection stipulated in this Section. City Engineer is responsible for quality assurance and reserves the right to inspect or acquire services of an independent third-party inspector who is fully knowledgeable and qualified to inspect surface preparation and application of high-performance coatings at all phases of coatings and linings work, field- or shop-applied. Contractor is responsible for proper application and performance of coatings and linings whether or not City Engineer provides such inspection.

END OF SECTION

SECTION 33 05 01.02
DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ductile iron pipe and fittings for water lines, gravity sanitary sewers, wastewater force mains and storm sewers.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. No separate payment will be made for ductile iron pipe and fittings under this Section, with the exception of extra fittings in place. Include cost in unit prices for work as specified in the respective sections.

C. Extra Ductile Iron Compact Fittings in Place shall be for additional fittings required to complete job. This is not to exclude extension of pipe across driveway or intersection for purpose of terminating line in more advantageous position. This determination shall be at discretion of Owner. This bid item includes additional fittings as may be necessary to complete job in conformance with intent of Drawings.

D. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

E. Payment for extra fitting shall be made on a per ton basis.

1.3 REFERENCES

F. ANSI A 21.4 (AWWA C 104) - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, for Water.

G. ANSI A 21.10 (AWWA C 110) - Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in.

H. ANSI A 21.11 (AWWA C 111) - Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

I. ANSI A 21.15 (AWWA C 115) - Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.

J. ANSI A21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings for Water Supply Service.

K. ANSI A 21.50 (AWWA C 150) - Standard for Thickness Design of Ductile-Iron Pipe.

L. ANSI A 21.51 (AWWA C 151) - Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.

M. ANSI A 21.53 (AWWA C 153) - Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.

N. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

O. ASTM D 1248 - Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.

P. ASTM F 477 - Elastomeric Seals (gaskets) for Joining Plastic Pipe.

Q. ASTM G 62 - Standard Test Methods for Holiday Detection in Pipeline Coatings.

R. AWWA C 102 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

S. AWWA C 300 - Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.

T. AWWA C 600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

U. SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.

V. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.

W. American Association of State Highway Transportation Officials (AASHTO).

1.4 SUBMITTALS

X. Conform to requirements of Section 01 33 00 Submittal Procedures.

Y. For pipes 20 inches and greater submit shop drawings signed and sealed by Professional Engineer registered in State of Texas showing the following:

1. Manufacturer's pipe design calculations.
2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by City. Provide final approved lay schedule on CD-ROM in Adobe portable document format (*.PDF).
3. Calculations and limits of thrust restraint.
4. Class and length of joint.

Z. Submit manufacturer's certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A 21.51.

AA. Submit certifications that pipe joints have been tested and meet requirements of ANSI A 21.11.

BB. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE

A. Ductile Iron Pipe Barrels: ANSI A 21.15, ANSI A 21.50 or ANSI A 21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for water lines and thickness Class 52 for sanitary sewers, or as shown on Drawings. Provide minimum thickness Class 53 for flanged pipe.

B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.

C. Furnish ductile iron pipe with polyethylene encasement. Use the following criteria:

1. Provide minimum thickness class.
2. Provide polyethylene encasement material and installation in accordance with AWWA C105, and backfill as specified. Minimum of two complete wraps of 8-mil-thick polyethylene.
3. Use polyethylene encasement for open cut installations only.
4. Adhere to other requirements specified herein (e.g., insulation kits, etc.).

D. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by Owner.

E. Clearly mark pipe section to show location and thickness/pressure class color coded.

2.2 JOINTS

F. Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.16 flanged end. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.

G. Where required by Drawings, provide approved restrained joints for buried service.

H. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.

I. Provide for restrained joints designed to meet test pressures required under Section 33 13 00 Hydrostatic Testing of Pipelines or Section 33 34 00 Sanitary Utility Sewerage Force Mains, as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.

J. Bond rubber gasketed joints to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.

K. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by City. When other methods are deemed satisfactory, install at no additional cost to City.

L. Restrained joints are required for all fittings, bends, valves, and tees and must meet City of Sugar Land approved products list.

2.3 GASKETS

M. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (One Bolt only); for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.

N. For pipes to be installed in potentially contaminated areas, provide submittals for review.

2.4 FITTINGS

O. Use bends and fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they serve. All bends, tees, valves, plugs, or other fittings shall include joint restraint devices.

P. Joint Restraint: Joint restraint devices shall be Mega-lug or approved equal and shall be factory tested and pressure rated in accordance with ASTM D-2466.

1. Joint restraint devices shall be designed specifically for use with ductile iron pipe of the joint type and pressure rating specified.
2. Restrained joints shall be used for a sufficient distance from each bend, tee, plug, valve, or other fitting to resist thrust which will be developed at the design pressure of the pipe.

2.5 COATINGS AND LININGS

Q. Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A 21.16 fusion bonded epoxy coating for interior; comply with NSF 61.

R. Sanitary Sewer and Force Main Interiors:

1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
2. Liner thickness: Nominal 40 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6-inches back from end.
3. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.
4. Acceptable Lining Materials:

    a. Provide approved virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
    b. Subject to compliance with requirements, provide Protecto-401 ceramic epoxy or equivalent product as approved by Engineer in writing.

S. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A 21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B, Sanitary Sewer and Force Main Interiors.

T. Exterior:

1. Water Lines:

    a. Auger Holes: Conform to requirements of Section 33 11 13.13 Polyurethane Coatings on Steel or Ductile Iron Pipe.
    b. Above Ground (or Exposed): Conform to requirements of Section 33 05 01.01 Steel Pipe and Fittings, Paragraph 2.03.
    c. Tunnel, Casing or Direct Bury: Conform to requirements of Paragraph 2.05E.

2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

U. Polyethylene Wrap: For buried pipes, provide polyethylene wrap unless otherwise specified or shown.

V. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.

2.6 MANUFACTURERS

W. Use pre-approved manufacturers listed in the City of Sugar Land approved products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conform to requirements of Sections 33 11 13 Water Lines, , 33 34 00 Sanitary Utility Force Mains, and 33 41 13 Public Storm Utility Drainage Piping, except as modified in this Section.

B. Install in accordance with AWWA C 600 and manufacturer's recommendations.

C. Install all ductile iron pipe in double polyethylene wrap, unless cathodic protection is provided.

FIELD REPAIR OF COATINGS

D. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

END OF SECTION

SECTION 33 05 01.04
HIGH DENSITY POLYETHYLENE PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. High density polyethylene (HDPE) pipe for gravity sanitary sewers and drains, including fittings.
2. High density polyethylene (HDPE) pipe for sanitary sewer force mains, including fittings.
3. High density polyethylene (HDPE) pipe for gravity storm sewers and drains, including fittings.
4. High density polyethylene (HDPE) pipe for storm sewers culverts.
5. High density polyethylene (HDPE) pipe for water distribution.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. No separate payment will be made for HDPE pipe under this Section.

C. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

D. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

E. ASTM D 618 - Standard Practice for Conditioning Plastics for Testing.

F. ASTM D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

G. ASTM D 2321 - Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.

H. ASTM D 2657 - Standard Practice for Heat Fusion Joining Polyolefin Pipe and Fittings.

I. ASTM D 2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

J. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

K. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

L. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

M. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

N. ASTM F 714 - Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.

O. ASTM F 894 - Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe.

P. ASTM F 2306 – Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.

Q. ASTM F 2487 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene Pipelines.

R. ASTM F 2510 – Standard Specification for Resilient Connectors between Concrete Manhole structures and Corrugated High Density Polyethylene Drainage Pipes.

1.3 SUBMITTALS

S. Conform to requirements of Section 01 33 00 Submittal Procedures.

T. Submit shop drawings showing design of pipe and fittings indicating alignment and grade, pipe length, laying dimensions, fabrication, fittings, flanges, gasket material, and special details.

U. Submit detailed calculations for pipe design.

V. Submit details of Pipe Joints and jointing procedure for HDPE pipe.

1.3 QUALITY CONTROL

W. Provide manufacturer's certificate of conformance to Specifications.

X. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.

Y. Project Manager reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.

1. Manufacturer's Notification: Should Project Manager wish to witness manufacture of specific pipes, manufacturer shall provide Project Manager with minimum three weeks' notice of when and where production of those specific pipes will take place.
2. Failure to Inspect. Approval of products or tests is not implied by Project Manager's decision not to inspect manufacturing, testing, or finished pipes.

Z. Pipe manufacturer to provide services of experienced, competent, and authorized representative to visit site to advise and consult Contractor during jointing and installation of pipe.

1.4 QUALIFICATIONS

AA. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide products manufactured by companies listed on the City of Sugar Land Approved Product List.

B. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.

C. Furnish profile-wall gravity sanitary sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.

D. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings.

E. Furnish corrugated profile-wall polyethylene (CPP) pipe for gravity storm sewer and storm sewer culvert pipe. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:

1. Integral Bell and Spigot. Bell shall overlap minimum of two corrugations of spigot end when fully engaged.
2. Exterior Bell and Spigot. Bell shall be fully welded to exterior of pipe and overlap

spigot end so that flow lines and ends match when fully engaged.

F. Jointing:

1. Gaskets:

a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both.
b. Pipes allowed to be installed in potentially contaminated areas, where free product is found near elevation of proposed sewer, shall have the following gasket materials for noted contaminants:

2. Lubricant: Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.
3. Gravity Storm Sewer Watertight Joints: When required, watertight joints shall be in accordance with the requirements of ASTM D 3212.

2.2 MATERIALS FOR SANITARY SEWER

G. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.

H. Other Pipe Materials: Materials other than those specified in Paragraph 2.02A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

2.3 MATERIALS FOR GRAVITY STORM SEWERS AND STORM SEWER CULVERTS

I. Pipe and Fittings: High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in ASTM D 3350. Manufacturing shall meet requirements of ASTM F 2306.

2.4 TEST METHODS FOR SANITARY SEWER

J. Conditioning: Conditioning of samples prior to and during tests is subject to approval by Project Manager. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or - 3.6 degrees F and 50 percent relative humidity plus or - 5 percent relative humidity for not less than

40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

K. Flattening: Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in suitable press until internal diameter has been reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.

L. Joint Tightness: Test for joint tightness in accordance with ASTM D 3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to pipe's outer contour.

M. Purpose of Tests: Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

2.5 TEST METHODS FOR GRAVITY STORM SEWERS AND STORM SEWER CULVERTS

N. All testing and material requirements shall be in accordance with ASTM F 2306.

2.6 MARKING

O. Mark each standard and random length of pipe in compliance with these Specifications with following information:

1. Pipe size.
2. Pipe class.
3. Production code.
4. Material designation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pipe in accordance with the manufacturers recommended installation procedures and ASTM D 2774.

B. HDPE pipe is not approved in applications requiring augering of pipe.

C. Bedding and backfill: Conform to requirements of Section 31 23 33.16 Excavation and Backfill for Utilities.

D. Use only workmen trained in the installation of HDPE Pipe.

E. Do not store pipe uncovered direct in direct sunlight. Allow pipe temperature to

approach ground temperature before each individual pipe section is terminally connected.

F. Joints: Join sections of HDPE pipe into continuous lengths above ground by thermal butt fusion method in accordance with AWWA C906 and pipe manufacturer's recommendations for specified service. Fusion joints: meeting minimum requirements of manufacturer for cool down time and other fusing requirements. Socket fusion and extrusion welding or hot gas welding will not be accepted.

G. Cutting Pipe: Comply with pipe manufacturer's recommendations. After cutting, leave end pipe in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 33 05 01.09
POLYVINYL CHLORIDE PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 20 inches.
2. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 48 inches.
3. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 20 inches.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. No separate payment will be made for PVC pipe under this Section.
2. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

C. ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.

D. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

E. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

F. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

G. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

H. ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

I. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

J. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

K. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

L. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

M. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

N. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

O. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

P. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.

Q. AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.

R. AWWA C 111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

S. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.

T. AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.

U. AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.

V. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

W. UI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

1.4 SUBMITTALS

X. Conform to requirements of Section 01 33 00 Submittal Procedures.

Y. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

Z. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.

AA. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this Section.

BB. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from other source is not acceptable. Furnish copies of test reports to City for review. Cost of testing paid by Contractor.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.

B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.

C. PVC Restrained Pipe: Must be listed on City's current Product Approval List.

D. Water Service:

1. Bear National Sanitation Foundation Seal of Approval (NSF-PW).

E. Gaskets:

1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.
3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.

F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.

G. Do not use PVC in potentially or known contaminated areas.

H. Do not use PVC in areas exposed to direct sunlight.

2.2 WATER SERVICE PIPE

I. Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.

J. Pipe 14 inch through 20 inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.

K. Provide Polyvinyl Chloride Pipe from approved manufacturers.

L. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by City.

M. Hydrostatically test pressure rated pipe in accordance with Section 01 45 16.16 Hydrostatic Testing of Pipelines.

2.3 GRAVITY SEWER PIPE

N. PVC gravity sanitary sewer pipe shall be in accordance with provisions in following table:

Manufacturer	**Usage**	**ASTM/AWWA Designation**	**SDR (Max)/ Pressure Rating (Min)**	**Diameter Size Range**
Must Meet City of Sugar Land Approved Products List	Gravity Sanitary Sewer, up to 12 foot depth	ASTM D2241 ASTM D3212	SDR 26/PR 160	6” to 12”
	Gravity Sanitary Sewer, up to 12 foot depth	ASTM D2241 ASTM D3212	SDR 26/PR 160	12” to 24”
	Gravity Sanitary Sewer, greater than 12 foot depth	AWWA C900 ASTM D3139 ASTM F477	DR 18/Class 150	6” to 12”
	Gravity Sanitary Sewer, greater	AWWWA C905	DR 18/Class 235	14” to 24”

	than 12 foot depth	ASTM D3139 ASTM F477		

O. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.

P. Bends and Fittings: ANSI A 21.10, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating.

Q. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or - 3.6 degrees F and 50 percent relative humidity plus or - 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

R. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch (305 mm) in length.

S. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

2.4 SANITARY SEWER FORCE MAIN PIPE

T. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in Section 33 34 00 Sanitary Utility Sewerage Force Mains.

Manufacturer	**Usage**	**ASTM/AWWA Designation**	**SDR (Max)/ Pressure Rating (Min)**	**Diameter Size Range**
Must meet City of Sugar Land Approved Products list	Force main all depths	AWWA C900 ASTM D3139 ASTM F477	DR 18/Class 150	6” to 12”
	Force main all	AWWA C905	DR 18/Class 235	16” to 24”

	depths	ASTM D3139 ASTM F477		

U. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.

V. Fittings: Provide approved ductile iron fittings as per Section 02501 - Ductile Iron Pipe and Fittings, Paragraph 2.04, except furnish fittings with one of following approved internal linings:

1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 248, heat fused to interior surface of fitting
2. Nominal 40 mils (35 mils minimum) polyurethane
3. Nominal 40 mils (35 mils minimum) ceramic epoxy
4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy

W. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as recommended by manufacturer.

X. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Section 33 13 00 Hydrostatic Testing of Pipelines.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

Y. Use bends and fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they serve. All bends, tees, valves, plugs, or other fittings shall include joint restraint devices.

Z. Joint Restraint: Joint restraint devices shall be Mega-lug or approved equal and shall be factory tested and pressure rated in accordance with ASTM D-2466.

1. Joint restraint devices shall be designed specifically for use with PVC pipe of the joint type and pressure rating specified.
2. Restrained joints shall be used for a sufficient distance from each bend, tee, plug, valve, or other fitting to resist thrust which will be developed at the design pressure of the pipe.

PART 3 - EXECUTION

3.1 PROTECTION

A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer’s recommendations.

3.2 INSTALLATION

B. Conform to requirements of Sections 33 11 13 Water Lines , 33 31 13 Public Sanitary Utility Sewerage Piping, and 33 34 00 Sanitary Utility Force Mains, except as modified in this Section.

C. Install PVC pipe in accordance with Section 31 23 33 16 Excavation and Backfill for Utilities, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations

D. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:

1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
2. Water service pipe 16 inches in diameter and larger 5 feet of cover.

E. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.

F. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.

G. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.

H. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

END OF SECTION

SECTION 33 05 16.14
CAST-IN-PLACE CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete manholes for storm sewers, including box sewers.
2. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for manholes is on a unit price basis for each manhole installed.
2. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCES

C. ASME B 16.1 – Cast Iron Pipe Flanges and Flanged Fittings.

D. ASTM A 307 – Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

E. ASTM C 270 – Standard Specifications for Mortar for Unit Masonry.

F. ASTM C 923 – Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.

G. ASTM C1107 – Standard Specifications for Packaged Dry, Hydraulic – Cement Grout (non-shrink).

H. ASTM D 698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3).

I. ASTM D 2665 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe, and Fittings.

J. ASTM D 2996 - Standard Specification for Filament-wound Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

K. ASTM D 2997 - Standard Specification for Centrifugally Cast Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

L. ASTM F 2306 – Standard Specification for 12 to 60 in. [300 to 1500 mm] Corrugated profile– Wall Polyethylene (PE) Pipe Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.

M. ASTM F 2510 – Standard Specification for Resilient Connectors Between Concrete Manhole Structures and Corrugated High Density Polyethylene Drainage Pipes.

N. AWWA C 213 - Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines.

1.4 SUBMITTALS

O. Conform to requirements of Section 01 33 00 Submittal Procedures.

P. Submit proposed design mix and test data for each type and strength of concrete.

Q. Submit manufacturer's data and details of following items for approval:

1. Frames, grates, rings, and covers.
2. Materials to be used in fabricating drop connections.
3. Materials to be used for pipe connections at manhole walls.
4. Materials to be used for stubs and stub plugs.
5. Plugs to be used for sanitary sewer hydrostatic testing.
6. Installation instructions for forms.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Conform to requirements of TxDOT 420 or as directed by the Engineer.

B. Provide concrete with minimum compressive strength of 4000 psi at 28 days unless otherwise indicated on Drawings.

2.2 REINFORCING STEEL

C. Conform to requirements of TxDOT 440.

2.4 MISCELLANEOUS METALS

D. Provide cast-iron frames, grates, rings, and covers conforming to requirements of Section 33 05 16.16 Frames, Grates, Rings, and Covers.

2.5 DROP CONNECTIONS AND STUBS

E. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

2.6 PIPE CONNECTIONS

F. Sanitary Sewers:

1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:

    a. External clamps: Type 304 stainless steel
    b. Internal, expandable clamps on Standard manholes: Type 304 stainless steel,11 gauge minimum
    c. Internal, expandable clamps on corrosion-resistant manholes:

        1) Type 316 stainless steel, 11 gauge minimum
        2) Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C213

2. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene waterstop meeting physical property requirements of ASTM C 923, such as Pres-Seal WS Series, or approved equal.

G. Storm Sewers: Use non-shrink grout for storm sewer pipe connections to concrete manholes, unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.

H. Water Lines

1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Pres-Seal, Thunderline, Link-Seals, or approved equal. See Drawings for placement of assembly in manhole sections.
2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel take-up clamp and a rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-

Seal Gasket Corporation or approved equivalent.

2.7 SEALANT MATERIALS

I. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, such as Adeka Ultraseal P 231, or approved equivalent.

2.8 CORROSION-RESISTANT MANHOLE MATERIALS

J. Where corrosion-resistant manholes or PVC-lined manholes are indicated on the Drawings, provide one of the following:

1. PVC liner for precast cylindrical manhole section, base sections, and cone sections

2.9 BACKFILL MATERIALS

K. Conform to the requirements of Section 31 23 33.16 Excavation and Backfill for Utilities.

NON-SHRINK GROUT

L. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based non-shrink grout requiring only addition of water.

M. Provide grout meeting requirements of ASTM C 1107 and having minimum 28-day compressive strength of 7000 psi.

VENT PIPES

N. Provide external vent pipes for manholes where indicated on Drawings.

O. Buried Vent Pipes: Provide 3 or 4 inch PVC DWV pipe conforming to ASTM D 2665.

P. Vent Outlet Assembly: Provide vent outlet assembly as indicated on Drawings, constructed of the following specified materials:

1. FRP Pipe: Provide filament-wound FRP conforming to ASTM D 2996 or centrifugally cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations.
2. Joints and Fittings: Provide epoxy-bodied fittings and join pipe to fittings with epoxy adhesive, according to pipe manufacturer's instructions.
3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Meet bolt pattern and dimensions for ASME B 16.1, 125-pound flanges. Use Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B flange bolts.
4. Coating: Provide 2-component, aliphatic polyurethane coating, using

primer or tie coat recommended by manufacturer. Provide two or more coats to yield dry film thickness of at least 3 mils. Subject to compliance with requirements, provide Amershield, Tnemec 74 or equivalent product as approved by Owner from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines and grades are correct.

B. Determine if subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of material and base section. When proper density cannot be reached, moisture condition subgrade until that density is reached or treats as an unstable subgrade.

C. Do not build manholes in ditches, swales, or drainage paths unless approved by City

3.2 MANHOLES

D. Construct manholes to dimensions shown on Drawings. Commence construction as soon as possible after pipes are laid. On monolithic sewers, construct manholes at same time sewer is being constructed.

E. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify Owner for examination of subgrade to determine if subgrade has heaved upwards after being excavated. When heaving has not occurred, over-excavate subgrade to allow for 24-inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base. When there is evidence of heaving, provide pile-supported concrete foundation, as detailed on Drawings, under manhole base.

F. Cast manhole foundations and walls monolithically. Use cold joint with approved waterstop when manhole flow line depth exceeds 12 feet. No other joints will be allowed unless shown on Drawings. Wrap cold joints with external sealing material, minimum 6-inch width.

G. Top of manhole elevations shown on Drawings are approximate, based on current pavement and natural ground conditions as determined from elevations measured on 50-foot spacing. No additional payment will be made if final elevation of manhole ring and cover is higher or lower due to requirements of finished grade or replaced pavement surface.

H. Wrecking inside cast in forms shall not occur until concrete has set for 24 hours or has obtained a minimum compressive loading strength of 4000 psi.

3.3 PIPE CONNECTIONS

I. Install approved resilient connectors at each pipe entering and exiting water line and sanitary sewer manholes in accordance with manufacturer's instructions.

J. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetrations both inside and outside of manhole.

K. Ensure no concrete, cement stabilized sand, fill, or other solid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on interior or exterior of manhole. When necessary, fill space with compressible material to ensure resilient connector will maintain full flexibility where evidence of reduced flexibility is encountered.

L. Where new manhole is to be constructed on existing sewer, a rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe spring line using adhesive recommended and supplied by waterstop manufacturer.

M. Do not construct joints on sanitary sewer pipe within wall sections of manholes. Use approved connection material.

N. Construct pipe stubs with resilient connectors for future connections at locations and with material indicated on Drawings. Install approved stub plugs at interior of manhole.

O. Test connection for watertight seal before backfilling.

3.4 INVERTS FOR SANITARY SEWERS

P. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1 1/2 inch per foot maximum.
2. Depth of bench to invert:

    a. Pipes smaller than 15 inches: one-half of largest pipe diameter
    b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
    c. Pipes larger than 24 inches: equal to largest pipe diameter

3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of flow at pipe-manhole connections. Conform to following criteria.

Q. Form invert channels with Class A concrete if not integral with manhole base. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.5 DROP CONNECTIONS FOR SANITARY SEWERS

R. Provide backfill drop assembly in accordance with City of Sugar Land details.

S. Install connection when sewer line enters manhole higher than 36 inches above invert of manhole.

3.6 STUBS FOR FUTURE CONNECTIONS

T. In manholes where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.7 ADJUSTMENT RINGS AND FRAME

U. Combine precast concrete so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces to be joined with non-shrink grout. Set cast iron frame on adjustment ring in a bed of approved sealant material. Install a sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.

V. Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame, and ring and precast section.

W. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. Encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

3.8 BACKFILL

X. After concrete obtains adequate strength, place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Section 31 23 33.16 Excavation and Backfill for Utilities. Use embedment zone backfill material for adjacent utilities, as shown in City of Sugar Land Standard Details over each pipe connected to manhole. Provide trench zone backfill, as specified for adjacent utilities, above embedment zone backfill.

Y. Where rigid joints are used for connecting existing sewers to manhole, backfill under existing sewer up to spring line of pipe with Class B concrete or flowable fill.

Z. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 32 91 19.13 Topsoil Placement and Grading. Seed in accordance with Section 32 92 19 Hydro-Mulching, or sod disturbed areas in accordance with Section 32 92 23 Sodding.

3.9 FIELD QUALITY CONTROL

AA. Conduct leakage testing of Sanitary Sewer manholes in accordance with requirements of Section 33 31 13.10 Acceptance Testing for Sanitary Sewers.

PROTECTION

BB. Protect manholes from damage until subsequent work has been accepted. Repair or replace damaged elements of manholes at no additional cost to Owner.

END OF SECTION

SECTION 33 05 16.15
PRECAST CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete manholes for sanitary sewers, storm sewers, and water lines.
2. Precast concrete sanitary sewer manholes with PVC liner where corrosion resistant manholes are specifically indicated in Drawings.
3. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for normal depth manholes, up to 8 feet deep, is on a unit price basis for each manhole installed. Manhole depth is measured from top of cover to sewer invert.
2. Payment for shallow depth manholes is on a unit price basis for each manhole installed. Shallow manholes have a depth of 5 feet or less measured from top of cover to sewer inlet.
3. Payment for normal depth corrosion resistant manhole is on a unit price basis for each manhole installed.
4. Payment for standard manhole drops is on a unit basis for each drop installed. Standard manhole drops include both internal and external drops.
5. Payment for watertight manholes, including external vent pipe is on a unit price basis for each.
6. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

1.3 REFERENCES

C. ASME B 16.1 – Cast Iron Pipe Flanges and Flanged Fittings.

D. ASTM A 307 – Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

E. ASTM A 615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

F. ASTM C 270 – Standard Specification for Mortar for Unit Masonry.

G. ASTM C 443 – Standard Specifications for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

H. ASTM C 478 – Standard Specification for Precast Reinforced Concrete Manhole Sections.

I. ASTM C 923 – Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.

J. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

K. ASTM D 698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3).

L. ASTM D 2665 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.

M. ASTM D 2996 – Standard Specifications for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

N. ASTM D 2997 – Standard Specifications for Centrifugally Cast “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

O. ASTM F 2510 – Standard Specifications for 12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.

P. ASTM F 2510 – Standard Specifications for Resilient Connectors between Concrete Manhole Structures and Corrugated High Density Polyethylene Drainage Pipes.

Q. AWWA C 213 – Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines.

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

1.4 SUBMITTALS

S. Conform to requirements of Section 01 33 00 Submittal Procedures.

T. Submit manufacturer’s data and details of following items for approval:

1. Shop drawings of manhole sections, base units, and construction details, including reinforcement, jointing methods, materials, and dimensions.
2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as indicated.
3. Frames, grates, rings, and covers.
4. Material to be used in fabricating drop connections.

5. Materials to be used for pipe connections at manhole walls.
6. Materials to be used for stubs and stub plugs, if required.
7. Materials and procedures for corrosion-resistant liner and coatings, if required.
8. Plugs to be used for sanitary sewer hydrostatic testing.
9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches.

U. Seals Submittal drawings by Professional Engineer registered in State of Texas.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

A. Provide manhole sections, base sections, and related components conforming to ASTM C478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints. Design wall sections for depth and loading conditions in Paragraph 2.01 E, with minimum thickness of 6 inches. Base section shall have minimum thickness of 12 inches under invert.

C. Provide tops to support HS-20 vehicle loading, and receive cast iron frame covers, as indicated on Drawings.

D. Where manholes larger than 48-inch diameter are indicated on Drawings, provide precast base sections with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise shown on Drawings. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by City Engineer.

E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed, by manufacturer, to requirements of ASTM C 478 for depth as shown on Drawings and to resist following loads.

1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs.
2. Unit soil weight of 120 pcf located above portions of manhole, including base slab projections.
3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf.
4. Internal liquid pressure based on unit weight of 63 pcf.
5. Dead load of manhole sections fully supported by transition and base slabs.

F. Design: Manhole walls, transition slabs, cone tops, and manhole base slab shall be

designed according to requirements of ASTM C 478 and following:

1. Design additional reinforcing steel to transfer stresses at openings. Area of steel to be no less than shown on Drawings.
2. Wall loading conditions:

    a. Saturated soil pressure acting on empty manhole.
    b. Manhole filled with liquid to a halfway depth as measured from invert to cover, with no balancing external soil pressure.

3. Minimum clear distance between two wall penetrations shall be 12 inches or half diameter of smaller penetration, whichever is greater.

G. Provide joints between sections with o-ring gaskets conforming to ASTM C 443.

H. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.

I. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6 inches above inside surface of floor of base.

2.2 CONCRETE

J. Conform to requirements of Section 03 31 00 Concrete for Utility Construction.

K. Channel Inverts: Class A concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 3000 psi.

L. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, as shown on Drawings, conforming to requirements of Section 31 23 23.53 Cement Stabilized Sand.

M. Concrete Foundation: Provide Class A concrete with minimum compressive strength of 3000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

2.3 REINFORCING STEEL

N. Grade 60.

2.4 MISCELLANEOUS METALS

O. Provide cast-iron frames, rings, and covers conforming to requirements of Section 33 05 16.16 Frames, Grates, Rings and Covers.

2.5 DROP CONNECTIONS AND STUBS

P. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

2.6 PIPE CONNECTIONS TO MANHOLE

Q. Sanitary Sewers:

1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:

   a. External clamps: Type 304 stainless steel.
   b. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.

2. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene water-stop meeting physical property requirements of ASTM C 923, such as Press-Seal WS Series, or approved equivalent.

R. Storm Sewer Connections:

1. Provide watertight connections in accordance with ASTM C 923 and ASTM F 2510 as applicable.

S. Water Lines:

1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Res-Seal, Thunderline Link-Seal, or approved equivalent. See Drawings for placement of assembly in manhole sections.
2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel -up clamp and a rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

2.7 SEALANT MATERIALS

T. Use approved product.

U. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equivalent.

V. Provide approved external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equivalent.

2.8 BACKFILL MATERIALS

W. Conform to requirements of Section 31 23 33.16 Excavation and Backfill for Utilities.

2.9 NON-SHRINK GROUT

X. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.

Y. Meet requirements of ASTM C 1107 and have minimum 28-day compressive strength of 7000 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that lines and grades are correct.

B. Determine if subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. When proper density is not reached, moisture condition subgrade until that density is reached or treats as unstable subgrade.

C. Do not build manholes in ditches, swales, or drainage paths unless approved by the City Engineer.

3.2 PLACEMENT

D. Install precast manholes to conform to locations and dimensions shown on Drawings.

E. Place sanitary and storm manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise shown on Drawings.

3.3 MANHOLE BASE SECTIONS AND FOUNDATIONS

F. Place precast base on 12 inch thick (minimum) foundation of crushed stone wrapped in filter fabric, cement stabilized sand, or concrete foundation slab. Compact cement-sand in accordance with requirements of Section 31 23 23.53 Cement Stabilized Sand.

G. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify

City Engineer for examination of subgrade to determine if subgrade has heaved upwards after being excavated. When heaving has not occurred, over-excavate subgrade to allow for 24- inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base. When there is evidence of heaving, provide pile- supported concrete foundation, as detailed on Drawings, under manhole base.

3.4 PRECAST MANHOLE SECTIONS

H. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.

I. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.

J. Seal any lifting holes with non-shrink grout.

K. Where PVC liners are required, seal joints between sections in accordance with manufacturer’s recommendations.

L. Place precast concrete grade rings under casting to adjust to finish grade, no more than 6 inches as allowed by grade rings.

M. Do not incorporate steps in manhole sections.

3.5 PIPE CONNECTIONS AT MANHOLES

N. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.

1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight. Assemblies: “Press-Wedge,” “Res-Seal,” “Thunderline Link-Seals,” or approved equal. See Drawings for placement of assembly in manhole sections.
2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

O. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.

P. Ensure no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.

Q. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.

R. Test connection for watertight seal before backfilling.

3.6 INVERTS FOR SANITARY SEWERS

S. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inches per foot maximum
2. Depth of bench to invert:

    a. Pipes smaller than 15 inches: one-half of largest pipe diameter
    b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
    c. Pipes larger than 24 inches: equal to largest pipe diameter

3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

T. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.7 DROP CONNECTIONS FOR SANITARY SEWERS

U. Backfill drop assembly with crushed stone wrapped in filter fabric, cement stabilized sand, or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of 6 inches outside bells.

V. Install drop connection when sewer line enters manhole higher than 36 inches above invert of manhole.

3.8 STUBS FOR FUTURE CONNECTIONS

W. In manholes, where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.9 MANHOLE FRAME AND ADJUSTMENT RINGS

X. Combine precast concrete or HDPE adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based

bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.

Y. Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame and adjustment rings and precast section.

Z. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase manhole frame in non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

BACKFILL

AA. Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Section 31 23 33.16 Excavation and Backfill for Utilities. Provide embedment zone backfill material, as specified for adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to manhole. Provide trench zone backfill, as specified for adjacent utilities, above embedment zone backfill.

BB. Where rigid joints are used for connecting existing sewers to manhole, backfill under existing sewer up to springline of pipe with Class B concrete or flowable fill.

CC. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 32 91 19.13 Topsoil Placement. Seed in accordance with Section 32 92 13 Hydro-Mulching. When shown on Drawings, sod disturbed areas in accordance with Section 32 92 23 Sodding.

FIELD QUALITY CONTROL

DD. Conduct leakage testing of sanitary sewer manholes in accordance with requirements of Section 33 31 13.10 Acceptance Testing for Sanitary Sewer Pipes.

PROTECTION

EE. Protect manholes from damage until work has been accepted. Repair damage to manholes at no additional cost to City.

END OF SECTION

SECTION 33 05 16.17
VALVES BOXES, METER BOXES, AND METER VAULTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Valves boxes for water service.
2. Meter boxes for water service.
3. Meter vaults for water service.

MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for each size meter vaults is on unit price basis per vault. Payment will be made for each vault installed, regardless of depth.
2. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

D. ASTM A 48 – Standard Specification for Gray Iron Castings.

E. ASTM D 256 – Standard Test Methods for Determining the Izod Pedulum Impact Resistance of Plastics.

F. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics

G. ASTM D 648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

H. ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

I. ASTM D 2240 – Standard Test Method for Rubber Property-Durometer Hardness.

1.4 SUBMITTALS

J. Conform to requirements of Section 01 33 00 Submittal Procedures.

K. Submit manufacturers' product data for following items for approval:

1. Each type of valve box and lid.
2. Each type of meter box and cover.
3. Each type of meter vault frame and cover.

L. Submit design calculations and shop drawings for precast vault elements, sealed by an Engineer registered in State of Texas.

M. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings.

N. Submit manufacturer's certification that plastic meter boxes meet requirements for Plastic Meter Boxes.

PART 2 - PRODUCTS

2.1 VALVE BOXES

A. Provide approved Type A, adjustable valve box, cast-iron/ductile-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid.

B. Unless otherwise specified, uncoated cast iron.

C. Riser Pipe:

1. Provide 6-inch PVC, Class 150, DR 18, riser pipes in accordance with Section 33 05 01.09 PVC Pipe and Fittings.
2. 6-inch ductile-iron, thickness Class 51 riser pipes in accordance with Section 33 05 01.02 Ductile Iron Pipe and Fittings.
3. Provide single section of pipe.

D. Concrete for valve box placement:

1. For locations in new concrete pavement, provide strength and mix design of new pavement.
2. For other locations, provide concrete for sidewalks conforming to requirements of Section 32 13 13 Concrete Paving.

E. Cast Letters: Provide as required by City of Sugar Land per standard details, for valves serving potable water lines.

2.2 METER BOXES

F. Provide meter boxes for 5/8-inch through 1-inch meters of the following materials:

1. Non-traffic bearing locations: Cast iron, concrete or plastic.

2. Traffic bearing locations: Cast iron.

G. Provide meter boxes for 1 1/2-inch and 2-inch meters of plastic.

H. Provide meter box with reading lid. Provide lids with spring-type latching devices. Lids shall contain sufficient metal that meter box can be easily located with metal detector. Cast the words into the lid in accordance with City of Sugar Land details.

I. Meter box dimensions shall conform to City of Sugar Land standards.

J. Extensions: Meter box extensions 3 inches and 6 inches in height shall be available from manufacturer as standard item.

2.3 CAST-IRON METER BOXES

K. Cast-Iron Boxes: Clean and free from sand blow-holes or other defects conforming to requirements of ASTM A 48, Class 30B. Bearing surfaces shall be machined so that covers seat evenly in frames.

L. Boxes and lids shall have dipped, coal-tar-pitch, varnish finish.

M. Provide lock-type meter boxes when required by Drawings. Lock mechanisms shall work with ease.

2.4 CONCRETE METER BOXES

N. Concrete Meter Boxes: Made of Class A concrete, with minimum 4000 psi compressive strength, conforming to requirements of Concrete for Utility Construction Section. Construct to dimensions shown on Drawings.

O. Castings: Free from fractures, large or deep cracks, blisters or surface roughness or any other defects that may affect serviceability.

2.5 PLASTIC METER BOXES

P. Plastic Meter Boxes: Made of high density polyethylene conforming to the following ASTM standards:

ASTM	**REQUIREMENT**
D 256	Impact Strength = 1.9 ft.-lb./inch (Izod, Notched)

D 256	Impact Strength = 6.4 ft.-lb./inch (Izod, Un-Notched)
D 638	Tensile Strength (2.0 min.) = 3400 psi
D 648	Deflection Temperature = 170 degrees F
D2240	Shore D, Hardness, 55-65 Impact Strength, Falling Dart Method, 160 inch-lb.
D790	Flexural Modulus = 90,000 psi

Q. Meter boxes shall meet the following test requirements:

1. Static Load: Not less than 2500 pounds using 6-inch disc with direct compression exerted at center of top of meter box with solid plastic lid.
2. Deflection: Not less than 1000 pounds load required to deflect top edge of meter box 1/8- inch.

R. Meter box body, without lid, shall weigh approximately 7 pounds.

2.6 METER VAULTS

S. Meter vaults may be constructed of precast concrete, cast-in-place concrete, or a specific type of construction is required by Drawings.

T. Concrete for Meter Vaults: Class A concrete, conforming to requirements of Division 03 Concrete Sections.

U. Reinforcing steel for meter vaults: Conform to requirements of Section 03 21 00 Reinforcing Steel.

V. Grates and Covers: Conform to requirements of Section 33 05 16.16 - Frames, Grates, Rings, and Covers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain approval from City Engineer for location of meter vault.

B. Verify lines and grade are correct.

C. Verify compacted subgrade will support loads imposed by vaults.

3.2 VALVE BOXES

D. Install riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.

1. Install with bell on top of valve
2. Place riser pipe in plumb, vertical position

E. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. End of pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of pipe.

F. Set, align, and adjust valve box so that lid is level with final grade.

G. Paint covers of new valve boxes in fluorescent orange when installed. After completion and acceptance by Owner, repaint covers black.

3.3 METER BOXES

H. Install cast iron or plastic boxes in accordance with manufacturer's instructions.

I. Construct concrete meter boxes to dimensions shown on Drawings.

J. Adjust top of meter boxes to conform to cover elevations specified.

K. Do not locate under paved areas unless approved by the City Engineer. Use approved traffic type box with cast iron lid when meter must be located in paved areas.

3.4 METER VAULTS

L. Construct concrete meter vaults to dimensions shown on Drawings. Do not cast in presence of water. Make bottom uniform. Verify lines and grades are correct and compacted subgrade will support loads imposed by vaults.

M. Precast Meter Vaults:

1. Install precast vaults in accordance with manufacturer's r recommendations. Set level on a minimum 3-inch-thick bed of sand conforming to requirements of Section 31 23 33.16 - Excavation and Backfill for Utilities.
2. Seal lifting holes with cement-sand mortar or non-shrink grout.

N. Meter Vault Floor Slab:

1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per

foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center for keying walls to floor slab.

2. Precast floor slab elements may be used for precast vault construction

O. Cast-in-Place Meter Vault Walls:

1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.
2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.
3. Set frame for cover in concrete

3.5 FRAME AND COVER FOR METER VAULTS

P. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:

1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade
2. In paved areas, set top of meter box or meter vault cover flush with adjacent concrete but no higher than 1/2-inch

3.6 BACKFILL

Q. Provide bank run sand in accordance with Utility Backfill Materials sections and backfill and compact in accordance Excavation and Backfill for Utilities sections.

R. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope 1- to-5 slope from top to natural grade.

S. In paved areas, slope concrete down from meter box or vault to meet adjacent paved area.

END OF SECTION

SECTION 33 05 16.18
ADJUSTING MANHOLES, INLETS, AND VALVE BOXES TO GRADE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for adjusting elevation of manholes, inlets, and valve boxes to new grades.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. There will be no extra payment for adjusting utility structures to grade. Include cost in unit price for the following:

   a. Manholes.
   b. Inlets.
   c. Valve boxes.

2. Payment for adjusting existing utility structures to grade is on unit price basis for each.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Provide concrete, conforming to requirements of Section 03 31 00 Structural Concrete.

B. Provide precast concrete manhole sections and adjustment rings conforming to requirements of Section 33 05 16.15 Precast Concrete Manholes.

2.2 CAST-IRON MATERIALS

C. Provide cast-iron materials conforming to requirements of Section 33 05 16.16 Frames, Grates, Rings, and Covers.

2.3 PIPING MATERIALS

D. For riser pipes and fittings, refer to Sections 33 05 01.02 Ductile-iron Pipe and Fittings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, piping and connections for damage or defects affecting adjustment to grade. Report damage or defects to Owner.

3.2 ESTABLISHING GRADE

B. Coordinate grade related items with existing grade and finished grade or paving, and relate to established bench mark or reference line.

3.3 ADJUSTING MANHOLES AND INLETS

C. Rebuild adjustment portion of manhole or inlet by adding or removing Adjustments. Follow procedures for the type of structure being adjusted detailed in the following Sections:

1. Section 33 05 16.14 Cast-In-Place Concrete Manholes
2. Section 33 05 16.15 Precast Concrete Manholes
3. Section 33 44 13.13 Catch Basins

D. Salvage and reuse cast-iron frame and cover or grate if in acceptable condition as determined by the city.

E. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to bottom during adjustment.

F. Elevation of manhole or inlet can be raised using precast concrete rings, metal adjusting rings; use of brick for adjustment of manholes to grade is prohibited. Elevation of manhole or inlet can be lowered by removing masonry, adjusting rings or the top section of barrel below new elevation and then rebuilding or raising elevation to the proper height.

G. Install cast-in-place slab at the top of the manhole barrel to receive the cast-iron frame and cover. Form concrete slabs to no less than 6 inches thick and install 2x2 pad around lid.

H. Set cast-iron frame for manhole cover or grate in a full non-shrink grout bed and adjust to established elevation. In streets, adjust covers to be flush with pavement.

I. Verify that manholes and inlets are free of visible leaks as result of reconstruction. Repair leaks in manner subject to Owner approval.

J. Maximum ring adjustment is not to exceed 18”.

K. Maximum inlet adjustment shall be ±1 foot

3.4 ADJUSTING VALVE BOXES

L. Salvage and reuse valve box and surrounding concrete block as approved by City Engineer.

M. Remove and replace 6 inch ductile iron riser pipe with suitable length for depth of cover required to establish adjusted elevation to accommodate actual finish grade.

N. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.

O. After valve box has been set, align and adjust so that top lid is level with final grade.

P. Install cast-in-place slab at the top of the manhole barrel to receive the cast-iron frame and cover. Form concrete slabs to no less than 6 inches thick and install 2x2 pad around lid.

3.5 BACKFILL AND GRADING

Q. Backfill area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Section 31 23 10 Structural Excavation and Backfill.

R. Grade ground surface to drain away from each manhole and valve box. Place earth fill around manholes to level of upper rim of manhole frame. Place earth fill around valve box concrete slab.

S. In unpaved areas, grade surface at uniform slope of 1 to 5 from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 32 91 19.13 Topsoil Placement and Grading. Provide seeding in accordance with Section 32 92 13 Hydro-Mulching.

END OF SECTION

SECTION 33 05 16.19
ABANDONMENT OF SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for abandonment of in-place of existing sewers, junction structures, manholes, and force mains.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices.

1. Payment for grout fill and abandonment of existing sewers, including boxes and elliptical shaped sewers, is on linear foot basis for each diameter of sewer being abandoned. Measurement will be along centerline of sewer from centerline to centerline of manholes.
2. Payment for grout fill and abandonment of sewer manholes or junction structure is by each manhole or junction structure abandoned in conformance with this Section.
3. Payment will be full compensation for all material, equipment, and labor required for complete abandonment grouting, including air venting, testing, temporary plugs, PVC pipes and incidentals.
4. No separate payment will be made for plugging and abandoning sewer force mains. Include cost of such abandonment in related work.
5. Refer to Section 01 29 00 – Payment Procedures for unit price procedures.
6. Acceptability of grout material is based on achieving average strength within range of 75 to 150 psi. Shrinkage in grout material placements shall be remedied by Contractor as specified without additional compensation.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

D. Abandonment: Sewer abandonment consists of demolition and removal of portion of manholes existing within specified depth of surface, and abandonment in place of sewer lines and manholes as specified in this Section.

E. Flowable Fill: Flowable fill (abandonment grout) shall be controlled low-strength material consisting of fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in sewer pipes or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access.

Long-term hardened strength shall be within specified range.

F. Backgrouting: Secondary stage pressure grouting to ensure that voids have been filled within abandoned sewer. Backgrouting will only be required at critical locations indicated on Drawings or if there is evidence of incomplete flowable fill placements.

1.4 REFERENCE STANDARDS

G. ASTM C 150 - Standard Specification for Portland Cement.

H. ASTM C 494 - Standard Specification for Chemical Admixture for Concrete.

I. ASTM C 618 - Standard Specification for Fly Ash and Raw or Calcinated Natural Pozzolan for use as Mineral Admixture in Portland Cement Concrete.

J. ASTM C 937 - Standard Specification for Grout Fluidifier for Pre-placed Aggregate Concrete.

K. ASTM C 940 - Standard Test Method for Expansion and Bleeding of Freshly Mixed Grout for Replaced Aggregate Concrete in the Laboratory.

L. ASTM C 1017 - Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete.

M. ASTM C 1107 - Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

1.5 SUBMITTALS

N. Conform to requirements of Section 01 33 00 - Submittal Procedures.

O. Flowable fill mix design report:

1. Flowable fill type and production method. Describe if fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at placement location.
2. Aggregate gradation of fill. Aggregate gradation of mix shall be used as pilot curve for quality control during production.
3. Fill mix constituents and proportions including materials by weight and volume, and air content. Give types and amounts of admixtures including air entrainment or air generating compounds.
4. Fill densities and viscosities, including wet density at point of placement.
5. Initial time of set.
6. Bleeding and shrinkage.
7. Compressive strength.

P. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.

Q. Experience record for proposed crew, showing minimum of 100 cubic yards of flowable fill placed using proposed or similar equipment and methods.

R. At least 60 days prior to commencing abandonment activities, submit plan for abandonment, describing proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of work.

PART 2 - PRODUCTS

2.1 FLOWABLE FILL

A. Design Mix Criteria: Provide design of one or more mixes to meet design criteria and conditions for placement. Present information required by Paragraph 1.05B in mix design report including following:

1. Cement: ASTM C 150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 100 pounds per cubic yard.
2. Fly ash: ASTM C 618 Class C or F. Volume and weight per cubic yard of fill. Provide minimum Fly ash content of 200 pounds per cubic yard.
3. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.
4. Aggregate gradation: 100 percent passing 3/8-inch sieve and not more than 10 percent passing No. 200 sieve. Mix design report shall define pilot gradation based on following sieve sizes 3/8-inch, Nos. 4, 8, 16, 30, 50, 100, and 200. Do not deviate from pilot gradation by more than plus or - 10 percentage points for any sieve for production material.
5. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, add at least 30 percent of natural aggregate to provide workability.
6. Admixtures: Use admixtures meeting ASTM C 494 and ASTM C 1017 as needed to improve pumpability, to control time of set, and reduce bleeding.
7. Fluidifier: Use fluidifier meeting ASTM C 937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
8. Performance additive: Use flowable fill performance additive, such as Darafill or approved equal, to control fill properties.

B. Flowable Fill Requirements:

1. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 28 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
2. Placement characteristics: self-leveling.
3. Shrinkage characteristics: non-shrink.
4. Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C 940.
5. Minimum wet density: 90 pounds per cubic foot.

2.2 PLUGS FOR FORCE MAINS

C. Grout Plugs: Cement-based dry-pack grout conforming to ASTM C 1107, Grade B or C.

D. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned.

PART 3 - EXECUTION

3.1 PREPARATION

A. Have fill mix design reports and other submittals accepted by Owner prior to start of placement. Notify Owner at least 24 hours in advance of grouting with flowable fill.

B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.

C. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project, and report them to Owner. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

D. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume. Dispose of waste material in compliance with Section 01576 - Waste Material Disposal.

3.2 EQUIPMENT

E. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.

F. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.3 DEMOLITION OF SEWER MANHOLES, PIPELINE STRUCTURES, AND FORCE MAINS PRIOR TO ABANDONMENT

G. Remove manhole frames and covers and castings from other existing pipeline structures. Salvaged castings may be used upon approval by Owner for constructing new manholes on this project.

H. Demolish and remove precast concrete adjustment rings and corner section, or brick and mortar corbel and chimney, or other pipeline structure, to minimum depth of 4 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned sewer.

I. When adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to manhole, in preparation for filling manhole.

J. Excavate overburden from force mains to be abandoned at locations indicated on Drawings and in conformance with Excavation and Backfill for Utilities Sections. Cut existing force main, when necessary, to provide an end surface perpendicular to axis of pipe and suitable for plug to be installed. Remove force main piping material remaining outside of segment to be abandoned.

3.4 INSTALLATION

K. Abandon sewer lines by completely filling sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, within depth of structures left in place.

L. Place flowable fill to fill volume between manholes. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.

M. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.

N. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep lines free of flowable fill.

O. Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.

P. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill sewer from downstream end, to discharge at upstream end.

Q. Plug each end of force main being abandoned.

R. Force Main Abandonment:

1. Clean inside surface of force main at least 12 inches from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare exterior pipe surface if manufactured cap is to be used.
2. When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.
3. When using manufactured plug or cap, install fitting as recommended by

manufacturer's instructions, to form water tight seal.

S. Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill.

T. Collect and dispose of excess flowable fill material and other debris.

3.5 FIELD QUALITY CONTROL

U. Provide batch plant tickets for each truck delivery of flowable fill. Note on tickets addition of admixtures at site.

V. Check flow characteristics and workability of fill as placement proceeds.

W. Obtain at least three test cylinders for each placement area for determination of 28-day compressive strength and bleeding. Acceptance of placement will be based on average strength of three tests.

3.6 PROTECTION OF PERSONS AND PROPERTY

X. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

Y. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to work.

END OF SECTION

SECTION 33 05 23.12
AUGERING FOR SEWER LINES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Installation of casing for sewer pipe by dry augering or slurry boring methods, together with installation of sewer pipe in casing.
2. Installation of sewer pipe by slurry boring methods. Construction casing may be used at Contractor's option.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Casing, including sewer pipe, installed by augering methods in mid-run of open cut segments where shown on Drawings, will be measured and paid by linear foot from end to end of casing. Casing may be installed, at Contractor's option, at locations other than shown on Drawings, at no additional cost to Owner.
2. Sewer pipe installed by augering method in mid-run of open-cut segments where shown on Drawings, will be measured and paid by linear foot from end to end of augered section.
3. Pipe or casing segments installed by augering methods in locations other than mid-run of open cut segments and shown on Drawings, will be measured and paid by linear foot along centerline of completed sewer from centerline to centerline of manholes to ends of stubs or termination of pipe, and to inside face of lift stations and other structures.
4. Payment will include and be full compensation for labor, equipment, materials and supervision for excavation and construction of sewer, complete in place including disposal of excess materials, shoring, dewatering, utility adjustments, grouting, backfill, clean-up, and other related work necessary for construction as indicated on Drawings and specified in this Section.
5. Cost for pits and other excavations are included in unit price for pipe with or without casing.
6. Trench safety systems for pits are paid as specified in Section 31 23 33.13 Trench Safety.
7. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

C. Augering means either “dry augering” or “slurry augering”.

D. Dry augering is jacking casing while excavating soil at heading and transporting spoil back through casing by otherwise uncased auger.

E. Slurry Auger Method: Installation of casing or pipe by first drilling small diameter pilot hole from shaft to shaft, followed by removing excess soil and installing pipe or conduit by pull back or jacking method.

1.4 REFERENCE STANDARDS

F. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.

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

1.5 REGULATORY REQUIREMENTS

H. Conform to Texas State Department of Highways and Public Transportation for installations under state highways. Owner will obtain required permits for State Highway crossings.

I. Installations under Railroads:

1. Secure and comply with requirements of right-of-entry for crossing railroad company's easement or right-of-way from railroad companies affected. Comply with railroad permit requirements.
2. Use dry auger method only.
3. Damages due to delays caused by railroad requesting work to be done at hours which will not inconvenience the railroad will be at no additional cost to Owner.

1.6 SUBMITTAL

J. Conform to requirements of Section 01 33 00 Submittal Procedures.

K. For installation by augering, submit for review:

1. Description of mechanized excavating equipment.
2. Method of controlling line and grade.
3. Grouting techniques to be used for filling annular void between pipe and casing, and void between sewer pipe or casing and ground, including equipment, pumping and injection procedures, pressure grout types, and mixes.
4. Locations and dimensions of pits.
5. Pit design and construction drawings.
6. Identification of casings required and paid under Contract and casings installed

at Contractor's option.

7. Design of casings.
8. Copy of railroad company permits and right-of-entry.

L. Prepare auger pit and casing design submittals that are site specific. Have auger pit and casing design submittals signed and sealed by qualified Professional Engineer registered in State of Texas.

M. Include in construction phase submittals:

1. Daily logs of augering and boring operations.
2. Settlement monitoring data to meet requirements as specified.
3. Submit daily logs and settlement monitoring data within 5 calendar days after day of observation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall meet the requirements of the City of Sugar Land products list or specified per submittal.

B. Piping and Fittings: As required by Specifications and Drawings.

C. Casings: Where shown on Drawings, and in accordance with Section 33 05 01.01 “Steel Pipe and Fittings”.
1. Casing and spacers shall be submitted for approval by the city.

D. Casing End Seals: Provide Pipeline Seal and Insulator Model C or approved equivalent.

E. Runners (for large-diameter water mains) supported by 10-gauge carbon steel MIG risers welded to shell:

1. Tensile Strength: ASTM D 638; 17,600 psi.
2. Flexural Strength: ASTM D 790; 25,300 psi.
3. Compression Strength: ASTM D 695; 18,000 psi.
4. Deflection Temperature at 264 psi: ASTM D 648; 405 F.

PART 3 - EXECUTION

3.1 PREPARATION

A. Conform to applicable provisions in Section 02 11 0 “Clearing and Grubbing”.

B. Utility Relocations: Relocate utility lines clear of pit and zone of potential significant settlement or other ground disturbance.

C. Install casings as required by Drawings, and in accordance with Specifications.

D. Install temporary solid plug at end of water main to prevent contamination.

3.2 TRAFFIC CONTROL

E. Conform to applicable provisions of the Texas Manual for Uniform Traffic Control.

F. Secure right-of-entry for crossing railroad company easement or right-of-way if applicable.

G. During construction operations, furnish and maintain barricades and lights to safeguard traffic and pedestrians, until such time as backfill has been completed and removed from site. Provide additional barricades and lights as directed by Engineer.

3.3 PITS

H. Construct pits on segments of line and within right-of-way. Locate auger pits where there is minimum interference with traffic or access to property. Do not locate pits close to storm drainage channels, ditches, storm water lines, or culverts. Avoid pit locations near potentially contaminated areas.

I. Pit Size: Size pits to provide adequate room to meet operational requirements for auger construction as well as any structures indicated on Drawings. Provide minimum 6-inch space between pipe and walls of bore pit. Maximum allowable width of pit shall be 5 feet. Width of pit at surface shall not be less than at bottom. Maximum allowable length of pit shall be no more than 5 feet longer than one full joint of pipe and shall not exceed 25 feet.

J. Excavate bore pits to finished grade at least 6 inches lower than grade indicated by stakes.

K. Backfill in accordance with Section 31 23 33 “Excavation and Backfill for Utilities”.

L. Auger pits that are excavated and backfilled as part of open-cut water line construction shall be in accordance with Section 31 23 16 “Excavation and Backfill for Structures” and Section 31 23 33 “Excavation and Backfill for Utilities”.

M. The provisions for safety protection against traffic and accidental or unauthorized entry, as specified in Section 02 31 4 “Tunnel Shafts” shall be followed in applicable situations.

N. Install sheeting, lining, shoring, and bracing required for protection of workmen and public.

O. Provide groundwater control and drainage from pits while work is in progress and until pit is properly backfilled.

3.4 AUGERING (BORING)

P. Auger from approved pit locations. Excavate for pits and install shoring as specified. Auger mechanically with use of a pilot hole entire length of crossing and check for line and grade on opposite end of bore from work pit. Large hole is to be no more than 2 inches larger than diameter of bell. Place excavated material outside working pit and dispose of as specified. Use water or other fluids in connection with boring operation only to lubricate cuttings. Jetting is not permitted.

Q. In unconsolidated soil formations, a gel-forming colloidal drilling fluid may be used. Fluid is to consist of at least 10 percent of high-grade processed bentonite and shall consolidate cuttings of bit, seal walls of hole, and shall furnish lubrication of subsequent removal of cuttings and installation of pipe.

R. Depending on the character of the soil encountered during augering operations, conduct without interruption as practical to prevent hole from collapsing or pipe from seizing up in hole before installation is complete.

S. Allowable variation from line and grade shall be as specified in “Jacking Casing” paragraphs.

T. Remove and replace any pipe damaged in augering operations.

3.5 FILLING ANNULAR SPACE

U. For installation of water main, block void space around pipe in augered hole with approximately 12 inches of non-shrink grout.

3.6 JACKING CASING

V. If grade of casing at jacking end is below ground surface, excavate pits or trenches for conducting jacking operations and for placing end joints of casing. Where end trenches are cut into sides of embankment or beyond it, sheath securely and brace such work to prevent earth caving.

W. Make up only one joint at a time in pit or trench prior to jacking.

X. Do not interfere with operation of railroad, street, highway, or other facility. Do not weaken or damage embankment or structures.

Y. Use heavy-duty jacks sized for forcing casing through embankment. Use appropriate jacking head, usually of timber, and bracing between jacks and jacking head, and jacking frame or backstop. Apply jacking pressure uniformly around ring of casing. Set casing to be jacked on guides, properly braced together, to support section of casing and to direct it in proper line and grade. Place jacking assembly in line with direction and grade of casing. Excavate embankment material just ahead of casing and remove material through casing. Force casing through embankment with jacks into excavated auger hole.

Z. Conform excavation for underside of casing to contour and gradeof casing for at least one third circumference of casing. Provide clearance of not more than 2 inches for upper half of casing. Taper off upper clearance to zero at point where excavation conforms to contour of casing.

AA. Excavation may extend beyond end of casing depending on character of material, but shall not exceed 2 feet in any case. Decrease advance excavation at the direction of Engineer if character of material being excavated makes it desirable to keep advance excavation closer to end of casing.

BB. Jack casing from low or downstream end. Lateral or vertical variation in final position of casing from line and gradeas shown on Drawings will be permitted only to extent of 1 inch in 10 feet, provided such variation is regular and only in one direction and that final grade of flow line is in direction indicated on Drawings.

CC. Use cutting edge of steel plate around head end of casing extending short distance beyond of casing with inside angles or lugs to keep cutting edge from slipping back onto casing.

DD. Once jacking of casing has begun, continue without interruption as practical to prevent casing from becoming firmly set in embankment.

EE. Remove and replace casing damaged in jacking operations.

FF. Backfill pits or trenches excavated to facilitate jacking operations immediately after completion of jacking of casing.

GG. Grout all annular space between casing and excavated.

3.7 SPACER INSTALLATION

HH. There must be no inadvertent metallic contact between casing and carrier pipe. Spacing of spacers should ensure that carrier pipe is adequately supported throughout its length, particularly at ends, to offset settling of casing and carrier pipe or type of spacer used. Spacing between spacers depends largely on load bearing capabilities of pipe coating and flexibility of pipe.

II. Select spacer size to limit carrier pipe movement within case pipe.

JJ. Grade bottom of trench adjacent to each casing to provide firm, uniform, and continuous support for carrier pipe. If trench requires some backfill to establish final trench bottom grade, place backfill material in 6-inch lifts and compact to the density of undisturbed soil.

KK. Install casing spacers in accordance with manufacturer’s instructions. Take special care to ensure subcomponents are correctly assembled and evenly tightened, and that no damage occurs during tightening of insulators or carrier pipe insertion.

LL. Seal annulus between carrier pipe and casing with casing end seals at each end of

casing.

3.8 CLEANUP

MM. Clean construction site to existing or better condition prior to construction at no additional cost to the Owner.

END OF SECTION

SECTION 33 11 13
WATER LINES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements for installation of both small diameter water lines and large diameter water lines.

1. When specifications for large diameter water lines differ from those for small diameter water lines, large diameter specifications will govern for large diameter pipe.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for water lines installed by open-cut, augered with or without casing, aerial crossing, and pipe offset section on linear foot basis for each size of pipe installed. Separate pay items are used for each type of installation (open cut and auger) measured along the axis of the pipe and includes all restrained joint fittings and appurtenances.
2. When directed by Owner to install extra fittings, as required to avoid unforeseen obstacles, payment will be based on the following:

   a. Extra fittings requested by the Owner and delivered to jobsite will be paid by the Owner.
   b. Payment will include and be full compensation for items necessary for installation and operation of water line.

1.3 REFERENCES

C. ANSI A 21.11/AWWA C111 - Standard for Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings.

D. ANSI/NSF Standard 61 - Drinking Water System -Health Components.

E. ASTM A 36 - Standard Specification for Carbon Structural Steel

F. ASTM A 536 - Standard Specification for Ductile Iron Castings

G. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

H. ASTM B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes.

I. ASTM B 98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.

J. ASTM B 301 - Standard Specification for Free-Cutting Copper Rod and Bar.

K. ASTM B 584 - Standard Specification for Copper Alloy Sand Casting for General Application.

L. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination.

M. ASTM E 709 - Standard Guide for Magnetic Particle Examination

N. ASTM F 1674 - Standard Test Method for Joint Restraint Products for Use with PVC Pipe.

O. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

P. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches.

1.4 SUBMITTALS

Q. Conform to requirements of Section 01 33 00 - Submittal Procedures.

R. Conform to submittal requirements of applicable Section for type of pipe used.

S. Submit, a minimum of 15 calendar days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:

1. Disinfection; not to exceed 2,000 linear feet per section.
2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.
3. Site restoration; not to exceed limits specified; Sequence in order of disturbance.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Install pipe materials which conform to following:

1. Section 33 05 01.02 Ductile Iron Pipe and Fittings.
2. Section 33 05 01.01 Steel Pipe and Fittings
3. Section 33 05 01.09 Polyvinyl Chloride Pipe and Fittings.
4. Section 33 05 01.03 Prestressed Concrete Cylinder Pipe and Fittings.

B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.

2.2 WELDED JOINT PROTECTION FITTING FOR SMALL DIAMETER STEEL PIPE

C. Cylindrical Corrosion Barrier: Provide approved cylindrical corrosion barrier.

D. O-rings: Conform to National Sanitary Foundation requirements.

2.3 RESTRAINED JOINTS

E. Ductile-Iron Pipe: See Section 33 05 01.02 Ductile Iron Pipe and Fittings.

F. PVC Pipe: See Section 33 05 01.09 Polyvinyl Chloride Pipe and Fittings

G. Restrained Joints where required on DIP and PVC pipe:

1. Joint Restraint: Joint restraint devices shall be Mega-lug or approved equal and shall be factory tested and pressure rated in accordance with ASTM D-2466.
2. Joint restraint devices shall be designed specifically for use with PVC pipe of the joint type and pressure rating specified.
3. Restrained joints shall be used for a sufficient distance from each bend, tee, plug, valve, or other fitting to resist thrust which will be developed at the design pressure of the pipe.

2.4 COUPLINGS AND APPURTENANCES FOR LARGE DIAMETER WATERLINE

H. Flap Valves: Provide approved flap valves on discharge of manhole drainline as shown on Drawings.

1. Body and Flap: ASTM A 126-B cast iron.
2. Seats: ASTM B 21-CA482 or ASTM B 301-CA145 bronze.
3. Resilient Seat.
4. Hinge Arms: ASTM B 584-CA865 high tensile bronze.
5. Hinge pins: ASTM B 98-CA655 silicon bronze.

PART 3 - EXECUTION

3.1 PREPARATION

A. Conform to applicable installation specifications for types of pipe used.

B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.

C. Lay pipe to lines and grades shown on Drawings. Use adequate surveying methods and equipment; employ personnel competent in us of equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record “as-built” horizontal alignment and vertical grade at maximum of every 50 feet on record drawings.

D. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with a unique designation on the inside of pipe. Minimum letter height shall be 4 inches.

E. Laying Large-Diameter Water Main:

1. Lay not more than 200 feet of pipe in trench ahead of backfilling operations.
2. Dig trench proper width as indicated. When operations cause trench width below top of pipe to become 4 feet wider than specified, install higher class pipe or improved bedding, as determined by Engineer. No additional payment will be made for higher class of pipe or improved bedding.
3. Prevent damage to coating when placing backfill. Backfill material shall be free of large rocks or stones, or other material which could damage coatings.
4. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation. Groove pipe to manufacturer’s specifications.

F. Confirm that nine feet minimum separation from gravity sanitary sewers and manholes from potable waterline.

G. Where above clearances cannot be attained, and special design has not been provided on Drawings, obtain direction from the City before proceeding with construction.

H. Inform Owner if unmetered sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by the City.

I. City of Sugar Land Utility Operations Division will handle, at no cost to Contractor, operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers.

J. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this Project.

K. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on inside of pipe along with pressure class. Locate unique identifying mark minimum of five feet away from either end of each section of pipe. Provide one unique identifying mark in middle of each fitting. Place markings at consistent locations. Use permanent black paint and minimum letter height of 4 inches to mark designations.

L. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements

are not met.

3.2 HANDLING, CLEANING AND INSPECTION

M. Handling:

1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight
3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.
4. For large diameter water lines, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
5. Use precautions to prevent injury to pipe, protective linings and coatings.

    a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
    b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
    c. Do not lift pipe using hooks at each end of pipe.
    d. Do not place debris, tools, clothing, or other materials on pipe.

6. Repair damage to pipe or protective lining and coating before final acceptance.
7. Reject pipe with visible cracks (not meeting exceptions) and remove from project site.

N. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.

O. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.3 EARTHWORK

P. Conform to applicable provisions of Section 31 23 33.16 Excavation and Backfilling for Utilities.

Q. Bedding: Use bedding materials in conformance with Section 31 23 33.13 Backfill

R. Backfill: Use bank run sand or earth or native soil as specified in Section 31 23 33.13 Backfill. Backfill excavated areas in same day excavated. When not possible, cover

excavated areas using steel plates on paved areas and other protective measures elsewhere.

S. Place material in uniform layers of prescribed maximum 8-inch loose lifts and wet or dry material to approximately optimum moisture content. Compact to prescribed density Water tamping is not allowed.

T. Pipe Embedment: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

3.4 PIPE CUTTING

U. Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by the City. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

3.5 PIPING INSTALLATION

V. General Requirements: (*Notify City immediately upon encountering wet conditions!)*

1. Lay pipe in subgrade free of water.
2. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material.
3. Properly form bedding to fully support bell without wedging or blocking up bell.
4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe. Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than nominal city block length of not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.

W. Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of the City prior to skipping any portion of Work.

X. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.

Y. Perform Critical Location as shown on Drawings. Refer to Section 31 23 33.16 Excavation and Backfill for Utilities.

Z. Laying Large Diameter, 24-inch or greater Water Line

1. Lay not more than 200 feet of pipe (unless approved by the City) in trench ahead of backfilling operations.
2. Dig trench proper width as shown. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as

determined by the City. No additional payment will be made for higher class of pipe or improved bedding.

3. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 100 feet on record drawings.
4. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones (Maximum of 3-inch), or other material which could damage coatings.
5. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation.
6. Prior to proceeding with critical tie-ins submit sequence of work based on findings from "critical location" effort.

AA. Perform following additional procedures when working on plant sites.

1. Seventy-two hours prior to each plant shut down or connection, schedule coordination meeting with City and Water Production personnel. At this meeting, present proposed sequencing of Work and verification of readiness to complete Work as required and within time permitted. Do not proceed with Work until the City agrees key personnel, equipment and materials are on hand to complete Work.
2. Prior to fully excavating around existing piping, excavate as minimal as possible to confirm type and condition of existing joints. Verify size, type, and condition of pipe prior to ordering materials or fully mobilizing for Work.
3. Do not proceed with connections to existing piping and identified critical stages of work unless approved by the City and the City's Utility Maintenance Division operator is present to observe.
4. Coordinate with City's Utility Department to obtain reduction in operating pressures prior to performing connections to existing piping.
5. Make connections to existing piping only when two valves are closed off between connection and source of water pressure. Do not make connection relying solely on one valve, unless otherwise approved by the City.
6. Perform critical stages of Work identified on Drawings at night or during low water demand months as specified in Section 01 11 00 Summary of Work.
7. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.
8. Submit Lone Star Notification transmittal number to the City prior to beginning excavation.
9. Before each "dig" with mechanical excavator, probe ground to determine potential obstructions. Repeat procedure until existing pipe is located or excavation reaches desired elevation. Perform excavations within one foot to existing piping by hand methods.
10. Provide adequate notice to pipe manufacturer's representative when connecting or modifying existing prestressed or pretension concrete cylinder pipe.
11. Provide field surveyed (horizontal and vertical elevations) "as-builts" of new construction and existing underground utilities encountered. Submit in accordance with Section 01 33 00 Submittal Procedures.

BB. For tie-ins to existing water lines, provide necessary material on hand to facilitate connection prior to shutting down existing water lines. Provide the City a minimum of one week notice prior to shutting down existing water lines. All valves shall be operated by City staff only.

3.6 JOINTS AND JOINTING

CC. Rubber Gasketed Bell-and-Spigot Joints for Concrete Cylinder Pipe, Bar Wrapped Pipe PVC, Steel, and DIP:

1. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
2. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
3. After pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.
4. Where preventing movement is necessary due to thrust, use restrained joints as shown on Drawings.

    a. Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.
    b. Do not include passive resistance of soil in thrust restraint calculations.

5. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other types of stops as approved by Owner.

DD. Flanged Joints where required on Concrete Cylinder Pipe, Bar Wrapped Pipe, Ductile Iron Pipe, or Steel Pipe:

1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south center line. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at factory to proper dimensions.
3. Black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets.
4. Full length bolt isolating sleeves and washers shall be used with flanged connections.
5. Furnish kits in accordance with Owner’s "Approved Products List."

EE. Restrained Joints

1. Restrain pipe joints with Mega lugs or approved equal and concrete thrust

blocks. Onsite mixing of concrete shall not be allowed.(Batch mix only).

2. Thrust restraint lengths shown on Drawings are minimum anticipated lengths. These lengths are based on deflections indicated and on use of prestressed concrete cylinder pipe for large diameter lines and ductile iron pipe for small diameter lines. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a Registered Professional Engineer in State of Texas for review by the City. Make adjustments in thrust restraint lengths at no additional cost to the City.
3. Passive resistance of soil will not be permitted in calculation of thrust restraint.
4. Installation.

    a. Install restrained joints mechanism in accordance with manufacturer's recommendations.
    b. Examine and clean mechanism; remove dirt, debris and other foreign material.
    c. Apply gasket and joint NSF 61 FDA food grade approved lubricant.
    d. Verify gasket is evenly seated.
    e. Do not over stab pipe into mechanism.

5. Prevent any lateral movement of thrust restraints throughout pressure testing and operation. Place 3000 psi concrete for blocking at each bend, change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made two days after completion of blocking if Type II cement is used.

FF. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by the City.

1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer
2. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section and install new pipe.
3. Replace, repair, or reapply coatings and linings as required.
4. Assessment of deflection may be measured by the City at location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
5. When rubber gasketed pipe is laid on curve, join pipe in straight alignment and then deflect to curved alignment.

3.7 SECURING, SUPPORTING AND ANCHORING

GG. Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.

HH. Where shown on Drawings, anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to distance each side of fitting.

Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).

II. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

3.8 POLYETHYLENE WRAP

JJ. Double wrap ductile iron pipe and appurtenances (except fire hydrants and fusion bond or polyurethane coated fittings) with 8-mil polyethylene film.

KK. Do not use polyethylene wrap if pipe is cathodically protected.

3.9 CLEANUP AND RESTORATION

LL. Cleanup and restore site as directed by the City of Sugar Land.

3.10 CLEANING PIPING SYSTEMS

MM. Remove construction debris or foreign material and thoroughly broom clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning. Owner must inspect water line for cleanliness prior to filling.

3.11 DISINFECTION OF WATER LINES

NN. Conform to TCEQ requirements for Disinfection of Water Utility Distribution.

3.12 FIELD HYDROSTATIC TESTS

OO. Conform to requirements of Section 33 13 00 Hydrostatic Testing.

END OF SECTION

SECTION 33 11 13.11
WET CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes wet connections for new water lines and service lines to existing water lines.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for wet connections shown on Drawings is on unit price basis for each wet connection. Separate payment will be made for each size of water line.
2. No compensation will be given for extra work or for damages occurring as result of incomplete shutoff.
3. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

D. AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

1.4 DEFINITIONS

E. Wet connections consist of isolating sections of pipe to be connected with existing valves, draining isolated sections, and completing connections.

F. Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch standard connections" or "gooseneck connections" will be measured as 2-inch wet connections. This item is not to be used as part of 2-inch service line.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe shall conform to requirements of applicable portions of Section 33 11 13 Public Water Utility Distribution Piping.

B. Corporation cocks and saddles shall conform to requirements of Section 33 11 13.12 Water Tap and Service Line Installation.

C. Valves shall conform to requirements of Section 33 12 16.23 - Gate Valves.

D. Brass fittings shall conform to requirements of AWWA C 800.

PART 3 - EXECUTION

3.1 CONNECTION OPERATIONS

A. Plan wet connections in manner and at hours with least inconvenience public. Notify the City at least 48 hours in advance of making connections.

B. Do not operate valves on water lines in use by City. City of Sugar Land Utility Department will handle, at no cost to Contractor, operations involving opening and closing valves for wet connections.

C. Conduct connection operations when Inspector is at job site. Connection work shall progress without interruption until complete once existing water lines have been cut or plugs have been removed for making connections.

3.2 2-INCH WET CONNECTIONS

D. Tap water line. Use corporation cocks, saddles, endopure poly blue tubing as required for line and grade adjustment, and brass fittings necessary to adapt to existing water line. Use 2-inch valves when indicated on Drawings for 2-inch copper gooseneck connections.

END OF SECTION

SECTION 33 11 13.12
WATER TAP AND SERVICE LINE INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tapping existing mains and furnishing and installing new service lines for water.
2. Relocation of existing small water meters.

B. Specifications identify requirements for both small-diameter (less than or equal to 20 inches) water lines and large-diameter (greater than 20 inches) water lines. When specifications for large-diameter water lines differ from those for small- diameter water lines, paragraphs for large-diameter water lines will govern for large-diameter pipe.

MEASUREMENT AND PAYMENT

C. Unit Prices:

1. Payment for water taps and endopure poly blue tube service lines for 1 inch is on unit price basis for each installation. Separate measurements will be made for "short side", "long side" and "extra long side" connections.
2. Payment for water taps and service lines 1 1/2 inch through 2 inch is on unit price basis for each installation. Separate measurements will be made for "short side", "long side" and "extra long side" connections.
3. Payment for "short side, "long side" and "extra long side" includes locating water line, tap installation and connection to meter and restoring site.
4. Payment for each small meter includes labor, materials, and equipment to relocate existing small meter.
5. No additional payment will be made for bedding, backfill, compaction, push under pavement, etc.
6. Refer to Section 01 29 00 Payment Procedures for unit price procedures

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

REFERENCES

D. AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

E. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution.

DEFINITIONS

F. Near Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water line on same side of street.

G. Far Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water line on opposite side of street or from center of streets where supply line is located in street center such as boulevards and streets with esplanades. Distance not to exceed 60 linear feet (at right angles to water line).

H. Extra Far Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water line on opposite side of street or from center of streets where supply line is located in street center such as boulevards and streets with esplanades. Distance greater than 60 linear feet (at right angles to water line).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Polyethylene Tubing: use products listed in the City's approved product list.

B. Corporation Stops: AWWA C 800 as modified in this Section:

1. Inlet End: AWWA standard thread.
2. Valve Body: Tapered plug type, O-ring seat ball type, or rubber seat ball type.
3. Outlet End: Flared-copper connection for use with endopure poly blue tube.

C. Provide taps for water line types and sizes in accordance with pipe tapping schedule located at end of this Section.

D. Dual Strap Saddles: stainless-steel epoxy-coated body and straps.

E. Taps for PVC Water Lines: Use dual-strap or single, wide-band strap saddles which provide full support around circumference of pipe and bearing area of sufficient width along axis of pipe, 2 inches minimum, ensuring that pipe will not be distorted when saddle is tightened. Provide approved stainless-steel tapping saddle with AWWA standard thread.

F. Taps for Steel Pipe: Not allowed, unless specifically approved by Owner. Use saddle only when tap is approved on steel pipe.

G. Curb Stops and Brass Fittings: AWWA C 800 as modified in this Section.

1. Inlet End: Flared connection or compression-type fitting
2. Valve Body: Straight-through or angled, meter-stop design equipped with following:

   a. O-ring seal straight plug type.
   b. Rubber seat ball type.

3. Outlet End: Female, iron-pipe thread or swivel-nut, meter-spud thread on 3/4-inch and 1-inch stops and 2-hole flange on 1 1/2 and 2-inch sizes.
4. Fittings: Provide approved fittings. Use same size open end wrenches and tapping machines as used with respective Mueller fittings.
5. Factory Testing of Brass Fittings:

    a. Submerge in water for 10 seconds at 85 psi with stop in both closed and open positions.
    b. Reject fitting that shows air leakage. Owner may confirm tests locally. Entire lot from which samples were taken will be rejected when random sampling discloses unsatisfactory fittings.

H. Angle Stops: In accordance with AWWA C 800; ground-key, stop type with bronze lockwing head stop cap; inlet and outlet threads conform to application tables of AWWA C 800; and inlets flared connection or compression.

1. Outlet for 3/4-inch and 1-inch size: Meter swivel nut with saddle support.
2. Outlet for 1 1/2-inch through 2-inch size: O-ring sealed meter flange, iron pipe threads.

I. Fittings: In accordance with AWWA C 800 and following:

1. Castings: Smooth, free from burrs, scales, blisters, sand holes, and defects which would make them unfit for intended use.
2. Nuts: Smooth cast and has symmetrical hexagonal wrench flats.
3. Flare-Joint Fittings: Smooth cast. Machine seating surfaces for metal-to-metal seal to proper taper or curve, free from pits or protrusions.
4. Thread fittings, of all types, shall have N.P.T. or AWWA threads, and protect male threaded ends in shipment by plastic coating, or approved equal.
5. Compression tube fittings shall have Buna-N beveled gasket.
6. Stamp of manufacturer's name or trademark and of fitting size on body.

PART 3 - EXECUTION

3.1 GENERAL

A. For service lines and lateral connections larger than those allowed in Pipe Tapping Schedule, branch connections and multiple taps may be used. Space corporation stops minimum of 2 feet apart.

B. Tapped saddle of appropriate sizes: Approved in new construction only provided they are set at right angles to proposed meter location.

C. Use tapping machine manufactured for pressure tapping purposes for 2-inch and smaller service taps on pressurized water lines.

D. For new meter see City Detail. When existing meter is in conflict with proposed pavement improvements, locate water meters one foot inside right-of-way, or when this

is not feasible, one foot on curb side of sidewalk. Contact City Engineer when major landscaping or trees conflict with service line and meter box location. No additional payment will be made for work on customer side of meter.

E. New location and installation of existing small meter shall conform to requirements of this Section.

3.2 SERVICE INSTALLATION

F. Set service taps at right angles to proposed meter location and locate taps in upper pipe segment within 45 degrees of pipe springline.

G. Install service lines in open-cut trench in accordance with Section 31 23 33.16 - Excavation and Backfill for Utilities. Install service lines under paved roadways, other paved areas and areas indicated on Drawings in bored hole in accordance with requirements.

H. Lay service lines with minimum of 24 inches measured from the top of the subgrade or, in absence of curbs, from centerline elevation of crowned streets or roads. Provide minimum of 18 inches of cover below flow line of ditches to service lines.

I. Service lines across existing street (push-unders): Pull service line through prepared hole under paving. Use only full lengths of tubing. Take care not to damage endopure poly blue tubing when pulling it through hole. No coupling under paving.

J. Maintain service lines free of dirt and foreign matter.

K. Install service lines so that top of meter will be 4 to 6 inches below finished grade.

L. Anticipate existing sanitary and storm sewers to have cement stabilized sand backfill minimum 12 inches above pipe. Include cost of such crossings in unit price for services.

3.3 CURB STOP INSTALLATION

M. Set curb stops or angle stops at outer end of service line inside of meter box. Secure opening in curb stop to prevent unwanted material from entering. In close quarters, make S-curve in field. Do not flatten tube. In 1-inch services; install meter coupling, swivel-nut, or curb stop ahead of meter. Install straight meter coupling on outlet end of meter.

3.4 SEQUENCE OF OPERATIONS

N. Open trench for proposed service line in accordance with Section 31 23 33.16 Excavation and Backfill for Utilities.

O. Install curb stop on meter end of service line.

P. With curb stop open and prior to connecting service line to meter in slack position, open corporation stop and flush service line thoroughly. Close curb stop, leaving corporation stop in full-open position.

Q. Check service line for apparent leaks. Repair leaks before proceeding.

R. Schedule inspection with City Engineer prior to backfilling. After inspection, backfill in accordance with Section 31 23 33.16 Excavation and Backfill for Utilities.

S. Install meter box centered over meter with top of lid flush with finished grade. Meter box: Refer to Section 33 05 16.17 Valve Boxes, Meter Boxes, and Meter Vaults.

END OF SECTION

SECTION 33 11 13.14
CUT, PLUG, AND ABANDONMENT OF WATER LINES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cut, plug and abandonment of water lines.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for cut, plug, and abandonment of water lines is on a unit price basis for each cut, plug, and abandonment performed. Separate payment will be made for each size of water line.
2. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

C. Conform to requirements of Section 01 33 00 Submittal Procedures.

D. Submit product data for proposed plugs and clamps for approval.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete for reaction blocks: Class B conforming to requirements of Section 03 31 00 Structural Concrete.

B. Plugs and clamps: Applicable for type of pipe to be plugged.

PART 3 - EXECUTION

3.1 APPLICATION

A. Do not begin cut, plug and abandonment operations until replacement water line has been constructed, disinfected, and tested, and service lines have been transferred to replacement water line.

B. Install plug, clamp, and concrete reaction block and make cut at location shown on Drawings.

C. Main to be abandoned shall not be valved off and shall not be cut or plugged other than at supply water line or as shown on Drawings.

D. After water line to be abandoned has been cut and plugged, check for other sources feeding abandoned water line. When sources are found, notify City Engineer immediately. Cut and plug abandoned water line at point of other feed as directed by City Engineer.

E. Plug or cap ends or openings in abandoned water line in manner approved by City Engineer.

F. Remove and dispose of surface identifications such as valve boxes and fire hydrants. Valve boxes in improved streets, other than shell, may be filled with concrete after removing cap.

G. Backfill excavations in accordance with Section 31 23 33 Excavation and Backfill for Utilities.

H. Repair street surfaces in accordance with Section 32 01 29 Paving Repair

END OF SECTION

SECTION 33 12 16.16
AIR RELEASE AND VACUUM RELIEF VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes air release and vacuum relief valves.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment for air release and vacuum relief valves is on unit price basis for each valve installed.
2. Payment includes manhole or vault (when required), fittings, vent piping and bollard(s) and appurtenances necessary for complete installation of valve.
3. Payment for valve assembly on aerial crossing includes fittings, anti-vandalism protection, freeze protection, vent piping and appurtenances necessary for complete installation of valve.
4. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

C. ASTM A 48 - Standard Specification for Gray Iron Castings.

D. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

E. ASTM A 240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

F. ASTM A 276 - Standard Specification for Stainless Steel Bars and Shapes.

G. ASTM A 313 - Standard Specification for Stainless Steel Spring Wire.

H. ASTM B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

1.4 SUBMITTALS

I. Conform to requirements of Section 01 33 00 Submittal Procedures.

J. Submit manufacturer's product data for proposed valves for approval.

K. Conform to the City of Sugar Land Approved Products List.

1.5 QUALITY CONTROL

L. Provide manufacturer's affidavit that air release and vacuum relief valves purchased for Work, were manufactured and tested in United States, and conform to requirements of this Section.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Provide combination air valves designed to fulfill functions of air release (permit escape of air accumulated in line at high point of elevation while line is under pressure) and vacuum relief.

B. Provide inlet and outlet connections, and orifice as shown on Drawings.

C. Valve exterior: Painted with shop-applied primer suitable for contact with potable water.

2.2 MATERIALS (See approved products list)

D. Air Release and Vacuum Relief Valves: Provide single-body, standard combination valves or duplex-body custom combination valves as indicated on Drawings.

1. For 2 inch and 3 inch, single-body valves, provide inlet and outlet size as shown on Drawings and orifice sized for 100 psi working pressure.

    a. Valve materials: body, cover, and baffle, ASTM A 48, Class 35, or ASTM A 126, Grade B cast iron; plug or poppet, ASTM A 276 stainless steel; float, ASTM A 240 stainless steel; seat, Buna-N; other valve internals, stainless steel.

2. For 3 inch and larger duplex body valves as shown on Drawings, provide approved air release valve.

    a. Air and vacuum valve materials: body and cover, ASTM A 48, Class 35, cast iron; float, ASTM A 240 stainless steel; seat, Type 304, stainless steel and Buna-N; other valve internals, stainless steel or bronze.
    b. Air release valve: Constructed as specified in paragraph above on Air Release Valves.

E. Vacuum Relief Valves: Provide approved air inlet vacuum relief valves with flanged inlet and outlet connections as shown on Drawings. Provide air release valves in

combination with inlet and outlet, and orifice as shown on Drawings. Valve shall open under pressure differential not to exceed 0.25 psi.

1. See approved product list.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Conform to applicable provisions of Section 31 23 33.16 Excavation and Backfill for Utilities.

3.2 SETTING VALVES IN MANHOLES AND VAULTS

B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that parts are in satisfactory working condition.

C. Install valves and valve manholes and vaults where indicated on Drawings or as located by Owner. Set manholes and vaults plumb and as detailed. Center manholes on valves. Compact cement-stabilized sand around each manhole and vault for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Provide above-ground vents for manholes and vaults as indicated on Drawings.

3.3 PAINTING OF PIPING AND VALVES

D. Paint piping and valves located in manholes, stations, above ground using approved paint, and color.

END OF SECTION

SECTION 33 12 16.17
TAPPING SLEEVES AND VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes tapping sleeves and valves for connections to existing water system.

1.2 MEASUREMENT AND PAYMENT

B. Unit Prices:

1. Payment is on unit price basis for each tap installed.
2. Refer to Section 01 29 00 Payment Procedures for unit price procedures.
3. For water lines 4-inches and greater, no payment will be made until coupon (cut out portion of pipe tapped) is delivered to City.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

D. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

E. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

F. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service

G. AWWA C 110 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and other Liquids.

H. AWWA C 200 - Standard for Steel Water Pipe - 6 in. and Larger.

I. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in.

J. AWWA C 500 - Standard for Metal Seated Gate Valves, for Water Supply Service.

1.4 SUBMITTALS

K. Conform to requirements of Section 01 33 00 Submittal Procedures.

L. Submit results of tapping sleeves NPT test opening.

M. Submit manufacturer's affidavit as required in Section 33 12 16.23 Gate Valves.

1.5 DELIVERY, STORAGE AND HANDLING

N. Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tapping Sleeves

1. Stainless Steel tapping-sleeve bodies and flange.

   a. Flange: ASTM A240 Stainless Steel, Type 304, ANSI 150 pound drilling.
   b. Gasket: Full circumferential, affixed around recess of tap opening to prevent rolling or binding during installation, compounded for water and sewer service.
   c. Body: ASTM A240 Stainless Steel, Type 304.
   d. Bolts: ASTM A193 Stainless Steel, Type 304.
   e. Nuts: ASTM A194 Stainless Steel, Type 304
   f. Branch Outlet: Heavy Stainless Steel Pipe
   g. Provide approved stainless steel tapping sleeves.
   h. Do not use sleeves for taps greater than 75 percent of pipe diameter.

B. Tapping Valves: Meet requirements of Section 33 12 16.23 Gate Valves with following exceptions:

1. Inlet Flanges:

   a. AWWA C 110; Class 125.
   b. AWWA C 110; Class 150 and higher: Minimum 8-hole flange.

2. Outlet: Standard mechanical or push-on joint to fit any standard tapping machine.
3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without contact with valve body; resilient seat wedge.

C. Valve Boxes: Standard Type "A" valve boxes conforming to requirements of Section 33 05 16.17 Valve Boxes, Meter Boxes, and Meter Vaults.

PART 3 - EXECUTION

3.1 APPLICATION

A. Install tapping sleeves and valves at locations and of sizes shown on Drawings. Install sleeve so valve is in horizontally level position unless otherwise indicated on Drawings.

B. Clean tapping sleeve, tapping valve, and pipe prior to installation and in accordance with manufacturer's instructions.

C. Hydrostatically test installed tapping sleeve to 150 psig for minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.

D. When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than water line being tapped.

E. Tapping asbestos-cement line prohibited except under authorization of the City Engineer.

3.2 INSTALLATION

F. Verify outside diameter of pipe to be tapped prior to ordering sleeve.

G. Tighten bolts in proper sequence so that undue stress is not placed on pipe.

H. Align tapping valve properly and attach to tapping sleeve. Insert insulation sleeves into flange holes of tapping valve and pipe. Make insertions of sleeves on pipe side of tapping valve. Do not damage insulation sleeves during bolt tightening process.

I. Make tap with sharp, shell cutter:

1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.
2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.

J. Withdraw coupon and flush cuttings from newly-made tap.

K. Wrap completed tapping sleeve and valve in accordance with manufacturer’s recommendations

L. Place concrete thrust block behind tapping sleeve (not over tapping sleeve and valve).

M. Request inspection of installation prior to backfilling.

N. Backfill in accordance with Section 31 23 33.16 Excavation and Backfill for Utilities

END OF SECTION

SECTION 33 12 16.23
GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes gate valves.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for gate valves is on a unit price basis. Unit price includes cost of required box for gate valves.
2. Payment for 2-inch blow-off valve with box is on a unit price basis for each installation
3. Refer to Section 01 29 00 Payment Procedures for unit price procedures

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

B. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Casting.

C. ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.

D. ASTM B 763 - Standard Specification for Copper Alloy Sand Casting for Valve Application.

E. AWWA C 500 - Standard for Metal-Seated Gate Valves for Water Supply Service.

F. AWWA C 509 - Standard for Resilient-Seated Gate Valves for Water Supply Service.

G. AWWA C 515- Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.

H. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

1.4 SUBMITTALS

A. Conform to requirements of Section 01 33 00 Submittal Procedures.

B. Submit manufacturer's product data from approved product list for the proposed valves.

1.5 QUALITY CONTROL

A. Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

PART 2 - PRODUCTS

2.01 MATERIALS (See approved product list and design standards)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Earthwork. Conform to applicable provisions of Section 31 23 33.16- Excavation and Backfilling for Utilities.

B. Operation. Do not use valves for throttling without prior approval of manufacturer.

3.2 SETTING VALVES AND VALVE BOXES

A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.

B. Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.

C. For pipe section of each riser, use only 6 inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve. Assemble and brace box in vertical position as indicated on Drawings.

3.3 DISINFECTION AND TESTING

A. Disinfect valves and appurtenances as required by Section 33 10 30 Disinfection of

Water Utility Distribution and test as required by Section 01 45 16.16 Hydrostatic Testing.

B. Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.

C. Repair or replace valves which exceed leakage rate.

3.4 PAINTING OF VALVES

A. Paint valves in vaults, stations, and above ground with paint as specified and approved in the City of Sugar Land Approved Products List.

END OF SECTION

General Note:
Double Plastic Wrap All Fittings

SECTION 33 12 16.26
BUTTERFLY VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes butterfly valves.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for butterfly valves is on a unit price basis. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

C. AWWA C 504 - Standard for Rubber-Seated Butterfly Valves.

D. AWWA C 550 - Standard for Protective Interior Coatings for Valves and Hydrants.

1.4 SUBMITTALS

A. Conform to requirements of Section 01 33 00 Submittal Procedures.

B. Submit manufacturer's product data for proposed valves and actuators for approval.

C. Submit manufacturer's affidavit for proposed valves and actuators certifying compliance with specifications.

D. Submit manufacturer's affidavit that butterfly valves were manufactured in the United States, and conform to applicable requirements of AWWA C 504 and that they have been satisfactorily tested in the United States in accordance with AWWA C 504 using test pressure of 150 psi in both directions. Submit Proof-of-Design and hydrostatic testing procedure in accordance with AWWA C 504.

E. Submit manufacturer's affidavit that coating for interior surfaces of valves conform to applicable requirements of AWWA C 550. Submit results of holiday test and thickness measurements of coatings.

F. Furnish, at time of delivery, affidavit of compliance, as specified in Section 6.3 of AWWA C 504 certifying compliance with applicable portion of AWWA C 504 and modification or supplements herein. Furnish certified drawings and material test records by manufacturer covering items included in Section 4.3 of AWWA C 504, for review. Furnish certified copies of test reports covering items in Sections 4.5.8.5.5, 4.5.8.5.8 and 5.2.1 through 5.2.4.3 of AWWA C 504 for review.

G. Submit data indicating maximum torque required to open valve, maximum torsional strength of shaft and torque output of actuator.

H. Provide submittal information on CD-ROM in Adobe portable document format (*.PDF) or provide submittal information in hard copy format.

I. Include number of turns to operate valves to fully open/closed.

J. Conform to the City of Sugar Land Approved Products List.

1.5 QUALITY CONTROL

A. Perform valve leakage tests in both directions at 150 psi in factory and field. Hydrostatic field tests of 150 psi shall be made against dished head plug or similar arrangement.

B. For purposes of interpreting referenced AWWA tests, the following shall apply: Shutoff pressure is 150 psi; cycle consists of rotating disc from fully opened to fully closed position, for valves larger than 72 inches, proof of design shall require 1000 cycles and shall be performed on valve greater than 72 inches of like design and construction. When proof of design tests are performed on valve delivered to job site, replace disc, bushing, shaft and seals with new and unused items, and test and certify as described above.

C. Hydrostatic Testing by Manufacturer:

1. Certification of hydrostatic testing shall be furnished upon request

PART 2 - PRODUCTS

2.1 VALVES AND ACTUATORS (See approved product list)

A. Butterfly Valves and Actuators: Provide approved butterfly valves and actuators. Conform to AWWA C 504, except as modified or supplemented herein.

B. If type of valve is not indicated on Drawings, use butterfly valves for line valve sizes 16-inch and larger. When type of valve is specified on Drawings, no substitute will be allowed, unless otherwise approved by City Engineer.

C. Butterfly valves shall be short-body, flanged design and installed at locations as shown on Drawings.

D. Direct-bury valves and valves in subsurface vaults shall open counter-clockwise. Above-ground and plant valves shall open counterclockwise.

E. Provide flanged joints when valve is connected to steel or PCCP.

F. Butterfly Valves and Actuators (Additional Requirements for Large Diameter Water Lines):

1. Provide valves from approved manufacturer. Provide all valves for single project, from same manufacturer.
2. Provide manual actuators for single project, from same manufacturer.
3. Shaft connecting actuator to valve body must be fully enclosed. Bonnet and extension to be fully enclosed and watertight.

2.2 VALVE CONSTRUCTION

A. Valves: AWWA C 504, Class 150 B Body; Cast iron, ASTM A 126, Class B Flanges: ASME B 16.1, Class 125 lb.

B. Discs for Butterfly Valves: Either cast iron or ductile iron. Valves greater than 54” in diameter must utilize flow through disc.

C. Seats: Buna-N or neoprene, and may be applied to disc or body. Seats shall be mechanically secured and may not rely soley on adhesive properties of epoxy or similar boding agent to attach seat to body. Seats on disc shall be mechanically retained by stainless steel (18-8) retaining ring held in place by stainless steel (18-8) cap screws that pass through rubber seat for added retention. When seat is on disc, seat shall be retained in position by shoulders located on both disc and stainless-steel retaining ring. Mating surfaces for seats: Type 304 or 316, stainless steel and secured to disc by mechanical means. Sprayed-on or plated mating surfaces will not be allowed. Seat must be replaced in field for valves greater than 30 inches in diameter. Valves with segmented retaining rings will not be accepted.

D. Coat interior wetted ferrous surfaces of valve, including disc, with epoxy suitable for potable water conditions. Epoxy, surface preparation, and epoxy application: In accordance with AWWA C 550 and coating manufacturer's recommendations. Provide three coats of two-component, high-build epoxy with minimum dry film thickness of 12 mils. Provide approved epoxy coating. Coatings shall be holiday tested and measured for thickness.

E. Valve shaft and keys: 24 inches in diameter and greater valves require a minimum of two (2) taper pins used for attaching valve shaft to valve disc, use of torque plug for

purposes of attaching valve shaft to valve disc is not permitted: Type 316 stainless steel. Shaft Bearings: Stainless steel, bronze, nylon, or Teflon (supported by fiberglass mat or backing material with proven record of preventing Teflon flow under load) in accordance with AWWA C 504. Sinter stainless steel bearing material. Design valve shaft to withstand 3 times amount of torque necessary to open valve.

F. Packing: Self adjusting and wear compensating, full or split ring V-type, and replaceable without removing actuator assembly.

G. Retaining Hardware for Seats: Type 304 or 316 stainless steel. Nuts and screws used with clamps and discs for rubber seats shall be held securely with locktight, or other approved method, to prevent loosening by vibration or cavitational effects.

H. Valve disc shall seat in position at 90 degrees to pipe axis and shall rotate 90 degrees between full-open and tight-closed position. Install valves with valve shafts horizontal and convex side of disc facing anticipated direction of flow, except where shown otherwise on Drawings.

I. For valves utilizing retaining rings, tighten bolts to a uniform torque. Measure torque prior to testing valve.

2.3 VALVE ACTUATOR CONSTRUCTION

A. Provide actuators for valves with size based on line velocity of 12 feet per second and uni-directional service, and, unless otherwise shown on Drawings, equip with geared manual actuators. Provide fully enclosed and traveling-nut type, rack-and-pinion type, or worm-gear type for valves 16 inches and smaller. Provide worm-gear type for valves 20 inches and larger.

B. Provide actuator designed for installation with valve shaft horizontal unless otherwise indicated on Drawings.

C. Provide bonnet extensions, as required, between valve body and actuator. Space between actuator housing and valve body shall be completely enclosed so that no moving parts are exposed to soil or elements.

D. Provide oil-tight and watertight actuator housings for valves, specifically designed for buried service or submerged service when located in valve vaults, and factory packed with suitable grease.

E. Install valve position indicator on each actuator housing located above ground or in valve vaults. Valves shall be equipped with 2-inch actuator nut only.

F. Indicate direction of opening of valve on exposed visible part of assembly and cast direction of open on 2 inch nut on top of valve operator extension. Paint 2 inch actuator nut and extension shaft black when counter clockwise open and red when clockwise to open.

G. Design worm-gear or traveling-nut actuators to be self-locking and designed to transmit twice the required actuator torque without damage to faces of gear teeth or contact

faces of screw or nut.

2.4 VALVE BOXES

A. Provide Standard Type "A" valve boxes conforming to requirements of Section 33 05 16.17 Valve Boxes, Meter Boxes, and Meter Vaults.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Conform to applicable provisions of Section 31 23 33.16 Excavation and Backfill for Utilities.

3.2 SETTING VALVES AND VALVE BOXES

A. Prior to Hydrostatic testing of water line and valve:

1. Test valve by opening and closing valve at a minimum of two times to verify valve seats properly.
2. Verify number of turns from fully open to fully closed position is same as identified in manufacturer's submittal.
3. Adjust valve as required if number of turns do not match.
4. Remove foreign matter from within valves.

B. Install valves where shown on Drawings or as located by Owner. Use valve vaults for 16 inch and larger. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet.

C. Avoid disturbing or overstressing valve body when installing valves. Perform field adjustment of valves under pressure to ensure shutoff occurs in number of rotations as described in valves operation and maintenance manual.

D. Attach two four (4) foot lengths of pipe to each side of valve prior to installation in line.

E. Submit certification that large diameter valve was installed, adjusted, and exercised in accordance with manufacturer's instructions. Manufacturer's certification shall state that all performance characteristics of large diameter valves, as installed, have been met. Adjustments made to valve, for any reason, must be made by manufacturer's representative.

3.3 COATING OF PIPING

A. Coat valves located in vaults, stations, and above ground using approved paint. Minimum of two (2) coats shall be applied with minimum of three (3) mil thickness. Apply coating in accordance with manufacturer's recommendations.

END OF SECTION

General Note:
Cover piping with plastic and double wrap all fittings.

SECTION 33 12 19
FIRE HYDRANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire hydrants.
2. Adjustment of fire hydrants and gate valves.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment is on a unit price basis for each fire hydrant unit installed, including 6-inch gate valve and box, installed regardless of barrel depth.

B. No separate payment for the adjustment of fire hydrant units. Include payment in the installation of the fire hydrants

1. Installation includes hydrant, 6 inch head, 6 inch gate valve, tee, restraints and fittings, and necessary appurtenances.

1.3 REFERENCES

A. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants

B. SSPC SP2 - Hand Tool Cleaning

C. SSPC SP3 - Power Tool Cleaning

D. SSPC SP10 - Near-White Blast Cleaning

E. SSPC SP11 - Power Tool Cleaning to Bare Metal

F. SSPC Paint Spec No.21

G. SSPC-Paint 21 - White or Colored Silicone Alkyd Paint

H. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

I. SSPC-Paint 104 - White or Tinted Alkyd Paint

J. Federal Standard A-A-2962A - Enamel, Alkyd, Solvent Based Low VOC

1.4 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

PART 2 - PRODUCTS

2.1 HYDRANTS

A. Provide fire hydrants approved by City Engineer and the City of Sugar Land Approved Products List.

B. The City Engineer may, at any time prior to or during installation of hydrants, randomly select furnished hydrant for disassembly and laboratory inspection, at Owner's expense, to verify compliance with Specifications. When hydrant is found to be non-compliant, replace, at Contractor's expense, hydrants, with hydrants that comply with Specifications.

2.2 LEADS

A. Branches (Leads): Conform to requirements of Section 33 05 01.02 Ductile Iron Pipe and Fittings, Section 33 05 01.01 Steel Pipe and Fittings, and Section 33 05 01.09 Polyvinyl Chloride Pipe and Fittings.

2.3 HYDRANT PAINTING

A. New hydrants and refurbished hydrants shall be shop coated as specified herein.

B. Fire hydrants shall be painted and/or repainted with GEO-361 polyurethane enamel (silver) manufactured by GEO-GLEN enterprises, Inc. (Discuss blast before applying paint)

1. Surface preparation shall include removal of oil, grease and moisture, followed by media blasting to SSPC-SP15-10-63 specifications (near white metal) as per manufacturer's recommendations.
2. Prime bear metal with TP-251 epoxy primer or with TP-221, TP-231 or TP-241 Universal Primer. 80 degrees F and 50 percent relative humidity are optimal conditions for application of primer and of paint.
3. Do not apply primer and/or when surface to be painted is less than 5° above the dew pointing order to prevent moisture from condensing on the surface to be primed and/or painted.
4. Install blue traffic button on the street 6 inches off the center line for each hydrant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set fire hydrant plumb and brace at locations and grades as shown on Drawings. When barrel of hydrant passes through concrete slab, place 1-inch-thick piece of standard sidewalk expansion joint material around section of barrel passing through concrete.

B. Locate nozzle center line minimum 18 inches above finish grade.

C. Place 12-inch by 12-inch yellow indicators (plastic, sheet metal, plywood, or other material approved by Project Manager) on pumper nozzles of new or relocated fire hydrants installed on new water lines not in service. Remove indicators after new water line is tested and approved by the City Engineer.

D. Do not cover drain ports when placing concrete thrust block.

E. Gravel will be placed around all drain ports.

F. Obtain City Engineer approval in writing prior to installation of hydrants which require changes in bury depth due to obstructions not shown on Drawings. Unit price adjustments will not be allowed for changes in water line flow line or fire hydrant barrel length caused by obstructions.

G. Plug branch lines to valves and fire hydrants shown on Drawings to be removed. Deliver fire hydrants designated for salvage to City Utility Department.

H. Install branches (leads) in accordance with Section 33 11 13 Water Lines.

I. Coating Requirements:

1. Apply coatings in strict accordance with manufacturer's recommendations. No requirements of this specification shall cancel or supersede written directions and recommendations of specific manufacturer so as to jeopardize integrity of applied system.
2. Furnish affidavit of compliance that coatings furnished complies with requirements of this specification and referenced standards, as applicable.

J. Use following color code for field coating of hydrant bonnet and caps to indicate size of water line supplying hydrant:

Supply Water Line Diameter (inches)	Bonnet Color
6 and less	Yellow

8	White
12 to 16	Green
Greater than 16	Orange

END OF SECTION

SECTION 33 13 00
HYDROSTATIC TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Field hydrostatic testing of newly installed water pipelines.
2. Requirements for both small-diameter (4-12 inches) water mains and large-diameter (greater than 16 inches) water mains. When specifications for large-diameter water mains differ from those for small-diameter water mains, paragraphs for large-diameter water mains will govern for large-diameter pipe.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices: No payment will be made for hydrostatic testing of pipelines under this Section. Include cost of unit price for pipelines being tested.

1.3 REFERENCES

A. AWWA C 651 - Standard for Disinfecting Water Mains.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Disinfect water system pipelines prior to hydrostatic testing.

B. Hydrostatically test newly installed water pipelines after disinfection, if required, and before connecting City of Sugar Land water distribution system.

C. Small diameter pipelines shall be tested in lengths between valves, or plugs, or not more than 2000 feet.

D. Large diameter pipelines shall be tested in lengths between valves, or plugs, or not more than 4000 feet.

E. Conduct hydrostatic tests in presence of Engineer's Field Representatives and City of

Sugar Land Inspectors as required.

3.2 TEST PROCEDURES

A. Furnish, install, and operate connections, pump, meter, and gages necessary for hydrostatic testing.

B. Allow pipeline to sit a minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar ling to become saturated.

C. For all-diameter pipelines, expel air and apply a minimum test pressure of 150 psi.

D. Maintain test pressure for 4 hours. If a large quantity of water is required to maintain pressure during test, testing shall be discontinued until cause of water loss is identified and corrected.

E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

3.3 ALLOWABLE LEAKAGE FOR WATER MAINS

A. During hydrostatic tests, NO leakage will be allowed for sections of water mains consisting of welded joints.

B. Maximum allowable leakage for water mains with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing at 150 psi.

3.4 CORRECTION FOR FAILED TESTS

A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove any cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.

B. Engineer may require failed lines to be disinfected after repair and prior to retesting. Conduct subsequent disinfection operations in accordance with requirements.

C. Repeat test until satisfactory results are obtained.

3.5 COMPLETION

A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION

SECTION 33 31 13
GRAVITY SANITARY SEWER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes gravity sanitary sewers and appurtenances, including stacks and service connections.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for gravity sanitary sewers shall be on linear foot basis, complete in place, including sewer pipe, connections to existing manholes, post installation television inspection and testing. Measurement will be taken along centerline of pipe from centerline to centerline of manholes.
2. Payment for television inspection of existing gravity sanitary sewer will be on a linear foot basis. Measurement will be taken along centerline of pipe from centerline to centerline of manholes. See Section 33 31 13.11 Cleaning and Television Inspection.
3. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 QUALITY ASSURANCE

A. Qualifications. Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 3 31 13.10 Acceptance Testing for Sanitary Sewer Pipe.

B. Regulatory Requirements.

1. Install sewer lines to meet minimum separation distance from potable water line, as scheduled below. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.
2. Make notification to City Engineer when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.
3. Lay gravity sewer lines in straight alignment and grade in accordance with

approved Design Plans.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Inspect pipe and fittings upon arrival of materials at job site.

B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.

C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

PART 2 - PRODUCTS (See approved product list)

2.1 PIPE

A. Provide piping materials for gravity sanitary sewers of sizes and types indicated on Drawings or as specified.

B. Unlined reinforced concrete pipe is not acceptable.

2.2 PIPE MATERIAL SCHEDULE

A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in one or more of following Sections:

1. Section 33 05 01.12 PVC Pipe and Fittings.
2. Section 33 05 01.02 Ductile Iron Pipe and Fittings.
3. Section 33 05 01.01 Steel Pipe and Fittings.
4. Section 33 05 01.04 HDPE Pipe.

B. Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.

C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.3 APPURTENANCES

A. Stacks: Conform to requirements of City Design Standards, latest version.

B. Service Connections: Conform to requirements of City Design Standards, latest version

C. Roof, street or other type of surface water drains shall not be connected or

reconnected into sanitary sewer lines.

2.4 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill: Conform to requirements of Section 31 23 33.16 Excavation and Backfill for Utilities, Section 31 23 23.13 Backfill, and Section 31 23 23.53 Cement Stabilized Sand.

B. Topsoil: Conform to requirements of Section 32 91 19.13 Topsoil Placement and Grading.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affect traffic.

B. Provide barricades, flashing warning lights, and warning signs for excavations. Maintain barricades and warning lights where work is in progress or where traffic is affected by work.

C. Perform work in accordance with OSHA standards. Employ a trench safety system for excavations over 5 feet deep.

D. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from City Engineer and agency or utility company for repairs or relocations, either temporary or permanent.

E. Remove old pavements and structures including sidewalks and driveways as per plans or unless otherwise directed by City of Sugar Land.

F. Do not allow sand, debris or runoff to enter sewer system.

3.2 DIVERSION PUMPING

A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner.

B. Design piping, joints and accessories to withstand twice maximum system pressure or 50 psi, whichever is greater.

C. No sewage shall be diverted into area outside of sanitary sewer.

D. In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify City Engineer.

3.3 EXCAVATION

A. Earthwork. Conform to requirements of Section 31 23 33.16 Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.

B. Line and Grade. Establish required uniform line and grade in trench from benchmarks. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.

C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Section 31 23 33.16 Excavation and Backfill for Utilities.

3.4 PIPE INSTALLATION BY OPEN CUT

A. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.

B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed.

C. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.

D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.

E. Form concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe.

G. Provide lubricant, place and drive home newly laid sections so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will be allowed when protective measures are provided and approved in advance by City Engineer.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.

J. Where gravity sanitary sewer is to be installed under existing water line with

separation distance of at least 2 feet and less than 9 feet, install new sewer pipe so that one full18 foot long pipe is centered on water line crossing. Embed sewer pipe in cement stabilized sand for minimum distance of 9 feet on each side of crossing.

K. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 6-inch separation distance.

L. Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

3.5 PIPE INSTALLATION OTHER THAN OPEN CUT

A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

3.6 INSTALLATION OF APPURTENANCES

A. Service Connections: Install service connections to conform to requirements of City Design Standards.

B. Stacks. Construct stacks to conform to requirements of City Design Standards.

C. Construct manholes to conform to requirements of Section 33 05 16.14 Cast-in-Place Concrete Manholes, Section 33 05 16.15 Precast Concrete Manholes, as applicable.

3.7 INSPECTION AND TESTING

A. Visual Inspection: Check pipe alignment in accordance with Section 02533 – Acceptance Testing for Sanitary Sewers.

B. Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Section 33 31 13.10 - Acceptance Testing for Sanitary Sewers.

C. Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Section 33 31 13.10 Acceptance Testing for Sanitary Sewers. Maintain piezometer installed to conform with Section 01 57 10 Temporary Control of Ground Water and Surface Water, until acceptance testing is completed.

3.8 BACKFILL AND SITE CLEANUP

A. Backfill and compact soil in accordance with Section 31 23 33.16 Excavation and Backfill for Utilities.

B. Backfill trench in specified lifts only after pipe installation is approved by City Engineer.

C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as directed by Engineer.

D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil as specified in Section 32 91 19.13 Topsoil Placement and Grading and apply hydromulch according to requirements of Section 32 92 13 Hyrdo-Mulching.

E. Provide sodding in areas of residential land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil per Section 32 91 19.13 Topsoil Placement and Grading.

END OF SECTION

General Note:
The City Engineer may request a television inspection at his discretion.

SECTION 33 31 13.10
ACCEPTANCE TESTING FOR SANITARY SEWER PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acceptance testing of sanitary sewers including:

1. Visual inspection of sewer pipes.
2. Mandrel testing for flexible sewer pipes.
3. Leakage testing of sewer pipes.
4. Leakage testing of manholes.
5. Smoke testing of point repairs.
6. TV Inspection.

B. Tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
2. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM C 828 - Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.

B. ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.

C. ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D. ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

E. ASTM F 1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between manholes as shown on the approved Design Plans.

B. Perform air testing in accordance with requirements of this Section and Texas Commission of Environmental Quality. Refer to Table 2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 3, Minimum Testing Times for Low Pressure Air Test, and Table 4, Vacuum Test Time Table, at end of this Section.

1.5 SUBMITTALS

A. Conform to requirements of Section 01 33 00 Submittal Procedures.

B. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Owner. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.

C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.6 GRAVITY SANITARY SEWER QUALITY ASSURANCE

A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.

B. Provide testing reports and video tape of television inspection as directed by City Engineer.

C. Upon completion of tape reviews by Owner, Contractor will be notified regarding final acceptance of sewer segment.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate testing schedules with City Engineer. Perform testing under observation of City Engineer.

PART 2 - PRODUCTS

2.1 DEFLECTION MANDREL

A. Mandrel Sizing: Rigid mandrel shall have outside diameter (O.D.) equal to 95 percent of inside diameter (I.D.) of pipe. Inside diameter of pipe, for purpose of determining outside diameter of mandrel, shall be average outside diameter - two minimum wall thicknesses for O.D. controlled pipe and average inside diameter for I.D. controlled pipe, dimensions shall

be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing. Comply with the Texas Commission on Environmental Quality for deflection testing.

B. Mandrel Design: Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of inside diameter of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.

C. Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.

D. Mandrel Dimensions (5 percent allowance). Average inside diameter and minimum mandrel diameter are specified in Table 5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by City Engineer.

2.2 LOW PRESSURE AIR TEST

A. Minimum Requirement for Equipment:

1. Control panel
2. Low-pressure air supply connected to control panel.
3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
4. Air hoses from control panel to:

    a. Air supply.
    b. Pneumatic plugs.
    c. Sealed line for pressuring.
    d. Sealed line for monitoring internal pressure.

B. Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

2.3 GROUND WATER DETERMINATION

A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.4 SMOKE TESTING

A. Equipment:

1. Pneumatic plugs.
2. Smoke generator as supplied by Superior Signal Company, or approved equal.

3. Blowers producing 2500 scfm minimum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

B. Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Section 01 57 10 Temporary Control of Ground Water and Surface Water.

3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and relay or replace pipe segment.

3.3 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.

B. Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.

C. Retest repaired or replaced sewer sections.

3.4 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

A. Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.
2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo physical inspection prior to testing.
3. Perform leakage testing after backfilling of line segment, and prior to tie-in of service connections.

B. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 2.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter. Lines 36-inch average inside diameter and larger shall be tested at each joint. Minimum time allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during joint test shall be 10 seconds, regardless of pipe size.
2. For pipe sections less than 36-inch average inside diameter:

    a. Determine ground water level.
    b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
    c. After manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
    d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 2 at end of this Section.
    e. To determine air loss, measure time interval for pressure to drop to 2.5 psig. Time must exceed that listed in Table 2 at end of this Section for pipe diameter and length. For slip lining, use diameter of carrier pipe.

C. Retest: Repair and retest any section of pipe which fails to meet requirements.

3.5 TEST CRITERIA TABLES

A. Low Pressure Air Test:

1. Times in Table 1, Time Allowed For Pressure Loss From 3.5 psig to 2.5 psig, at end of this Section, are based on equation from Texas Commission of Environmental Quality (TCEQ) Design Criteria 317.2(a)(4)(B).

T = 0.0850(D)(K)/(Q)		
where:	T =	time for pressure to drop 1.0 pounds per square inch gauge in seconds
	K =	0.000419 DL, but not less than 1.0
	D =	average inside diameter in inches
	L =	length of line of same pipe size in feet
	Q =	rate of loss, 0.0015 ft3/min./sq. ft. internal surface

2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 2, Minimum Testing Times for Low

Pressure Air Test.

a. When two sizes of pipe are involved, compute time by ratio of lengths involved.
b. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
c. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
d. If joint test is used, perform visual inspection of joint immediately after testing.
e. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, minimum times allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

3.6 LEAKAGE TESTING FOR MANHOLES

A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.

B. Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged when lines entering manhole have not been backfilled.

C. Vacuum Testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.
2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 3, Vacuum Test Time Table.
3. If drop in vacuum exceeds 1 inch Hg over specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

D. Perform hydrostatic exfiltration testing as follows:

1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.
3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.7 SMOKE TEST PROCEDURE FOR POINT REPAIRS

A. Application: Perform smoke test to:

1. Locate points of line failure for point repair.
2. Determine when point repairs are properly made.
3. Determine when service connections have been reconnected to rehabilitated sewer.
4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.

B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.

C. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to Owner 24 hours prior to actual smoke testing.

D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.

E. Smoke Introduction:

1. Operate equipment according to manufacturer's recommendation and as approved by Owner.
2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.
3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.

F. Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling of excavation is not completed within one work day, properly barricade and cover each excavation as approved by Owner.

G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

Table 1 ACCEPTANCE TESTING FOR SANITARY SEWERS

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG														
Pipe Diam. (in)	Min. Time (min/ sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)										
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

Table 2 MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

PIPE DIAMETER *(INCHES)*	**MINIMUM TIME *(SECONDS)***	**LENGTH FOR MINIMUM TIME *(FEET)***	**TIME FOR LONGER LENGTH *(SECONDS)***
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

Table 3 VACUUM TEST TIME TABLE

DEPTH IN FEET	TIME IN SECONDS BY PIPE DIAMETER		
	48"	60"	72"
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96

Table 4 PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size (Inches)	Average ID (Inches)	Minimum Mandrel Diameter (Inches)
PVC Solid (SDR 26)	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC Solid (SDR 35)	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC Profile	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725

END OF SECTION

SECTION 33 34 00
SANITARY UTILITY SEWERAGE FORCE MAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sanitary sewer force mains.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for installation of force main pipe shall be on linear foot basis. Measurement will be taken along center line of pipe from end to end. Payment will be made for each foot of force main installed, complete in place including pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes, acceptance testing, and pipe and accessories.
2. The Unit Price item identifies line segments between stations as shown on Drawings.
3. Refer to Section 01 29 00 Payment Procedures for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCE STANDARDS

A. ACI 318 - ACI Building Code and Commentary.

B. ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 C and 30 C with a Vitreous Silica Dilatometer.

C. ASTM D 2310 - Standard Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced- Thermosetting-Resin) Pipe.

D. ASTM D 2992 - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.

E. ASTM D 2996 - Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

F. Uni-Bell UNI-B-3 Polyvinyl Chloride (PVC) Pressure Pipe (complying with AWWA C 900).

1.4 SUBMITTALS

A. Conform to requirements of Section 01 33 00 Submittal Procedures.

B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Force mains 24 inches in diameter and larger: Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.

PART 2 - PRODUCTS

2.1 PIPE FITTING MATERIAL SCHEDULE

A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in Section 33 05 01.09 -Polyvinyl Chloride Pipe and Fittings.

2.2 THRUST RESTRAINT

A. Unless otherwise shown on Drawings, provide concrete thrust blocking for all force mains, to prevent movement of buried lines under pressure at bends, tees, caps, valves and hydrants. Blocking shall be Portland cement concrete, as specified in Section 03 31 00 Structural Concrete. Place concrete in accordance with details on Drawings. Place thrust blocks between undisturbed ground and fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below pipe or fitting to 12 inches above.

B. For force mains larger than 12 inches in diameter, and where indicated on Drawings, provide restrained joints conforming to requirements of force main pipe material specifications. Install restrained joints for length of pipe on both sides of each bend or fitting for full length shown on Drawings.

C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.

D. Horizontal and vertical bends between 10 degrees and 90 degrees deflection angle shall have thrust restraint as shown on Drawings.

E. Provide thrust restraint at all fittings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION BY OPEN-CUT

A. Perform excavation, bedding, and backfill in accordance with Section 31 23 33.16 - Excavation and Backfill for Utilities.

B. Wrap ductile-iron pipe and fittings with polyethylene wrap in accordance with requirements of manufacturer. Do not install polyethylene wrap on ductile iron pipe protected by cathodic protection system or fusion bonded or polyurethane coated fittings.

C. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.

D. Install pipe only after excavation is completed, bottom of trench is fine graded, bedding material is installed.

E. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.

F. Install pipe with spigot ends toward direction of flow. Form concentric joint with each section of adjoining pipe so as to prevent offsets.

G. Keep interior of pipe clean as installation progresses. Where cleaning after laying pipe is difficult because of small pipe size, use suitable swab or drag in pipe and pull it forward past each joint immediately after joint has been completed. Remove foreign material and debris from pipe.

H. Provide lubricant, place and drive home newly-laid sections so as to eliminate damage to sections. Install pipe to “home” mark where provided. Use of back hoes or similar powered equipment will be allowed if protective measures are provided and approved in advance by Owner.

I. Keep excavations free of water during construction and until final inspection.

J. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.

K. Where sanitary sewer force main is to be installed under existing water line with separation distance of less than 2 feet, install one full joint length of pipe, minimum 18 foot length, centered on water line and maintain minimum 6-inch separation distance.

3.2 PIPE INSTALLATION OTHER THAN OPEN-CUT

A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification section of augering or tunneling work.

3.3 HYDROSTATIC TESTING

A. After pipe and appurtenance have been installed, test line in accordance with Section 33 31 13.10 Acceptance Testing for Sanitary Sewer Pipe.

END OF SECTION

SECTION 33 42 13

STORM UTILITY DRAINAGE

REINFORCED CONCRETE PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item includes the furnishing of labor, materials, equipment, and supervision in the operations required in the laying and jointing of reinforced concrete pipe.

1.2 MEASUREMENT AND PAYMENT

A. Measurement shall be made based upon the length of pipe as laid in the field. Length of inlets and junction boxes are not included in this measurement. Pipe shall be paid for at the unit price bid in the Proposal for each size and type of pipe, which price shall be full compensation for trenching and backfilling, furnishing and laying the pipe, and furnishing all equipment, labor, materials, tools and incidentals necessary to complete the work.

1.3 SUBMITTALS

A. Submit certification from independent testing laboratory at manufacturer expense that the pipe meets the requirements of ASTM C76/C76M and ASTM C497/C497M.

PART 2 – PRODUCTS

2.1 MATERIALS

The Publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM C76 Standard Specification for Reinforced Concrete Culvert Storm Drain and Sewer Pipe (Latest Revision)

ASTM C443 Standard Specification for Joints for Circular Concrete Sewer and

Culvert Pipe, Using Rubber Gaskets (Latest Revision)

A. Reinforced Concrete Pipe:

1. Reinforced concrete pipe to meet the requirements of ASTM C76. The pipe shall be Class III unless otherwise shown on PLANS.
2. Joint reinforced for rubber gasket joints to meet the requirements of paragraph 8 of ASTM C76.
3. Joints shall be rubber gasket per ASTM C443 unless otherwise shown on PLANS. Lubricant materials for installation purposes to be per manufacturers recommendations. Mineral lubricants are not to be used.
4. Pipe coating requirements are shown on PLANS if required.

TESTING REQUIREMENTS

Testing methods for the reinforced concrete pipe shall conform to the latest revision of ASTM C497 (Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile).

REJECTION: The pipe may be rejected for having defects or failure to meet requirements as follows:

A. Variations in any dimension exceeding the permissible variations prescribed.

B. A piece broken out of the bell or spigot end of such size that the water-tightness of the joint would be impaired.

C. Any shattering or flaking of concrete or other conditions indicating an improper concrete mix.

D. Lack of uniformity in placement of steel which might preclude all joints being typical of those tested.

E. Cracks sufficient to impair the strength, durability or serviceability of the pipe.

F. Failure to conform with any of the specifications herein set forth or referenced

G. Failure of pipe to go completely "home" due to binding of spigot against bell.

PART 3 – EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Shipment of pipe to be in accordance with the manufacturer's recommendations. Pipe to be unloaded and stored in a location where pipe will be protected from damage.

3.2 TRENCH/BACKFILL

A. Pipe trench excavation and backfill to be in accordance with SECTION 31 23 33 – EXCAVATING, TRENCHING, AND BACKFILLING and/or as shown on Plans or as directed by the City Engineer.

3.3 JOINTING OF PIPE

A. Lay pipe sections in trench to true alignment and grade. Take exceptional care in placing pipe and making field joints. Avoid bumping of pipe in trench.

B. Properly lubricate groove end of pipe and rubber gasket with lubricant. Stretch gasket over the spigot end of the pipe. Gasket shall be "equalized" by placing a screwdriver between the gasket and spigot and run around the full joint circumference. Do not twist, roll, cut, crimp, or otherwise injure gaskets or force out of position during closure of joints.

C. Pull or push "home" pipe for closure of the joint. Correct joint rebound before backfilling of pipe.

D. Remove foreign matter or dirt from pipe, and keep clean during and after laying.

E. Any damages in pipe installation or prior to final acceptance is to be repaired or replaced in accordance with ASTM C76 at no additional cost to the City.

END OF SECTION

SECTION 33 42 16

PRECAST REINFORCED CONCRETE BOX CULVERTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification shall govern for the furnishing and placing of precast reinforced concrete box culverts of the size, type and configuration installed to the lines and grades established by the plans.

1.2 MEASUREMENT AND PAYMENT

A. All box culverts installed in accordance with the above specifications and accepted by the Engineer shall be considered as a complete installation, in place and paid for by the linear foot as noted in the Bid Proposal complete in place, of the type, size and depth constructed. The unit price bid shall be full compensation for furnishing all material, equipment and labor for all excavation, shaping of trench bottom, jointing, laying, dewatering, sheeting, bracing, bedding, backfilling, and specials necessary to install the box sewers in accordance with this specification and of the size, type and depth as shown on the plans.

1.3 SUBMITTALS

A. Manufacturer's certification that the Precast Reinforced Concrete Box Sections meets the required ASTM Standards.

PART 2 – PRODUCTS

2.1 MATERIAL

Precast reinforced concrete box culverts shall be manufactured in accordance with the latest revisions published by the American Society for Testing Materials of the following specifications:

A. ASTM C1577 – Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains and Sewers, Designed According to AASHTO LRFD.

B. ASTM C1677 – Joints for Concrete Box Using Rubber Gaskets
Unless otherwise specified, all boxes furnished under this specification shall be fabricated with rubber gasket joints.

PART 3 – EXECUTION

3.1 GENERAL

A. Joints in concrete boxes shall be made watertight by the use of rubber gaskets or ramnek.

3.2 INSTALLATION

A. Trenches shall be excavated with suitable type equipment such as ladder type trenching machines or trench hoes or other equipment that may be approved by the Engineer. Trenches for precast box sewers shall have a width below the top of the box of not less than the outside width of the box plus 16 inches and shall be wide enough to permit making up the joints.

B. After the trench has been excavated to the bottom, the trench shall be fine graded to the established sub-grade and re-compacted to a density of at least 95% of maximum as determined using ASTM D 698. Any over excavation of the subgrade shall be filled with 3 sack per cubic yard of cement stabilized sand. Cement stabilized sand shall be in accordance with SECTION 31 23 23.53 – CEMENT STABILIZED SAND BACKFILL. The Contractor shall establish the grade line in the trench from grade stakes. The Contractor shall maintain this grade control a minimum of 100 feet behind and ahead of the box laying operation. The Contractor shall, at his expense, furnish and place in position all necessary stakes, grade and batter boards for locating the work.

C. The precast box sections shall be so laid in the trench that after the sewer is completely installed, the interior surface shall conform accurately to the grade and alignment as shown on the plans or as established and given by the Engineer. All box sections must be laid in a straight line with the tongue end of the box section pointed downstream entering the grooved end of the previously laid box section, to full depth. Caution shall be taken to not drag cement stabilized sand or earth into the annular space. Box sections shall be fitted together and matched to achieve a finished storm sewer with a smooth and uniform invert.

D. When the tongue is correctly aligned with the flare of the groove the box section shall be pulled or pushed home with sufficient force and power (backhoe, shovel, chain hoist, ratchet hoist or winch) to fully home the spigot into the bell. Each box section shall be pulled home in a straight line with all parts of the box section on line and grade at all times.

E. No box sewer shall be laid in a trench in the presence of water. All water shall be removed from the trench sufficiently ahead of the sewer placing operation to insure a dry, firm bed on which to place the sewer, and if necessary, the trench will continue to be dewatered until after the sewer is bedded and backfilled as directed by the Engineer. Removal of water may be accomplished by pumping, or pumping in connection with the well point installation as the particular situation may warrant. The Contractor shall satisfy himself as to the soil conditions to be encountered.

F. Where necessary, to comply with OSHA Regulation 1926.650, the side of the trench or other excavation shall be braced and rendered secure to the satisfaction of the Engineer. Board sheeting and/or steel sheeting may be utilized as directed by the Engineer. The

bracing shall be in accordance with OSHA requirements.

G. Following compaction of the trench bottom at the established grade, the Contractor shall place a minimum of a 6 inch thickness cement stabilized sand bedding in such a manner that once the box sections are laid, the invert elevation in the box section shall conform to the plan elevations. No voids in the bedding material shall be permitted. Cement stabilized sand shall be composed of a minimum of 3 sacks of cement per cubic yard of sand.

H. When installing concrete box culverts in an existing channel, ditch or gully, cement stabilized sand shall be placed up to the spring line of the box culvert.

I. When installing concrete boxes in a trench condition, backfill shall consist of material excavated on the site, and deemed adequate by the Engineer, or materials obtained from a suitable borrow site. Suitable materials shall be CL/CH materials as determined by the Uniform Soil Classification System that are cohesive in nature, free of debris and organic materials and acceptable to the Engineer. Backfill shall be placed in maximum eight (8) inch lifts, sprinkled as required and compacted to a density of 95% standard proctor density. Moisture content shall be controlled so that the required density is achieved at a moisture content ranging from optimum moisture to 3 percent above optimum density.

J. Backfill over box sections will be permitted as installation proceeds. Prior to backfilling, the Contractor shall remove all steel sheeting and/or cut off all timber sheeting a minimum of three (3) feet below finished grade as shown by the plans. Backfill shall consist of material excavated on the site and deemed adequate by the Engineer or materials obtained from a suitable borrow site. Suitable materials shall be CL/CH materials as determined by the Uniform Soil Classification System (ASTM D 2487) and are cohesive in nature, free of debris and organic materials and acceptable to the Engineer. Backfill shall be placed in maximum eight (8) inch lifts, sprinkled as required and compacted to a density of 95% standard proctor density (ASTM D 698). Moisture content shall be controlled so that the required density is achieved at a moisture content ranging from optimum moisture to 3 percent above optimum density.

K. Where backfill occurs beneath a road surface the material from two (2) feet below subgrade to the established base material shall be compacted to a density of 98% standard proctor density (ASTM D 698).

L. A seal slab shall be installed, when shown by the drawings. If precast seal slabs are used, the joint of the seal slab shall not coincide with the joint of the box.

M. Laboratory tests will be performed as the backfill proceeds. All backfill not meeting this specification shall be removed and re-compacted to the satisfaction of the Engineer at no cost to the Owner.

N. All surplus excavated material shall become the property of the Contractor and shall be disposed of by the Contractor.

O. The angles in box type sewers shall be built in accordance with the plans and

specifications. The cost of making these angles and all cost incidental to them shall be included in the unit price bid for box sewer.

P. Where junction with other storm sewers are to be made, openings may be left in the walls the size of which shall be the outside dimensions of the connecting sewer. A bond length of each reinforcing bar shall be left in the opening for connecting with the concrete collar or future sewer. Where a stub sewer is to be built, the end of the concrete of the stub sewer at the box sewer shall be at the inside face of the sewer box wall. All openings shall be closed with a 12-inch thick brick bulkhead. The cost of providing bulkheads shall be included in the unit price for the box sewer.

END OF SECTION

SECTION 34 41 13.01
TRAFFIC SIGNAL CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for Installation of traffic signals and traffic signal related improvements.

B. Related improvements include, but are not limited to:
   I. Traffic Control
   II. Service pole, meter, conduit, and cable to the controller
   III. Signal controller foundation
   IV. Signs attached to the signal poles or mast arms
   V. Any required permits

1.02 MEASUREMENT AND PAYMENT

A. Measurement: This Item will be measured as each signalized intersection controlled by a single traffic signal controller.

B. Payment - The work performed and materials furnished in accordance with this Section and measured as provided under “Measurement” will be paid for at the unit price bid for “Traffic Signal Construction”. This price is full compensation for furnishing, installing, and testing the completed installation, controller and associated equipment, controller foundations, luminaires, signs, poles, mounting hardware; preservation and replacement of damaged sod, shrubbery and trees; permits; removal and replacement of curbs and walks; and equipment, labor, tools, and incidentals.

The City will pay for electrical energy consumed by the traffic signal.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

2.02 ELECTRICAL SERVICE

A. See Texas Department of Transportation (TXDOT) Approved Products List for “Roadway Illuminations and Electrical Supplies”. All electrical service components must meet TXDOT specifications unless otherwise specified by the City.

B. The service enclosure should be secured with a lock and key. The key should be fabricated as a 2195 key.

C. The service pole and enclosure should be type designated as "ELEC SERV TY D 120/240 070 (NS) SS (E) SP (U)" unless specified on plans. The service drop should be run in conduit underground.

2.03 TRAFFIC CABINET FOUNDATION

A. Grounding rod should be made of copper and measure 5/8" x 10'.

B. Class B concrete may be used unless otherwise specified.

C. Provide reinforcing steel according to TXDOT's 2004 Standard Specification for Construction Item 440 "Reinforcing Steel".

2.04 OVERHEAD SIGNS

A. All signs shall be fabricated with 3M Diamond Grade (DG^3) Reflective Sheeting Series 4000.

B. All signs unless otherwise specified should be fabricated according to the Texas Manual on Uniform Traffic Control Devices and details in the Standard Highway Sign Designs for Texas (SHSD).

C. All street name signs shall be Helvetica Bold font with blue background and white lettering. The font size shall be 9" lettering for street name and 4" lettering for street type and block numbers. The sign black shall be 14" in height with length varying.

D. SkyBracket cable clamp kits should be used when mounting signs. All other hardware unless specified should be stainless steel or galvanized steel.

E. Only stainless steel bolts, nuts, washers, screws, and lock washers shall be used.

2.05 WARRANTY

A. All items installed under this specification, having a manufacturer's warranty shall be installed by or under the direction of the manufacturer or his certified agent, when so required to conform with the manufacturer's warranty, and all such manufacturer's warranties and bonds shall be forwarded to the City. The Contractor, by accepting this contract, guarantees all workmanship, materials and equipment performed or furnished and installed under this specification for a period of one year from date of completion and shall, at their entire expense and within said term of warranty, repair, replace or adjust all faulty, broken, or maladjusted materials and/or equipment furnished and installed under this specification, including lamp replacement.

PART 3 - EXECUTION

3.01 PRECONSTRUCTION MEETING

A. The Owner will schedule a Preconstruction Meeting after award of contract and prior to commencement of construction. The Contractor or his authorized representative will be required to attend. For roadway contracts, the preconstruction meeting for the traffic signal work shall be coordinated by the roadway project manager.

3.02 ELECTRICAL SERVICE

A. The Contractor shall notify the City within seven (7) days after the award of contract for power at intersection.

B. Perform work in accordance with the details shown on the plans.

C. Obtain a City Electrical Permit prior to starting any work. Coordinate the inspection of service once the installation is complete and notify City of its approval. Upon its approval, the City will coordinate with its service provider to supply power and establish meter address.

D. Ensure components and installation of the electrical service meet the requirements of the TXDOT Electrical Detail Standards ED(1) through ED(13).

E. Follow NEC and local utility company requirements when installing the electrical equipment. Coordinate the utility companies' work for providing service.

3.03 TRAFFIC CABINET FOUNDATION

A. Locate all utilities prior to commencing work to avoid conflicts. Place foundation according to plans. If the foundation needs to be shifted please notify City for approval.

B. Steel reinforcement shall be placed according to TXDOT's 2004 Standard Specification for Construction Item 440 "Reinforcing Steel".

C. Hold anchor bolts in place with templates during concrete placement. Hold embedded items such as conduit or other hardware in place during concrete placement with templates or other approved means. Cap conduits before placing concrete. Ream conduit to remove burrs and sharp edges. Install bell ends or bushings on the conduit.

D. Allow concrete for traffic signal cabinet foundations to cure at least 4 days before placing cabinet on the foundation unless otherwise permitted.

E. Foundation shall have an ordinary finished surface. An ordinary finish will be described as per TXDOT's Standard Specification for Construction Item 420 section 420.4.M "Ordinary Surface Finish".

F. Foundation shall be level and proper measures should be made to prevent cabinet foundation from settling.

G. Backfill disturbed surface with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

3.04 OVERHEAD SIGNS

A. Install signs as shown on the plans or as directed by the City.

3.05 UTILITY COORDINATION

A. The Contractor shall contact the City's Right of Way section 72 hours before commencing any work to mark any City owned utility lines in the construction area. It is the Contractor's responsibility to physically locate any water, sewer, and existing traffic conduit lines and to adjust the location of any foundation(s), for approval by the City.

B. The exact location of underground utilities and pipelines is not certain. The Contractor shall contact Texas 811 to determine exact locations of privately owned underground utilities prior to drilling for foundations or any other work that might interfere with or damage present facilities. Contractor shall be responsible for keeping the transmittal number from the Texas 811 current during construction.

3.06 LOCAL CONDITIONS

A. The Contractor shall make any additional investigations he deems necessary to properly bid any and all work related thereto. No additional compensation will be made available to the Contractor for work arising from failure to examine the site and/or subsoil conditions. Staking of specific locations by the City shall not remove the Contractors responsibility for any damage caused by the Contractor to any underground utility.

3.07 SEQUENCE OF WORK

A. It shall be the sole responsibility of the Contractor to schedule and coordinate their work. All work shall be coordinated in such a manner as to prevent delays resulting from work to be performed by others and to complete his work within the specified time. On the week when the intersection is to be turned on or its "Turn On" date, the Contractor will be given a "punch list" from the Signal Inspector for any items that need attention concerning the conditions of signal equipment. These items shall be completed within ten (10) days of the date on the "punch list" given to the contractor. All necessary signing and striping must be complete before "Turn On".

3.08 TRAFFIC CONTROL AND PROTECTION

A. Barricades and Signs: Provide barricades, fences, lights, etc., for protection of property and the public as required by local and/or State Ordinances, project specifications and plans. Contractor will be held liable for all damage to property and/or persons.

1. Comply with Texas MUTCD. Such barricades and protective signs shall be provided by the Contractor at their expense.
2. The Contractor shall at all times so conduct their work as to insure the least possible obstruction to normal pedestrian and vehicular traffic including access to all public and private properties during all stages of construction, and inconvenience to the general public and the residents in the vicinity of the work, and to insure the protection of persons and property, in a manner satisfactory to the City.
3. Prior to closing any section of the project to traffic, the Contractor shall furnish, erect and maintain barricades and warning signs at and in the vicinity of all construction projects at all times, both day and night, during the construction period of the contract.
4. Unless otherwise set forth in these specifications, the Contractor shall receive no direct compensation for furnishing, erecting, and maintaining the necessary barricades, lights, flares, signs, or for any other incidentals necessary for the good and proper safety, convenience, and direction of traffic during the period prior to final inspection and acceptance by the City.
5. The Contractor shall have a Certified Worksite Traffic Supervisor who will be responsible for initiating, installing, and maintaining all traffic control devices as described in the TMUTCD.
    a. The Worksite Traffic Supervisor shall have at least one (1) year of experience directly related to worksite traffic control in a supervisory or responsible capacity and shall be certified by the American Traffic Safety Services Association or International Municipal Signal Association.
    b. The Worksite Traffic Supervisor will be incidental and will not be measured separately for payment.
    c. The Worksite Traffic Supervisor shall be available on a twenty-four (24) hour day basis and shall review the project on a day to day basis as well as being involved in all changes to traffic control.
    d. The Worksite Traffic Supervisor shall have access to all equipment and materials needed to maintain traffic control and handle traffic related situations.
    e. The Worksite Traffic Supervisor shall insure that routine deficiencies are corrected with a twenty-four (24) hour period.
    f. The Worksite Traffic Supervisor shall be available on the site within forty-five (45) minutes after notification of an emergency situation, prepared to positively respond to repair the work zone traffic control or to provide alternate traffic arrangements.
    g. Failure of the Worksite Traffic Supervisor to comply with these provisions may be grounds for decertification or removal from the project or both.
    h. Failure to maintain a designated Worksite Traffic Signal Supervisor or failure to comply with these provisions will result in

temporary suspension of all activities except traffic and such other activities deemed to be necessary for project maintenance and safety.

B. Traffic Safety and Flow: Flow of traffic shall not be interrupted completely without the approval of the City. Restriction and minor diversion will be kept to a minimum. No work will be permitted in the traffic lanes during peak hours from 7:00 to 9:00 AM and 4:00 to 6:00 PM Monday through Friday. Any open cuts in the intersections during these hours will be covered with steel plates to maintain uninterrupted traffic.

C. Contractor shall provide flagmen to direct traffic when directed by the City. This does not relieve Contractor of responsibility of taking other steps and providing other personnel who he may deem necessary for protection of work and public.

   I. Flagmen shall be certified flagmen or off-duty uniformed peace officers of the law.

D. Appropriate Personal Protective Equipment shall be worn by all contract personnel when on the job-site.

3.09 INSTALLATION

A. Material should be installed according to the technical specifications, drawings and standard details under the direction of the Owner.

B. All proposed changes in the signalization plan must be submitted to the Owner, in writing, for approval.

C. The Contractor shall be responsible for the protection of all present utilities that have been located by the various utility companies.

D. The Contractor shall maintain and protect the existing traffic signals and their related equipment from damage caused by subcontractors and employees under his Contract but only to the extent of the Contractor's normal work operation, and he shall not be responsible for routine maintenance, normal wear and tear, or an act of God, unless otherwise specified.

E. The Contractor shall bag all newly installed signal heads and/or pedestrian signal heads with burlap until final inspection and acceptance by the City. The signal shall be wrapped with burlap at least twice so that the entire signal head is covered, and cannot be seen until it is placed in operation.

F. The signal shall be de-energized while not in use.

G. If, in the opinion of the City, the new heads would create a hazard condition to motorists and/or pedestrians, the heads shall not be installed until one hour before turning on the new equipment. If the intersection is built in phases it is the responsibility of Contractor to coordinate with the City as to when each phase will be completed.

H. All existing traffic signal equipment removed by the Contractor shall be tagged to identify location.

I. A representative of Traffic Engineering and Operations shall be given 24 hour notice before delivery of existing traffic signal equipment to an approved location by City.

J. Equipment not identified will not be accepted and equipment not returned will result in the withholding of payment to the Contractor. Traffic Engineering and Operations personnel will issue a receipt to Contractor for returned equipment.

K. When the City determines that the need for a traffic signal is critical to the public welfare, early "turn on" of the signal shall be required before the completion of the project.
   1. If the need arises, the City will assume the responsibility for maintenance and liability, or negotiate with the Contractor for maintenance and liability for such a signal.
   2. The City may, at any time, authorize their personnel to enter the controller cabinet in order to restore any and all signal equipment to proper operation if the malfunction or nonfunction of such equipment poses a hazard or inconvenience to motorists or pedestrians.
   3. Such authorized entry may occur at any time within the period of the Contract and such authorized entry shall in no way relieve the Contractor or manufacture of their respective warranties.

L. Operate completed traffic signal installations continuously for at least 30-days in a satisfactory manner. If any Contractor-furnished equipment fails during the 30-day test period, repair or replace that equipment. This repair or replacement, except lamp replacement, will start a new 30-day test period. Replace materials that are damaged or have failed prior to acceptance. Replace failed or damaged existing signal system components when caused by the Contractor. The City will relieve the contractor of maintenance responsibilities upon passing a 30-day performance test of the signal system and acceptance of the contract.

M. During the burn-in period, the Contractor shall respond to malfunctions within one (1) hour after notification and restore operation of the installation within four (4) hours after notification of a malfunction. If the Contractor does not respond or restore operation within allotted times, the City shall have the option of making the necessary repair and billing the Contractor for the actual time and materials required.

N. When replacing sidewalks or curb and gutters, it shall be the responsibility of the Contractor to reinstall them to match existing color and/or surface texture.

O. Materials specified herein shall be installed as per Traffic and Transportation Construction Details drawings and as specified.

P. The Contractor shall be responsible for having an authorized manufacturer representative of traffic control equipment present for starting the system. Each work order or intersection shall be a stand alone "Turn Key Job" by the Contractor.

Q. Flexible stainless steel cable ties for strapping signal cable to messenger shall be min: 13.38 inches long, 120 lb. min. tensile holding strength, 3/16" to 3-1/2" wire bundle range. (Panduit Part #MLT 4H-LP or approved equal).

3.10 APPARATUS LOCATION

A. The locations of all poles, controllers, actuators and signals shown on the plans are diagrammatic only. The specific locations of such devices shall be decided by the appropriate design personnel or the City and shall be staked out under their direction. Vehicular and pedestrian traffic signals shall be placed and aligned as directed by the City.

3.11 CONCRETE POUR

A. The time of day of the concrete pour shall be stipulated by the Contractor but must fall within any time restrictions (typically due to lane closures) set by the City.

B. Honeycombed surfaces or other defects shall be patched with mortar of the same consistency as the mortar from which the concrete is made. Such mortar shall be well trowelled and then floated to remove trowel marks.

C. Finish for Formed Surfaces After patching above specified, exposed formed surfaces shall be finished by removing form marks, fins and other projections.

D. Finish for Uniformed Surfaces

I. Patches in streets, driveways and walks shall be finished to match adjacent surfaces.
II. Surfaces not Otherwise Specified – Steel trowel finish.

E. Immediately after placing or finishing, concrete surfaces shall be protected against moisture loss for a minimum of seven (7) days. Wet earth, waterproof paper, vinyl sheets or cotton mats shall be placed over concrete during curing period in order to insure fulfillment of this requirement. Membrane curing method may be used EXCEPT when concrete surfaces are to receive additional concrete or mortar, or are to be painted.

3.12 POLE RAKING

A. Poles shall be set with a sufficient amount of rake so that they are plumb with the signal load or slightly raked away from the signal load. Cantilever pole structures and 4-1/2" OD steel poles should be plumb, strain poles should have a slight backward rake (1 to 2 inches); wood poles shall utilize down guys to maintain appropriate signal height clearance during construction. The Contractor shall rake the poles to the satisfaction of the Traffic Signal Inspector. Rake is hereby defined as the inclination to the vertical measured at the top of the structure in the opposite direction of the strain axis.

3.13 RESTORING DAMAGED AREAS

A. For work at identified intersections and along communication cable routing, in the event that sidewalks, pavement, curbs, wheelchair ramps, driveways, landscaped areas, areas with special pavement treatment, sprinkler systems, lighting systems, or other items or properties both public and private that are damaged during this construction, shall be restored to their prior condition without expense to the City or third parties. No separate payment will be made for the restoration of these items. Where signal poles are installed inside the existing 4 foot sidewalk or within 12 inches of either side of the existing sidewalk, the Contractor shall provide a minimum of 4 foot paved sidewalk 12 inches away from edge of the signal pole. The horizontal slope for the sidewalk shall be a maximum of 2 percent.

B. Repairs shall be in accordance with the City's requirements and standard specifications for the items being repaired.

3.14 CLOSEOUT SUBMITTALS

A. Maintain in proper order and in good, clean condition at the project sites, one complete set of prints of all project drawings. On this set of drawings, the Contractor shall neatly print and accurately inscribe, in red pencil, any and all changes or deviations from construction and installation as originally indicated in the plans and specifications. This set of prints shall be delivered to the City at the time of final acceptance of the work by the City in order to provide the City with an "AS BUILT" set of plans.

END OF SECTION

SECTION 34 41 13.02
TRAFFIC SIGNAL POLES (INSTALL ONLY)

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes installation of ornamental or galvanized traffic signal pole assemblies, including anchor bolts. Pole types include mast arm poles, strain poles, pedestrian poles, and camera poles.

B. For City-funded traffic signal work, the City shall supply the poles to the contractor.

1.02 MEASUREMENT AND PAYMENT

A. Measurement - Traffic Signal Pole Assemblies will be measured by each traffic signal pole installed.

B. Payment - The work performed in accordance with this item will be paid for at the unit price bid for “Traffic Signal Pole Assemblies (Ornamental)” or “Traffic Signal Pole Assemblies (Galvanized)” of the various types and sizes as specified. This price is full compensation for erecting the pole upon a foundation; erecting required mast arms and installing luminaires; placing anchor bolts, installing nuts, washers, and templates; and furnishing equipment, materials, labor, tools, and incidentals.

PART 2 - PRODUCTS

2.01 PRODUCTS, GENERAL

A. Anchorage: Steel anchor bolts for each pole, complete with double hex nuts, lock washers and flat washers will be supplied to the contractor by the City. Once received, it is the responsibility of the contractor to maintain anchorage in new condition until accepted by city. Protect against damage or loss or replace at no cost to the City.

B. Pole bases: Request that the City of Sugar Land logo is stamped on each signal pole base during the order. The City logo shall be placed in the top ring of the base.

PART 3 - EXECUTION

3.01 Installation

A. Locate traffic signal poles as shown on the plans unless otherwise directed to secure a more desirable location or to avoid conflict with utilities. Stake the traffic signal pole locations for verification by the Engineer.

B. Construct foundations in accordance with Section 34 41 13.03 “Drilled Shafts”. Orient anchor bolts as shown on the plans. Pedestrian poles may use screw in foundations if shown on plans or as directed by the City.

C. Use established industry and utility safety practices when working near underground or overhead utilities. Consult with the appropriate utility company before beginning such work.

D. Erect structures after foundation concrete has attained its design strength as required. Coat anchor bolt threads and tighten anchor bolts in accordance with manufacture recommendations and industry standards.

E. After the traffic signal pole assembly is plumb and all nuts are tight, tack-weld each anchor bolt nut in 2 places to its washer. Tack-weld each washer to the base plate in 2 places. Do not weld components to the bolt. After tack-welding, repair galvanizing damage on bolts, nuts, and washers.

F. Do not grout between the base plate and the foundation.

END OF SECTION

SECTION 34 41 13.03
DRILLED SHAFT FOUNDATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. This item includes Drilled Shaft Foundations consisting of reinforced or concrete drilled shafts for traffic signal poles.

1.02 MEASUREMENT AND PAYMENT

A. Measurement

1. This item will be measured will be measured by the foot from the top to the bottom of the shaft.

B. Payment:

1. The work performed and materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid for “Drilled Shaft Foundations” of the of the specified diameter. The unit prices bid for the various classifications of drilled shafts will be full compensation for excavation; furnishing, placing, and removing casing; furnishing, processing, and recovering slurry; pumping; furnishing, and placing reinforcing steel; furnishing and placing concrete, including additional concrete required to fill an oversize casing or oversize excavation; conducting slump loss tests; backfilling; disposing of cuttings and slurry; and materials, tools, equipment, labor, and incidentals.
2. When the bottom of a drilled shaft is placed at an elevation below plan grade, no direct payment will be made for extra reinforcement placed to support the cage. The extra reinforcement will be considered subsidiary to the price bid per foot of shaft. No extra payment will be made for casings left in place.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Unless otherwise shown on the plans, use Class C concrete for drilled shafts

C. Use coarse aggregate Grade 4, 5, or 6 for drilled shaft concrete in reinforced drilled shafts. Grade 2 or 3 may be used if the shaft is dry and reinforcing steel has a 5-in. minimum clear spacing.

D. Use a water-reducing, retarding admixture in accordance with DMS-4640, "Chemical Admixtures for Concrete," in all concrete when using casing that will be pulled or when placing shafts underwater or under slurry.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Use concrete with the following slump
   1. Dry: 5 ½" to 7 ½" with a recommended slump of 6 ½".
   2. Underwater and under slurry: 7" to 9" with a recommended slump of 8".

B. When casing is to be pulled or when concrete is to be placed underwater or under slurry, perform a slump loss test in accordance with Tex-430-A before beginning work. Provide concrete that will maintain a slump of at least 4 in. throughout the entire anticipated time of concrete placement. Time of concrete placement is described in Sections 3.01.J, "Concrete," and 301.K, "Additional Requirements for Slurry Displacement or Underwater Concrete Placement Methods." Note the temperature of the concrete mix at the beginning of the slump loss test. If concrete temperature at the time of placement into the drilled shaft is more than 10° higher than the slump loss test temperature, do not place the concrete. Use ice or other concrete cooling ingredients to lower concrete temperature, or run additional slump loss tests at the higher temperatures. Slump loss testing will be waived if anticipated time of concrete placement is less than 90 minutes.

C. Use drilling slurry that meets the requirements of the table below, as determined by Tex-130-E, if needed.

Slurry Requirements

Before Introduction into the Excavation		Sampled from the Bottom of the Excavation before Concreting		
Specific Gravity	**Sand Content**	**Specific Gravity**	**Viscosity (seconds)**	**Sand Content**
≤ 1.10	≤ 1%	≤ 1.15	≤ 45	≤ 6%

D. Use mineral slurry consisting of processed bentonite or attapulgite clays mixed with clean fresh water. Do not use PHPA (partially hydrolized polyacrylamide) polymeric slurry or any other fluid composed primarily of a polymer solution. Before placing concrete, sample slurry from the bottom of the hole, and test it in accordance with Tex-130-E. Use a pump or air lift to remove slurry that does not meet the specified requirements while adding fresh clean slurry to the top of the hole to maintain the slurry level. Continue this operation until the slurry sampled from the bottom of the hole meets the requirements.

E. Place the shaft to within the following tolerances.
   1. Vertical plumbness – 1 in. per 10 ft. of depth.
   2. Center of shaft located under column – 1 in. of horizontal plan position.
   3. Center of shaft located under footing – 3 in. of horizontal plan position.

F. Excavation.
   1. The plans indicate the expected depths and elevations for encountering satisfactory bearing material. Excavate as required for the shafts through all materials encountered to the dimensions and elevations shown on the plans or required by the site conditions. If satisfactory founding material is not encountered at plan elevation, adjust the bottom of the shaft or alter the foundation, as determined by the City, to satisfactorily comply with design requirements. Blasting is not allowed for excavations. If caving conditions are encountered, stop drilling and adopt a construction method that stabilizes the shaft walls.
   2. Do not excavate a shaft within 2 shaft diameters (clear) of an open shaft excavation, or one in which concrete has been placed in the preceding 24 hours.
   3. Dispose of material excavated from shafts and not incorporated into the finished project. Dispose of excavated material in accordance with the plans and with federal, state, and local laws.
   4. Provide suitable access, lighting, and equipment for proper inspection of the completed excavation and for checking the dimensions and alignment of shafts.

G. Casing.
   1. Use casing when necessary to prevent caving of the material or to exclude ground water. Provide casing with an outside diameter not less than the specified diameter of the shaft. Use casing strong enough to withstand handling stresses and pressures of concrete and of the surrounding earth or water, and that is watertight, smooth, clean, and free of accumulations of hardened concrete.
   2. Drill the portion of the shaft below the casing as close as possible to the specified shaft diameter. The portion of shaft below the casing may be as much as 2 in. smaller than the specified shaft diameter.
   3. Use construction methods that result in a minimal amount of disturbed soil being trapped outside the casing. This does not apply to temporary undersized casings used to protect workers inside shafts or to drilled shafts designed for point bearing only.
   4. Do not leave any casing in place unless authorized or shown on the plans. Do not extract casing until after placing the concrete to an appropriate level. Maintain sufficient concrete in the casing at all times to counteract soil and water pressure. Before and during concrete placement, rotate or move the casing up or down a few inches if necessary to facilitate extraction of the casing.

H. Requirements for Slurry Displacement Method.
   1. Unless otherwise shown on the plans, the slurry displacement method may be used to construct drilled shafts. Use this method to support the sides of the excavation with processed mineral slurry that is then displaced by concrete to form a continuous concrete shaft.
   2. Do not use casing other than surface casing. Do not use surface casing longer than 20 ft. without approval. Do not extract the surface casing until after placing the concrete.

3. For slurry mixed at the project site, pre-mix it in a reservoir of sufficient capacity to fill the excavation and for recovery of the slurry during concrete placement. Do not mix slurry in the shaft excavation or other hole. Allow adequate time for hydration of the slurry prior to introduction into the excavation.
4. During and after drilling maintain a head of slurry in the shaft excavation at or near ground level or higher as necessary to counteract ground water pressure.
5. Just before placing reinforcing steel, use an air lift or proper size cleanout bucket to remove any material that may have fallen from the sides of the excavation or accumulated on the bottom after the completion of drilling. Use a cleanout bucket if material is too large to be picked up with an air lift.
6. If concrete placement is not started within 4 hours of the completion of the shaft excavation, reprocess the hole with the auger as directed. Then clean the bottom with an air lift or cleanout bucket, and check the slurry at the bottom of the hole for compliance with the slurry requirements.
7. If the slurry forms a gel before concrete placement, agitate the congealed slurry to liquefaction just before concrete placement and whenever directed.
8. Recover and dispose of all slurry as approved by the City, and in accordance with all federal, state, and local laws. Do not discharge slurry into or in close proximity to streams or other bodies of water.

I. Reinforcing Steel.

1. Completely assemble the cage of reinforcing steel, and place it as a unit immediately before concrete placement. The cage consists of longitudinal bars and lateral reinforcement (spiral reinforcement, lateral ties, or horizontal bands). If overhead obstacles prevent placement of the cage as a single unit, connect individual segments with couplers or by lapping steel as approved.
2. If the shaft is lengthened beyond plan length, extend the reinforcing steel cage to the bottom. Bars used to extend or support the cage may be lap spliced or welded by a qualified welder. Place the extension at the bottom of the shaft. If using spiral reinforcement, tie it to the longitudinal bars at a spacing of at most 24 in., or as required for a stable cage. Do not weld lateral reinforcement to longitudinal bars unless otherwise shown on the plans.
3. Center the reinforcing steel cage in the excavation using approved centering devices. Use enough devices to hold the cage in position along its entire length. Do not use square concrete spacer blocks in cased shafts.
4. Support or hold down the cage to control vertical displacement during concrete placement or extraction of the casing. Use support that is concentric with the cage to prevent racking and distortion of the steel.
5. Check the elevation of the top of the steel cage before and after concrete placement or after casing extraction when casing is used. Downward movement of the steel up to 6 in. per 20 ft. of shaft length and upward movement of the steel up to 6 in. total are acceptable.
6. Maintain the minimum length of steel required for lap with column steel. Use dowel bars if the proper lap length is provided both into the shaft and into the column. Locate and tie all dowel bars into the cage before placing concrete or insert dowel bars into fresh, workable concrete.
7. Locate and tie anchor bolts when required prior to placement of concrete. Use templates or other devices to assure accurate placement of anchor bolts.

J. Concrete.
   1. Form portions of drilled shaft that project above natural ground. Remove loose material and accumulated seep water from the bottom of the excavation before placing concrete. If water cannot be removed, place concrete using underwater placement methods.
   2. Place concrete as soon as possible after all excavation is complete and reinforcing steel is placed. Provide workable concrete that does not require vibrating or rodding. Vibrate formed portions of drilled shafts.
   3. Place concrete continuously for the entire length of the shaft. For dry shafts of 24 in. or smaller diameter, limit free fall of concrete to 25 ft. Use a suitable tube or tremie to prevent segregation of materials. Use a tube or tremie in sections to provide proper discharge and to permit raising as the placement progresses. For dry shafts over 24 in. diameter, concrete can be allowed to free fall an unlimited distance if it does not strike the reinforcing cage or sides of the hole during placement. When free fall is used, provide a hopper with a minimum 3-ft.-long drop tube at the top of the shaft to direct concrete vertically down the center of the shaft. Do not use a shovel or other means to simply deflect the concrete discharge from the truck.
   4. For cased shafts, maintain a sufficient head of concrete at all times above the bottom of the casing to overcome hydrostatic pressure. Extract casing at a slow, uniform rate with the pull in line with the axis of the shaft. Monitor the concrete level in the casing during extraction. Stop the extraction and add concrete to the casing as required to ensure a completely full hole upon casing removal. The elapsed time from the mixing of the first concrete placed into the cased portion of the shaft until the completion of extraction of the casing must not exceed the time for which the concrete maintains a slump of over 4 in. If the elapsed time is exceeded, modify the concrete mix, the construction procedures, or both for subsequent shafts.
   5. Cure the top surface and treat any construction joint area.

K. Additional Requirements for Slurry Displacement or Underwater Concrete Placement Methods.
   1. Place concrete on the same day that the shaft is excavated and as soon as possible after all excavation is complete and reinforcing steel is placed. Use an air lift or cleanout bucket of the proper size to clean the bottom of the excavation prior to placing the reinforcing steel cage and concrete. Place concrete through a closed tremie or pump it to the bottom of the excavation. Initially seal the tremie or pump line to positively separate the concrete from the slurry or water. Place concrete continuously from the beginning of placement until the shaft is completed. If using a tremie, keep it full of concrete and well submerged in the previously placed concrete at all times. Raise the tremie as necessary to maintain the free flow of concrete and the stability of any casing used. If using a pump, keep the discharge tube submerged in the previously placed concrete at all times. Place additional concrete to ensure the removal of any contaminated concrete at the top of the shaft. At the completion of the pour, allow the top portion of concrete to flush completely from the hole until there is no evidence of slurry or water contamination. Do not attempt to remove this concrete with shovels, pumps or other means. Level the top of shaft with hand tools as necessary.

2. Use a sump or other approved method to channel displaced fluid and concrete away from the shaft excavation. Recover slurry and dispose of it as approved. Do not discharge displaced fluids into or in close proximity to streams or other bodies of water. For pours over water, provide a collar or other means of capturing slurry and the top portion of concrete flushed from the shaft.
3. If concrete placement is interrupted due to withdrawal of the submerged end of the tremie or pump discharge tube before completion, remove the tube, reseal it at the bottom, penetrate with the tube into the concrete already placed by at least 5 ft., and recharge it before continuing.
4. The elapsed time from the mixing of the first concrete placed until the completion of concrete placement, including extraction of the casing, must not exceed the time for which the concrete maintains a slump of over 4 in. If the elapsed time is exceeded, modify the concrete mix, the construction procedures, or both for subsequent shafts.

END OF SECTION

SECTION 34 41 13.04
VEHICLE SIGNAL HEADS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes polycarbonate Vehicle Signal Heads with vehicle signal housings, light emitting diode (LED) lamp indications, back plates, Geometrically Programmed Louvers (GPL) and mounting attachments.

B. Vehicle signal housings supplied under this specification shall be selected from the TxDOT Approved Products List.

C. Light emitting diode (LED) lamp indication shall be General Electric GTx LED balls and General Electric GT1 LED arrows. All lenses shall be clear.

D. Mounting clamp kits shall be the SkyBracket cable clamp kit. Cable lengths shall be of appropriate lengths.

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement:

1. Vehicle Signal Sections will be measured by each vehicle signal section assembly (housing) with the LED indication color type specified with required mounting hardware.
2. Geometrically Programmed Louver (GPL) and adjustable full-circle visor will be measured as each unit required.
3. Back plates (black) will be measured as each unit required.

B. Payment

1. Payment for the work performed and materials furnished in accordance with this specification will be paid for at the unit price bid for each item listed in Measurement.
2. Complete assembled vehicle signal heads shall consist of one or more vehicle signal section with housing, LED indication(s), visor(s), mounting hardware, louvered back plates and any miscellaneous items required. The vehicle signal head housings, doors and visors shall be black unless otherwise specified on plans or by the City. The assembly and installation will be subsidiary to the various bid items.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

2.02 VEHICLE SIGNAL HEADS

A. Each traffic signal face shall consist of one or more signal sections rigidly fastened together as per manufacturer's recommendations in such a manner as to present a continuous pleasing appearance.

B. All material for the mounting attachments shall be metal.

C. Each traffic signal housing door shall be equipped with an easily detachable standard tunnel visor (unless requested otherwise). The visor shall be a polycarbonate resin to match the housing and door. The visor shall be rigidly attached to the door with rust-resistant connections in a manner that will prevent the leakage of light and moisture throughout the periphery of attachment.

D. Unless requested otherwise, the visor on the front of each door shall:

1. Be circular in section
2. Have a downward tilt of 2 to 8 degrees
3. Encompass approximately 300 degrees of the lens
4. Extend outward from the face of the lens a minimum of 9-1/2" (240 mm) for 12-inch (300 mm) diameter lens, (measured at its outer visible circumference)
5. Be of such design that the encircled portion of the lens will not be visible in the profile view of the traffic signal face
6. Be open at the bottom so as to prevent the accumulation of snow, dirt, and rain.

E. Visors shall be easily removed and replaced without damage to visor or signal head.

F. The four (4) tabs used to mount the visor to the signal shall be slotted. It shall not be necessary to completely remove the mounting screws to remove or replace the visor.

2.03 VEHICLE SIGNAL HEAD BACK PLATE

A. The back plate shall be attached to all new vehicle signals.

B. Back plates shall be vacuum formed ABS plastic or aluminum.

C. Vacuum formed ABS plastic back plates shall contain ultraviolet inhibitors and stabilizers for protection against UV degradation.

D. The back plate shall extend around the periphery of the signal face a distance of five (5) inches for faces with twelve (12) inch lenses, and shall have a 3" corner radius.

E. ABS vacuum formed back plates shall be black and color consistent throughout the entire piece without varying shades and tones.

F. The back plate shall be pre-drilled to fit the vehicle signal head for which it is designed.

G. ABS vacuum formed back plates shall have a minimum thickness of .125". All outside edges shall be formed with a ½" to 5/8" flange (inside dimension) turned away from the front surface. The back plate shall have a haircell finish on the front side and smooth finish on the back side.

H. Aluminum back plates shall be fabricated from anodized sheet aluminum and be painted dull black.

I. Stainless steel hardware for attaching the back plate to the vehicle signal head shall be provided.

2.04 GEOMETRICALLY PROGRAMMED LOUVER (GPL)

A. The louver shall have the following capabilities:

1. Fit all manufacturers' 12" vehicle signal heads.
2. Retrofit into existing 12" vehicle signal heads.
3. Provide a full round ball display, with minimum slat effect, throughout the selected view range.
4. Provide an absolute exact visual cut-off.
5. Allow the view angle within each signal section to be adjusted to a designated area.
6. Have minimum glow outside the view range.
7. Allow for controlling either the horizontal or vertical view range within the signal visor.

B. The louver housing shall consist of a two-piece assembly injection molded from black UV inhibited ABS plastic. Two (2) brass inserts shall be molded into the bottom half allowing the assembly to be fastened together with two (2) stainless steel screws.

C. The louver housing O.D. shall be 11-1/2" and have spherical contour which allows the light beam from the signal section to be directed up to 10-degrees in all directions from the centerline of the visor/lens system.

D. The inside surface shall have a multiplicity of grooves for positioning light directing baffles. The remaining inside surface shall be grooved to prevent surface reflections of light.

E. Two (2) sponge neoprene O-rings shall be positioned in grooves on the outside surface to prevent light leakage between the housing and the visor.

F. The louver housing design shall allow the baffle positions to be changed in order to adjust the view angle.

G. The baffles shall be molded from flat black, 10% glass filled UV inhibited virgin polycarbonate.

H. Each baffle shall be thin opaque disc with a multiple of parallel evenly spaced apertures (openings). Each structural member forming the aperture shall have a cross section which allows for good stiffness and structural integrity, but shall have a thin edge to prevent reflection (glow) outside the desired viewing range.

I. All baffles shall be identical in design and interchangeable within the housing. The plane of each baffle shall be 90-degrees to the centerline axis of the housing.

J. The louver shall be supplied with the necessary self-threading screw hardware to attach the louver to the vehicle signal head visor.

K. The louver shall include an installation kit that includes installation instructions, adjustment tool, visor marking template, and all incidentals necessary for attachment and positioning of the louver.

2.05 MOUNTING ATTACHMENTS

A. All mounting attachments shall be aluminum. Provision shall be made for carrying the signal leads enclosed in the mounting attachment. The mounting attachment, together with supporting arms and assembled housings, shall comprise a dust-and-moisture-proof enclosure for optical units and lead wiring. Mounting attachments shall be of one of the following types as specified for the particular vehicle signal head required.

1. Span-Wire Mounting (only for temporary construction). The span-wire mounting attachment shall consist of a cable clamp to receive a suspension cable of 3/8" (10 mm) diameter together with a suitable connection to the signal head. The mounting shall provide a "balance adjuster" between the signal head and span wire capable of permitting freedom of movement with reference to the point of suspension. The signal head shall be adjustable by rotation about its vertical axis in a horizontal plane and the mounting attachment shall be so constructed that the head may be firmly clamped in any position throughout the range of adjustment. The mounting shall provide a suitable outlet for wiring from the signal head tilted downward and so constructed as to effectively seal the interior of the head from dust and moisture and prevent undue abrasion of signal wiring. Mountings for signal head units not balanced at the point of support shall be provided with a suitable compensating device to insure that the signal head will assume a normally vertical position.
2. Mast-Arm Mounting. The mast-arm vehicle signal head mounting hardware shall be SkyBracket cable clamp bracket assembly. The 1-1/2” pipe attached to signal head shall be directly connected to SkyBracket mount so that the centerline of signal head lines up with centerline of mast arm and parallel to roadway. No elbows shall be used unless instructed by the City. Five-section vehicle signal heads require two SkyBracket assemblies for mounting.
3. Side-of-Pole Mounting. Supports for side-of-pole mounting of the signal head in a vertical position shall be 1-1/2" standard pipe bracket arms, attached to the top and bottom of the signal head with pipe nipples, serrated elbows and collared / cast nipples and band-on pole plates. Pole plates shall be provided with a cable guide. The mounting assembly shall consist of two standard pipe sections

extending 12-3/4" from and at right angles to the axis of rotational adjustment of the signal head. Both supports shall have running threads at least 1-1/4" long at the pole connection end. The signal head shall be adjustable, by rotation of the various signal faces about their vertical axis, throughout a radial angle of 360 degrees and shall be capable of being rigidly clamped in any position through the range of adjustment. The wiring from the signal head shall be able to be enclosed in the top or bottom support.

2.06 LIGHT EMITTING DIODE (LED) LAMP INDICATIONS

A. Light emitting diode (LED) lamp indication shall be General Electric GTx LED balls and General Electric GT1 LED arrows.

B. All LEDs shall have clear lenses.

C. LEDs must meet or exceed ITE intensity, color and uniformity specification. Lenses should have uniform (non-pixelated) appearance.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 34 41 13.05
COUNTDOWN PEDESTRIAN SIGNAL HEADS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for furnishing Countdown Pedestrian Signal Heads consisting of LED countdown pedestrian signal modules, housing, zigzag visor, and mounting attachments.

B. LED countdown pedestrian signal modules and housing supplied under this specification shall be selected from the TxDOT Approved Products List.

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement:

1. Countdown Pedestrian Signal Heads will be measured by each pedestrian signal section assembly (16” x 18” housing) with zigzag visor, LED countdown pedestrian module and required mounting hardware.

B. Payment

1. Payment for the work performed and materials furnished in accordance with this specification will be paid for at the unit price bid for each item listed in Measurement.
2. Complete assembled countdown pedestrian signal heads shall consist of LED countdown pedestrian module with housing, zigzag visor and any miscellaneous items required. The pedestrian signal head housings shall be black unless otherwise specified on plans or by the City. The assembly and installation will be subsidiary to the various bid items.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

2.02 MOUNTING ATTACHMENTS

A. Provide clamshell side mount hardware. Mounting height shall be 7'-0" minimum to the bottom of the housing. Pedestrian signal should be mounted to align with crosswalk being controlled.

B. Flat Black Finish: Signal housing and mounting attachments shall be primed and finished with a flat black paint finish. Finish shall be cured for a minimum of twenty (20) minutes at 350 degrees F.

2.03 PEDESTRIAN LED MODULES

A. Fully compliant with the latest ITE Pedestrian Traffic Signal Indication (PTCSI) LED Specification.

B. LED module must be of uniform appearance (non-pixelated).

C. The module shall be a single, self-contained device, not requiring on-site assembly for installation into a 16"x18" traffic signal housing.

D. The modules shall operate from a 60±3 Hertz ac line power over a voltage range from 80 VAC RMS to 135VAC RMS.

E. Must be compliant with latest Texas MUTCD for countdown applications

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 34 41 13.06
ACCESSIBLE PEDESTRIAN PUSH BUTTON SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for accessible pedestrian push button station (APS) assemblies with control units and mounting hardware.

B. APS shall be Polara 2-Wire Navigator Control Unit with Nav 2 Wire push button stations (or in case of end of life, should use the equivalent upgraded model from Polara). Color shall be black.

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Accessible Pedestrian Push Button System will be measured by each intersection complete with all push button assemblies and necessary central control unit.
2. Payment for the work performed and materials furnished in accordance with this item will be paid for at the unit price bid for “Accessible Pedestrian Push System.” The price shall be full compensation for furnishing, assembling, installing, made fully operational and testing the unit, as well as all mounting attachments, labor, tools, equipment, and incidentals necessary to complete the work.

   The sign attached to the Accessible Pedestrian Push Button Station will not be measured or paid for directly but will be subsidiary to this Item.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

2.02 WARRANTY

A. A minimum guarantee for both materials and workmanship shall be provided for the products bid as specified. The guarantee (warranty) period shall begin the day the City officially accepts the item. Any guarantee work is to be completed within 15 days after receipt of notice of material deficiencies.

B. Material, workmanship and labor furnished shall be covered by Supplier(s)/Manufacturer(s) guarantee and/or warranty for a minimum period of thirty-six (36) months. Warranty period shall begin the day the item is received by the City, either as new order or warranty repair. Bidder shall also be required to have resources to complete any required warranty work within fifteen (15) days after receipt of found defective item. The City's preference is for all non-warranty service to be charged a singular flat-rate. Successful bidder will include flat rate repair cost, if available in bid document for all non-warranty covered repairs. If flat rate repair charge is not available, then Supplier(s)/Manufacturer(s) will provide current hourly labor rate, along with any associated minimum charges that may apply.

1. Successful bidder shall bear all expenses connected with return of any material which the City deems necessary to return for adjustments during guarantee period. Said work shall be done by manufacturer's representative at no cost to the City.
2. The City may perform random sample testing on all shipments. Random sample testing will be completed within 45 days after delivery. The number of modules tested shall be determined by the quantity of each shipment. The City will determine the sampling parameters to be used for the random testing. Acceptance or rejection of the shipment shall conform to ANSI/ASQC Z1.4 for random sampled shipments.
3. The City reserves the right to withhold payments which may be due, should it be discovered that material does not meet specifications and/or claims of bidder.
4. Supplier(s)/Manufacturer(s) shall make all engineering data, diagrams, software changes or improvements, which increases performance of equipment purchased under this bid, available to the City at no additional cost during guarantee period.
5. Supplier(s)/Manufacturer(s) shall have field engineers or technicians available on request to assure satisfactory initial operation, and to consult with City, or his representative, on any special circuitry that may be required in certain applications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Unless specified otherwise, wire the APS to the nearest splicing point or terminal strip using stranded No. 12 AWG XHHW wire with 600-volt insulation. Do not use terminal connections or splice wire leads except in the hand holes located in the signal pole shaft, in the signal pole base, or at locations approved by the City. All allowed splices must be watertight. Attach wires to terminal posts with solderless terminals. Attach terminals to the wires with a ratchet-type compression crimping tool properly sized to the wire. Remove any burrs or rough edges on any holes drilled for wire entry to APS push buttons. Ensure push button stations are mounted at the proper height and orientation. Provide a neat workmanship in the installation of any wiring harnesses, control units, wiring panels, push button stations. Follow manufacturer’s recommendations regarding installation and weatherproofing.

END OF SECTION

SECTION 34 41 13.07
PEDESTRIAN PUSH BUTTON STATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for pedestrian push button station assemblies with mounting hardware.

B. Pedestrian push button shall be:
   1. Polara Bulldog III, Model# BDL3-B. Pushbutton shall be round with stainless steel button and black body unless otherwise instructed by City.
   2. Mounting hardware: Polara aluminum cup Model# APBC-x. Aluminum cup shall be black unless otherwise specified by City.

   No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices:

   1. Pedestrian Push Button Stations will be measured by each push button assembly and sign.
   2. Payment for the work performed and materials furnished in accordance with this item will be paid for at the unit price bid for “Pedestrian Push Button Station.” The price shall be full compensation for furnishing, assembling, installing, made fully operational and testing the unit, as well as all mounting attachments, labor, tools, equipment, and incidentals necessary to complete the work.

      The sign (R10-3e, size 9”x15”) attached to the Pedestrian Push Button Station will not be measured or paid for directly but will be subsidiary to this Item.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

2.02 WARRANTY

A. A minimum guarantee for both materials and workmanship shall be provided for the products bid as specified. The guarantee (warranty) period shall begin the day the City officially accepts the item. Any guarantee work is to be completed within 15 days after receipt of notice of material deficiencies.

B. Material, workmanship and labor furnished shall be covered by Supplier(s)/Manufacturer(s) guarantee and/or warranty for a minimum period of thirty-

six (36) months. Warranty period shall begin the day the item is received by the City, either as new order or warranty repair. Bidder shall also be required to have resources to complete any required warranty work within fifteen (15) days after receipt of found defective item. The City's preference is for all non-warranty service to be charged a singular flat-rate. Successful bidder will include flat rate repair cost, if available in bid document for all non-warranty covered repairs. If flat rate repair charge is not available, then Supplier(s)/Manufacturer(s) will provide current hourly labor rate, along with any associated minimum charges that may apply.

1. Successful bidder shall bear all expenses connected with return of any material which the City deems necessary to return for adjustments during guarantee period. Said work shall be done by manufacturer's representative at no cost to the City.
2. The City may perform random sample testing on all shipments. Random sample testing will be completed within 45 days after delivery. The number of modules tested shall be determined by the quantity of each shipment. The City will determine the sampling parameters to be used for the random testing. Acceptance or rejection of the shipment shall conform to ANSI/ASQC Z1.4 for random sampled shipments.
3. The City reserves the right to withhold payments which may be due, should it be discovered that material does not meet specifications and/or claims of bidder.
4. Supplier(s)/Manufacturer(s) shall make all engineering data, diagrams, software changes or improvements, which increases performance of equipment purchased under this bid, available to the City at no additional cost during guarantee period.
5. Supplier(s)/Manufacturer(s) shall have field engineers or technicians available on request to assure satisfactory initial operation, and to consult with City, or his representative, on any special circuitry that may be required in certain applications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Unless specified otherwise, wire the pedestrian push button using stranded two conductor No. 12 AWG XHHW wire with 600-volt insulation.

B. Do not use pole terminal connections or splice wire leads unless approved by the City. All allowed splices must be watertight.

C. Attach spade terminals to the wires with a ratchet-type compression crimping tool properly sized to the wire.

D. Remove any burrs or rough edges on any holes drilled for wire entry to push buttons.

E. Ensure push button stations are mounted at the proper height and orientation to meet ADA requirements.

F. Provide a neat workmanship in the installation of any wiring harnesses, control units, wiring panels, push button stations.

G. Follow manufacturer's recommendations regarding installation and weatherproofing. Silicon should be used to seal gaps where pushbutton makes connection with pole or ornamental base.

END OF SECTION

SECTION 34 41 13.08
TRAFFIC SIGNAL CONDUIT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for traffic signal conduit.

B. The Traffic Signal Conduit shall be selected from the TxDOT Approved Products List.

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement: This Item will be measured by the linear foot of the various sizes and types of conduit installed based on the type of surface as indicated in the bid item. Conduit shall be measured horizontally along the surface from center of pullbox to center of pullbox or foundation. Risers shall be measured as the amount of conduit extending from the ground surface.

B. Payment: The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Conduit” of the various types and sizes specified. The price shall be full compensation for furnishing and installing conduit; for directional drilling, boring, excavating, furnishing and placing backfill, replacing pavement structure, sod, riprap, curbs or other surfaces; for marking location of conduit (when required); for furnishing and installing all fittings, junction boxes, special radius sweeps, and expansion joints, conduit straps; and for all labor, tools, equipment and incidentals necessary to complete the work.

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified. Additional measurements or calculations will be made if adjustments of quantities are required due to an increase or decrease that exceeds 5%.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIRMENTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Traffic signal conduit installed above ground shall be rigid steel, hot-dipped, galvanized conduit. Underground conduit may be either rigid steel, hot dipped galvanized conduit

or Schedule 80 polyvinyl chloride (PVC) conduit, unless specified on the plans. Unless otherwise shown on the drawings, all conductors shall be in conduit except when in metal poles. All conduits and fittings shall be of the sizes and types shown on the drawings. Each section of conduit shall bear evidence of approval of Underwriter's Laboratories. The contractor may, at his own expense, use conduit of larger size than specified on the drawings providing that the larger size is used for the entire length of the conduit run.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. General: The contractor shall familiarize himself with the provisions of the General and Special Conditions in regard to permits, codes, laws and ordinances, and these provisions shall be controlling factors, except as specifically noted otherwise or supplemented herein. All work shall be done in accordance with the latest rules and regulations of the National Board of Fire Underwriters, the National Electrical Safety Code and all local ordinances.

B. Coordination: The work shall be carefully coordinated with work of other trades. Wherever work covered under this item, the order of work shall be carefully scheduled and coordinated to secure the completion of the various portions in the best possible manner. The rights of the various interests and the sequence when in dispute, shall be established by the Owner as to priority and scheduling shall be final and binding.

C. Placement:

1. Joints in conduit shall be cut square, reamed smooth and drawn up tight. Concealed conduit shall run in as direct a manner as practicable, with maximum radius bends of 60 degrees. Upward bends into ground boxes may be 90 degrees.

    a. Bends shall be free from dents or flattening.
    b. Not more than the equivalent of three quarter bends (two hundred seventy degrees) shall be used in any run between terminals, outlets and junction or pull boxes.
    c. Conduit joints shall be made with approved couplings and unions; where conduit cross expansion joints, expansion fittings shall be installed.

2. Conduit runs underground shall be installed a minimum of 24 inches below finished grade, except where it is impossible or impractical.

    a. Owner will be the sole judge of the permissible depth of conduit installation.
    b. The conduit shall be installed as shown on the plans or as directed by the Owner.

3. The conduit ends shall be capped or plugged until cabling and wiring operations commence.

4. Upon request of the Owner, the contractor shall draw a full-time metal brush, attached by swivel joint to a pull tape through "metal conduit" and a special template having a diameter not less than 75 percent of the inside diameter through PVC conduits to ensure that the conduit is clean and free from obstructions.

5. A nylon or non-metal pull tape shall be used in pulling cable and conductors through PVC conduit.

6. The conduits shall be placed as shown on the drawings or as directed by the Owner.

   a. Conduit placed for concrete encasement shall be secured and supported in such a manner that the alignment will not be disturbed during placement of the concrete.
   b. No concrete shall be placed until all of the conduit ends have been capped and all box openings closed.
   c. Boring is required for placing conduit under pavements.

7. Conduit which has been placed in position on the job site by others for this installation shall be checked to see that there are no obstructions in the conduit prior to threading the wire through. Any such obstructions shall be cleared without damage to the conduit, prior to installing cable.

8. Conduit runs shall be installed in such a manner as to minimize the accumulation of moisture at low points and pockets.

9. The components parts of conduits systems shall, in general, be of like material.

10. Where dissimilar metals are used together, suitable provisions shall be made to prevent galvanic action.

11. The ends of all conduit runs shall be closed immediately after installation to prevent the accumulation of water, dirt and other foreign material.

12. Conduit shall be swabbed out where necessary before conductors are pulled in.

13. Bends may be either factory or field made.

14. All 2 inch conduits shall be placed with special radius sweeps with a minimum radius of 18 inches. Standard bends shall not be allowed with 2 inch conduits.

D. Bonding: A No. 6 stranded soft bare copper bond wire shall be installed in each conduit. This bond wire shall be firmly attached to the grounding rod installed in each pull box and cabinet. The bond wire shall create a continuous grounding system for the entire conduit system. All conduits, including rigid metal, shall be bonded together with a No. 6 stranded bare copper wire and have continuity to every ground rod installed at each signal installation.

E. Pull Rope: A 5/16 inch nylon pull rope shall be installed in each conduit installed. A minimum of three feet of pull rope shall be coiled in each pullbox and cabinet.

F. Sealing:

1. After installation of cables and wires the conduits shall be sealed with a suitable electrical duct sealing compound to prevent the entrance of moisture or gases.
2. Electrical duct sealing compound must be a dough-like material, asbestos free, and have a flash point equal to or greater than 550 degrees F.

END OF SECTION

SECTION 34 41 13.09
TRAFFIC SIGNAL CABLE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes minimum requirements for traffic signal control cable and/or wire used in traffic signal installations.

B. The Traffic Signal Cable shall be stranded and selected from the TxDOT Approved Products List or the Manufacturer's recommended cable for specialty products.

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement - This item will be measured by the linear foot of traffic signal cables, as per the various sizes and types shown on the drawings. Measurement will not be made for cable inside signal heads and controllers and cable coiled pull boxes, in pole bases and coiled on span wires.

B. Payment - The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Traffic Signal Cables" of the various types and sized specified. This price shall be full compensation for furnishing and installing all materials, and for all, tools, equipment and incidentals necessary to complete the work.

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified. Additional measurements or calculations will be made if adjustments of quantities are required due to an increase or decrease that exceeds 5%.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Individual conductors must be copper with polyethylene insulation rated for 600 volts. Provide traffic signal cables in accordance with DMS-11110.

C. Provide traffic signal cables meeting the requirements of IMSA 20-1.

D. Unless otherwise shown on the plans, use conductors consisting of 7 copper strands.

E. For cables with more than 2 conductors, ensure individual conductors are laid up symmetrically in layers with fillers used when necessary, to produce a uniform assembly of conductors with a firm compact cylindrical core.

F. Ensure fillers are a non-metallic, moisture-resistant, non-wicking material.

G. Supply conductor assemblies that are covered with a wrapping of a moisture-resistant tape applied to overlap at least 10% of the tape width.

H. Ensure that the taped conductor assembly is covered with a tightly fitting black polyethylene jacket that is smooth and free from holes, splits, blisters, and any other imperfections.

I. Supply cables that clearly show the name of the manufacturer and the IMSA specification number applied at approximate 2-ft. intervals to the outer surface of the jacket by indent printing.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Splices are not permitted in cables unless shown on the plans or approved by the City in writing. Ensure that splices are watertight.

B. Test the cables after installation and prior to any connection to the cables. Cables testing less than 50 megohms insulation resistance at 500 volts will be rejected.

END OF SECTION

SECTION 34 41 13.10
PULL BOXES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes construction specifications for pull boxes of the various types and sizes complete with lids.

B. The Pull Boxes shall be selected from the TxDOT Approved Products List.

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement:
1. This item will be measured by each pull box complete in place.

B. Payment:
1. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Pull Boxes” of the types and sizes specified. This price is full compensation for excavating and backfilling; constructing, furnishing, and installing the pull boxes and concrete aprons; and equipment, labor, materials, tools, and incidentals.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Provide pull boxes and pull box covers constructed of polymer concrete. Metal lids will not be accepted.

C. Only rigid metal conduit elbows shall be used in pull boxes. Conduit elbows made of materials other than rigid metal will not be accepted.

D. Legibly imprint the cover with the appropriate message from the following list in letters at least 1 in. high or as required by plans.
1. “Danger High Voltage Traffic Signals”
2. “Danger High Voltage Illumination”

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installations shall not be made where vehicular traffic is planned unless approved by Owner.

B. Pull boxes shall not be installed in path of proposed pedestrian facilities which include sidewalks or ramps unless approved by the Owner. In such a case, the pull box shall be installed as to minimize possibility of a tripping hazard and susceptible to damage.

C. Pull boxes and extensions shall be furnished with the minimum outside dimensions (width x length x depth) for the purpose described unless otherwise instructed by Owner.
   1. **COSL Type 1 pull box**: Detector Loops & Hardwire Interconnect 11.5” x 21” x 20”
   2. **COSL Type 2 pull box**: Standard traffic signal pull box, but also used for detector loops where multiple loops enter the pull box.
      a. 17” x 30” x 22”
      b. 17” x 30” x 12” (Extension)
   3. **COSL Type 3 pull box**: Standard pull box used for most communications applications, or where a larger pull box is needed due to multiple conduits
      a. 24” x 36” x 24”
      b. 24” x 36” x 24” (Extension)

D. Each enclosure shall be designed and constructed flush to grade, pavement, or sidewalk with the cover fitting flush to the box.

E. Each enclosure shall be suitable for installation in either direct or buried native soil, embedded in concrete or embedded in asphalt surfacing. A concrete collar shall be furnished for each installation in asphalt, or where called for on the plans.

F. A concrete apron shall be installed for each pull box unless specified by the owner.

3.02 CONDUIT ENTRANCE TO PULL BOX

A. Hydraulic conduit entrance punchout tools or equivalent shall be used to provide necessary entrances to pull boxes leaving a clean surface area for the insertion of conduit.

END OF SECTION

SECTION 34 41 13.11
TS 2 CABINET ASSEMBLY

1.01 SUMMARY

A. This Section describes the minimum acceptable requirements for a TS 2 cabinet assembly to house a NEMA TS 2 Type 1 solid state full-actuated controller unit. The assembly shall include the cabinet, controller, flasher, card rack(s), an MMU, an external power supply, six flash transfer relays, and uninterruptible power supply (UPS).

B. Equipment shall be:
   1. Traffic Cabinet: Trafficware cabinet (NEMA TS2) with two standard 16 channel detector racks, 32 channel loop input panel, front and back door. Dimensions area 44”x68x27”.
   2. Traffic Controller: Trafficware 980 ATC TS2 Type 1 w/ Ethernet faceplate
   3. Power Supply: Naztec 5 amp.
   4. MMU: Naztec 516-LE
   5. Load Switches (SSS-86-3): PDC
   6. Solid State Flasher (SSF-88) PDC
   7. Flash Transfer Relay Switches: Naztec approved
   8. TS 2 130 BIU: Naztec
   9. UPS: Alpha FXM 2000 with:
      a. Battery Charge Management System: Alpha Guard (48V)
      b. Automatic Bypass Switch: Alpha UATS
      c. Batteries: Four(4) AlphaCell 220 Gold-HP GelCell Batteries

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement: This Item will be measured as each TS 2 cabinet assembly, complete in place and fully operational.

B. Payment - The work performed and materials furnished in accordance with this Section and measured as provided under “Measurement” will be paid for at the unit price bid for “TS 2 Cabinet Assembly”. This price is full compensation for furnishing, installing, and testing the completed installation of all items listed under Equipment in section 1.01.B; and all equipment, labor, tools, and incidentals required for a fully operational signal.

SECTION 34 41 13.12
EMERGENCY VEHICLE PREEMPTION (EVP)

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes system for EVP to identify presence of designated emergency vehicles and causes the traffic signal controller to advance to and/or hold a desired traffic signal display selected from phases normally available.

B. EVP shall be:
   1. Opticom Detectors: Global Traffic Technologies/Model 721
   2. Opticom Phase Selector(detector card): Global Traffic Technologies/Model 764
   3. Cable: Model 138 detector cable, per manufacturer's recommendations.

   In case of end of life for the Opticom detectors and detector card, should use the equivalent upgraded models from Opticom. No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement - This item will be measured by each intersection of the required optical detectors, detector cards and cable, complete in place.
   a. Number of detectors and detector cards required will be listed in quantities as subsidiary to this item.
   b. Length of cable required will be listed in quantities as subsidiary to this item.

B. Payment - The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Emergency Vehicle Preemption". This price shall be full compensation for furnishing, installing and testing the system; and for all labor, tools, equipment and incidentals necessary to complete the work.

PART 2 - PRODUCTS

2.01 PRODUCTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. The EVP is comprised of four basic matched components. To ensure system integrity, operation and compatibility, the four basic components (optical emitter, optical detector, detector cable, phase selector) shall be from the same manufacturer. The

bidder shall supply and install the optical detector(s), detector cable, and phase selector for each intersection called for on the plans. The bidder of the Emergency Vehicle Preemption equipment shall provide with the bid written certification from the manufacturer that the system components were designed, manufactured and tested as a system of matched components and will meet or exceed the requirements of this specification and work with the existing Owner's optical emitters.

2.02 WARRANY

A. A minimum guarantee for both materials and workmanship shall be provided by the Contractor for the products bid as specified. The guarantee (warranty) period shall begin the day the Owner officially accepts the item. Any guarantee work is to be completed within 15 days after receipt of notice of material deficiencies.

1. Warranties and Guarantees

   a. Equipment furnished shall be covered by manufacturer's guarantee or warranty for a period of twelve (12) months commencing on final acceptance date with respect to parts, workmanship, and performance of the product.
   b. Contractor shall bear all expenses connected with the return of any equipment which the Owner deems necessary to return to the Contractor for proper adjustment or repairs during the guarantee period.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The EVP system shall be installed by supplier factory certified installers and/or as recommended by the supplier and documented in installation materials provided by the supplier.

END OF SECTION

SECTION 34 41 13.13
REMOVING TRAFFIC SIGNALS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes removing, storing, and salvaging traffic signals.

1.02 MEASUREMENT AND PAYMENT

A. Measurement:
   1. This Item will be measured as each signalized intersection removed. A signalized intersection is a group of signals operated by a single controller.

B. Payment:
   1. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Removing Traffic Signals.” This price is full compensation for removing all existing traffic signal system components including electrical service; removing the foundations; disposal of unsalvageable material; hauling; and equipment, labor, tools, and incidentals.

PART 2 - EXECUTION

2.01 REMOVAL

A. Traffic signals must remain in operation during construction until their removal as directed. The Contractor will not be responsible for maintenance of the signals during this period of operation unless the existing traffic signal is modified by contractor to serve as a temporary signal. Maintenance would then be subsidiary to the “Temporary Traffic Signals” bid item.

B. Coordinate removal with the appropriate utility company before beginning work. Before the removal of the electrical service, disconnect and isolate any existing electrical service equipment in accordance with the utility company’s requirements. Use established industry and utility safety practices while removing electrical service equipment near any overhead utilities.

C. Remove existing electrical services, pedestal poles, strain poles, mast arm pole assemblies, luminaires, signal heads, controllers, cables, and any other equipment or structure associated with the signalized intersection.

D. Remove salvageable materials so that damage does not occur. Remove and store items designated for reuse or salvage at locations shown on the plans or as directed by the City.

E. Remove abandoned concrete foundations to a point 2 ft. below final grade. Backfill hole with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

F. Replace any surfacing such as asphalt pavement or concrete riprap with like material to equivalent condition.

G. Abandoned conduit or duct need not be removed unless shown on the plans.

H. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

END OF SECTION

SECTION 34 41 13.14
Traffic Signal LED LUMINAIRE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for LED luminaires.

B. LED luminaires shall be the Holophane Acrylic Washington Postlite II with adapter to fit signal pole tenon.

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement - This item will be measured by each LED luminaire furnished and installed, complete in place.

B. Payment - The work performed and materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid for “LED Luminaire”. This price shall be full compensation for furnishing and installing; and for all labor, tools, equipment and incidentals necessary to complete the work.

PART 2 - PRODUCTS

2.01 PRODUCTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Provide the following:
1. Diffuser: Clear Acrylic (CA)
2. Optics: Type III
3. Watt: 100-128 watts
4. Current: 500-525 mA Drive
5. LED color: Neutral White (NW)
6. Standard Texture Finish: Black
7. Adapter to fit signal pole tenon

2.02 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: One year from date of Substantial Completion.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 34 41 16.01
SOLAR POWERED FLASHING BEACON ASSEMBLY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for materials, composition, quality, sampling, and testing of a solar powered flasher controller assembly that includes a 16' tall 4" diameter aluminum pole with breakaway base and screw in foundations, solar generator, photovoltaic modules, two (2) 12 volt batteries, 12" – 12V DC LED signal indications, signs, cabinet, flasher, time clock, and other cabinet accessory equipment.

B. Flashing Beacon Assembly supplied under this specification shall be selected from the list of TxDOT pre-qualified material producers under DMS-11150.

C. Signs installed on the Flashing Beacon Assembly must meet the sign specification for the City of Sugar Land.

Other specified equipment:
1. Naztec Chronomax Time Switch clock
2. WiPath Communication Pager Model# PSR3000 with antenna

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement:

1. Solar Powered Flasher Controller Assembly will be measured by each assembly including 16' tall 4" diameter aluminum pole with breakaway base and screw in foundations, solar generator, photovoltaic modules, two (2) 12 volt batteries, LED signal indications, signs, cabinet, flasher, time clock, and other cabinet accessory equipment.
   a. Signs will be listed in quantities as subsidiary to this item. Sign messages and sizes to be shown on the plans.

B. Payment
1. Payment for the work performed and materials furnished in accordance with this specification will be paid for at the unit price bid for each assembly listed in Measurement, including all accessories and additional equipment required for a fully operational system.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

B. Size the system solar generator to provide an array-to-load ratio of 1:1 or greater. Provide a system-average state of charge 90 percent or greater throughout the entire year. The system-loss-of- load probability must remain 0 percent throughout the entire year. Design and make available the system in the following configurations:

1. School-zone assembly with two 12-in. signal beacon.
2. Advance-warning assembly with one 12-in. signal beacon.
3. Advance-warning assembly with two 12-in. signal beacon.

C. The specific configuration will be shown in the Contract. Provide a system-sizing report detailing the photovoltaic array, battery bank, array-to-load ratio analysis, system availability analysis, battery state-of-charge report, battery depth of discharge (DOD), and monthly installation information for that specified region.

D. LED signal indications shall be 12” LEDs operating at 12V DC

2.02 WARRANTY

A. All equipment must have no less than 95 percent of the manufacturer's standard warranty remaining on the date that the contractor submits equipment invoices for payment. Owner will not accept any equipment with less than 95 percent of its warranty remaining. Provide warranties in accordance with the following table, "Required Warranties":

1. Required Warranties:

   a. Item Warranty Type and Period:

      1) Photovoltaic modules limited 12 yr.
      2) Signal beacons limited 5 yr.
      3) Batteries prorated 5 yr.
      4) All other equipment 3 yr.

PART 3 - EXECUTION

3.01 DOCUMENTATION REQUIREMENTS

A. Supply two copies of the following documentation with each solar-power flasher assembly:

1. Complete and accurate schematic diagram.

2. Complete parts list, including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.
3. Full report on system analysis, including all manufacturers' supporting documentation.
4. Complete users' manual for the system.

END OF SECTION

SECTION 34 41 23.01
VIDEO DETECTION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes minimum requirements for a Video Imaging Vehicle Detection System (VIVDS) that monitors vehicles on a roadway via processing of video images and provides detector outputs to a traffic controller or similar device.

B. VIVDS shall be Iteris:
   1. Camera BIU: Iteris Vantage TS2-IM
   2. Camera: Iteris RZ-4 Advanced WDR
   3. Communication Card: Iteris Edge Connect Communication Card
   4. Camera Processor Cards: Iteris Vantage Edge 2 Processor
   5. VIVDS Cable: Iteris recommended cable
   6. Video monitor: 10” Color LCD Video monitor w/ necessary cables per manufacturer’s recommendations.

   No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement: This item shall be measured by each intersection including color cameras, mounted including fittings, conductors, brackets, appurtenances, video processor(s), cables, cabinet & communication interfaces, programming, communications software, and other associated equipment required for installation.
   1. Number of cameras required will be listed in quantities as subsidiary to this item.
   2. Number of camera processor cards required will be listed in quantities as subsidiary to this item.
   3. Length of cable required will be listed in quantities as subsidiary to this item.

B. Payment: This item shall be paid by each installation at an intersection. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Video Detection System". These prices are full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software package(s), supplies, support, personnel training, shop drawings, documentation, and incidentals.

   These prices also include any and all interfaces required for the field and remote communications links along with any associated peripheral equipment, including cables; all associated mounting hardware and associated field equipment; required for a complete and system per the manufacturer’s recommendations.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

2.02 WARRANTY

A. Material, workmanship and labor furnished shall be covered by Supplier(s)/Manufacturer(s) guarantee and/or warranty for a minimum period of twenty-four (24) months.

B. Warranty period shall begin the day the video detection system is activated by the Owner, either as new order or warranty repair.

C. The Owner's preference is for all non-warranty service to be charged a singular flat rate.

D. Successful bidder shall bear all expenses connected with return of any material, which the Owner deems necessary to return for adjustments during warranty period.

E. Successful bidder shall bear all labor cost associated with warranty items and maintenance in a timely manner; the quality of timely service is determined by the Owner and shall not exceed twenty-four (24) hours from the Time of Notification (TON) to initial field response by the successful bidder or their representative.

1. In essence, the successful bidder shall provide maintenance and field service (i.e. trouble calls) during the warranty period. Supplier(s)/Manufacturer(s) shall make all engineering data, diagrams, software changes or improvements, which increases performance of equipment purchased under this bid, available to the Owner at no additional cost.
2. Supplier(s)/Manufacturer(s) shall have field engineers or technicians available on request to assure satisfactory initial operation, and to consult with Owner's representative, on any special circuitry that may be required in certain applications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The video detection system shall be installed by supplier factory certified installers and as recommended by the supplier and documented in installation materials provided by the supplier. Proof of factory certification shall be provided.

B. The supplier of the video detection system shall supervise the installation and testing of the system. A factory certified representative from the supplier shall be on-site during installation. Up to 2 days of training shall be provided to personnel of the Owner in the operation, setup and maintenance of the video detection system. Instruction and materials shall be provided for a maximum of 20 persons and shall be conducted at a location selected by the Owner.

C. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the video detection system. These parts shall be available for delivery within 30 days of placement of an acceptable order at the supplier's then current pricing and terms of sale for said parts.

D. The supplier shall maintain an ongoing program of technical support for the video detection system. This technical support shall be available via telephone, or via personnel sent to the installation site upon placement of an acceptable order at the supplier's then current pricing and terms of sale for on-site technical support services.

END OF SECTION

SECTION 34 41 23.02
PTZ CAMERA

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes minimum requirements for a PTZ Camera.

B. PTZ Camera shall be Axis Q6052-E (or in case of end of life, should use the equivalent upgraded model from Axis). Included accessories shall be: AXIS T91A67 Pole Bracket, AXIS T8124 High PoE Midspan 1-port, IP66-rated RJ-45 connector kit, clear and smoked dome cover, sunshield, RJ45 Shielded Cat5 Modular Plugs, Windows decoder 1-user license, Video Insight license per camera, Installation Guide, CD with User's Manual, installation and management tools

No substitutes will be accepted.

1.02 MEASUREMENT AND PAYMENT

A. Measurement: This item shall be measured by each camera with all associated equipment required for installation.
   1. Length of cable (CAT 5e meeting Belden 7919a spec.) required will be listed in quantities as subsidiary to this item. This is a plans quantity measurement.
   2. Video Insight license per camera required will be listed in quantities as subsidiary to this item.

B. Payment: This item shall be paid by each camera installation. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "PTZ Camera". These prices are full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, cable, operational software package(s), supplies, support, personnel training, shop drawings, documentation, and incidentals.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. The items furnished and installed under this contract shall be new, unused of the latest product in production to commercial trade, and shall be of the highest quality as to materials used and workmanship.

2.02 WARRANTY

A. Material, workmanship and labor furnished shall be covered by Supplier(s)/Manufacturer(s) guarantee and/or warranty for a minimum period of twenty-four (24) months.

B. Warranty period shall begin the day the PTZ Camera is activated by the Owner, either as new order or warranty repair.

C. Successful bidder shall bear all expenses connected with return of any material, which the Owner deems necessary to return for adjustments during warranty period.

D. Successful bidder shall bear all labor cost associated with warranty items and maintenance in a timely manner; the quality of timely service is determined by the Owner and shall not exceed twenty-four (24) hours from the Time of Notification (TON) to initial field response by the successful bidder or their representative.

1. In essence, the successful bidder shall provide maintenance and field service (i.e. trouble calls) during the warranty period. Supplier(s)/Manufacturer(s) shall make all engineering data, diagrams, software changes or improvements, which increases performance of equipment purchased under this bid, available to the Owner at no additional cost.
2. Supplier(s)/Manufacturer(s) shall have field engineers or technicians available on request to assure satisfactory initial operation, and to consult with Owner's representative, on any special circuitry that may be required in certain applications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Contractor should contact the City to get approval of final location of PTZ camera to optimize view.

B. CAT 5e cable should not be run in conduit containing high voltage traffic signal cable unless approved by the City.

C. All CAT 5e cable connections shall be grounded with RJ45 connection and protected from the environment by heat shrink tubing. The City should inspect the connection before the heat shrink tubing is applied.

END OF SECTION

SECTION 34 41 23.03
WIRELESS MAGNETOMETER VEHICLE DETECTION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. This special specification sets forth the minimum requirements for a wireless magnetometer vehicle detection system (WMVDS) that detects vehicles on a roadway via changes to the earth's magnetic field. When a change is detected the WMVDS provides detector outputs to a traffic controller or similar device.

B. The WMVDS shall be the Valence Pod System consisting of any combination of the below listed items to make fully functional per the project:

1. Magnetometers (Pods)
2. Access Point and Antennas kits
3. Base Station (SDLC connection) and Antenna Kit
4. Panel Antenna Kit (if needed)
5. Fabick M-PP-450 Epoxy
6. Lightning Suppression
7. All necessary Cable(as recommended by Vendor)
8. All necessary Mounts

No substitutes will be accepted.

C. Definitions:

1. 3-Axis Magnetometer: Instrument used for measuring the magnitude and direction of the earth's magnetic field. Device used to detect changes in the earth's magnetic field within the vicinity of the instrument. The 3-axis magnetometer measures the height, width and length of the magnetic field around the instrument referenced as the X, Y, and Z axis.

2. Base Module: Shelf mounted processor to communicate with Access Points wired or wirelessly and output detector calls to traffic signal controller or detection rack.

3. Wireless Communications Link: Data communications channel connecting to nodes of a communications link using a radio frequency (RF) to connect the nodes. Wireless links to connect nodes such as: access point to the sensor and/ or access point to the repeater.

4. Access Point: Wireless communications device used as the connecting node to establish a data communications link from the sensor to the base module or interface module.

5. Pod Sensor: Device placed in the roadway and used to detect a change in the earth's magnetic field when a vehicle passes over its measured area of influence. Pod sensor houses the 3-axis magnetometer used to sense the change in the earth's magnetic field. Sensor acts as a data communications device to an access point to transmit contact closure when detection is achieved by the 3-axis magnetometer.

6. System software: Computer software used for set-up and monitoring of the WVMDS. Software allows the user to assign sensors to detector channels and to select sensitivity levels needed for the application. Software may be a Windows based application or else reside in the WMVDS system and provide access by means of a standard web-browser.

7. Detection zone: Area of measured magnetic lines of flux by the in-pavement sensor.

8. Presence Detection: The ability of a vehicle detector to sense that a vehicle, whether moving or stopped, has appeared in its zone of detection.

9. Detection Accuracy: The measure of the basic operation of a detection system (shows detection when a vehicle is in the detection zone and shows no detection when there is not a vehicle in the detection zone).

1.02 MEASUREMENT AND PAYMENT

A. Measurement:

The Wireless Magnetometer Vehicle Detection System (WMVDS) will be measured as each complete WMVDS (system) furnished, installed, and made fully operational in accordance with this specification and plans. This includes any communications or power cable, mounting hardware, labor/equipment needed for installation, and other incidentals needed to make system fully operational. The WMVDS will cover all detection zones as specified by plans and be cable of providing at a minimum 64 detector inputs.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2, "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

B. Payment:

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for a WMVDS system.

These prices are full compensation for all materials and furnishing all labor, tools, cabling, equipment and incidentals necessary to complete the work. These prices

include all associated mounting hardware and associated field equipment required for a complete and fully functional wireless magnetometer vehicle detection system.

PART 2 – PRODUCTS

2.01 FUNCTIONAL CAPABILITIES

A. The Wireless Magnetometer Vehicle Detection System (WMVDS) must be capable of detecting a variety of vehicle types including motorcycles, automobiles, and large trucks. The system must allow the user to select sensitivity levels needed to achieve contact closure to the assigned detector channel. Magnetometer sensitivity level adjustments must allow for different levels of vehicle detection. Sensitivity level settings to the magnetometer must be accomplished using WMVDS software via wireless communication.

B. The WMVDS must be able to perform presence detection as described in this specification.

C. Equipment failure such as: the Pod sensor, communications link, access point radio or interface module, shall result in constant vehicle call “fault state” on the affected detector channel to the traffic controller.

2.02 PRODUCT DESCRIPTIONS

A. Detection Performance

1. Detection accuracy must be comparable to properly operating inductive loops. Detection accuracy shall include the WMVDS ability to detect the presence of any vehicle within the sensors magnetic field and to communicate contact closure to the appropriate detector channel. If the WMVDS “false detects”, (system applies contact closure when a vehicle is not present in the sensors magnetic field), this will count against the accuracy measured during performance testing. A minimum of 95% detection accuracy must be achieved by the WMVDS when measured in a 24 hour period.

2. The WMVDS shall provide real-time vehicle detection (within 150 milliseconds (ms) of vehicle arrival). Once detection is achieved by the sensor, the traffic controller must receive contact closure to the assigned detector channel within the 150 ms time frame.

B. Pod Sensor

1. The Pod in-pavement sensor unit must be designed to operate reliably in adverse weather conditions and rated to operate from -40°F to +185°F.

2. Pod sensors must be capable of presence detection as defined in this specification. The Pod sensors as a minimum must create a 6’ length x 6’ width accurate area of detection when used for presence detection at an

intersection.

3. Pod sensors as a minimum must use a 3-axis magnetometer in the design and operation of the unit. The sensor must monitor the earth's magnetic field through out the course of the day and establish a baseline reference value for the X, Y, and Z axis. As a minimum the refresh rate on the magnetometer's processor will be 128 HZ, providing a sampling rate of 8ms to the earth's magnetic field. The sensor must be able to detect a change in the magnetic field as referenced to the sensitivity setting selected by the user.

4. The Pod sensor must operate on batteries without the need for underground power or communication cable connections to the unit.

5. The Pod shall provide up to 10 years of life with an average of 700 activations per hour, 24/7.

C. Base Module

1. The operating temperature range of the interface module, as a minimum must be -35°F to +167°F.

2. The base module shall be designed to operate in a NEMA TS-2 cabinet.

3. The base module as a minimum must make available 64 channels on the module. Sensors must be assignable, via the WMVDS software, to the available detector channels on the module.

4. The Base module must be able to interface with the controller via a NEMA TS-2 SDLC connector.

D. Access Point

1. Access points must be rated for outdoor use and housed in an appropriate NEMA enclosure. The operating temperature range of these devices, as a minimum, must be from -35°F to +167°F.

2. As a minimum, access points must be capable of handling data communications for up to 64 sensors.

3. The operational distance between the sensor/detector and an access point shall be a minimum of 250 feet when using an omnidirectional antenna.

4. The operational distance between the sensor/detector and an access point shall be a minimum of 700 feet when using a directional (or panel) antenna.

5. All communications equipment will operate in an unlicensed frequency range permitted by the FCC.

6. The communications system must accommodate other wireless equipment sharing the frequency band and have a means to avoid interference. Acceptable means shall include spread spectrum, frequency hopping, wi-fi, user-selectable frequency channels, and other substantial means.

7. All communications equipment must meet all applicable FCC standards as required for the frequency range used by the WMVDS.

8. Surge protection meeting GR 1089 standards must be used for devices receiving power over ethernet.

9. Access points must be able to operate from 120 VAC line power or power over Ethernet (48volts DC).

10. Access point must allow for wireless or EIA-485 connectivity between the Base Station.

11. Access point home run cable of up to 1000' long shall be supported. It shall have tough UV-resistant, waterproof polyethylene jacket, insulated conductors, and meet EIA-485 or CAT5e (Belden 7919a) requirements.

E. Software

1. Firmware for Pod sensors and access points must be upgradable via a wireless connection to the device.

2. The software must allow for sensitivity adjustments to the sensor detection algorithms used by the WMVDS. As a minimum the system will use 10 different sensitivity levels to adjust for site conditions and class of vehicle. The sensitivity adjustments must be selectable by the user. When a change to the magnetic field is equal to or greater than the selected sensitivity setting, a detect signal will be transmitted to the controller by a contact closure or other standard interface method.

3. The software must display each Pod sensor, sensor detection activity, battery level, and its communication status on a GUI display.

4. Software must show received signal strength indication (RSSI) for each Pod sensor used at the intersection.

5. The software will allow the user to assign selected sensors to specific radios or detector channels. Pod sensors must be assignable to radios or detector channels via system software.

PART 3 – EXECUTION

3.01 INSTALLATION AND TRAINING

A. Formal levels of factory authorized training are required for installers, contractors and system operators. All training must be certified by the manufacturer.
B. The WMVDS must be installed per the "Design and Installation Guide for Valence Pod Detection System".
C. All final locations of all equipment must be approved by the appointed City inspector prior to installation of any equipment.
D. Access points must be wired (EIA-485) to base station unless otherwise noted by the City.
E. No holes shall be drilled into the traffic cabinet to mount any equipment. If an antenna is necessary at the cabinet the ear holes and appropriate mounts should be used.

3.02 WARRANTY, MAINTENANCE AND SUPPORT

A. The Wireless Magnetometer Vehicle Detection System (WMVDS) must be warranted to be free of defects in material and workmanship for a period of 5 years from date of shipment from the supplier's facility. During the warranty period, the supplier shall repair with new or refurbished materials, or replace at no charge, any product containing a warranty defect provided the product is returned FOB to the supplier's factory or authorized repair site. This warranty does not apply to products damaged by accident, improper operation, abused, serviced by unauthorized personnel or unauthorized modification. The warranty does not cover the labor required to remove and replace components of the WMVDS in the field

B. During the warranty period, technical support must be available from the supplier via telephone within 8 hours of the time a call is made by a user, and this support shall be available from factory certified personnel or factory certified installers.

C. Ongoing software support by the supplier shall include updates of the WMVDS processor unit and software.

D. The supplier must maintain a program for technical support and software updates following expiration of the warranty period. This program shall be made available to the City of Sugar Land in the form of a separate agreement for continuing support.

E. The supplier must maintain an adequate inventory of parts to support maintenance and repair of the WMVDS.

END OF SECTION