Internally Bonded Fiber Reinforced Polymer (FRP) Composite System for Sewer Repairs

PART 1 – GENERAL

1.01 SCOPE

A. This specification is intended to define the minimum requirements of using internally bonded fiber reinforced polymer (FRP) composite systems to rehabilitate gravity sewer systems to prevent corrosion, seal leaks, and improve structural integrity.

B. The work includes the furnishing of all design calculations stamped by Georgia Professional Engineer, all materials, labor, equipment and services for the supply and installation of internally bonded FRP composite system.

C. The FRP Contractor shall include all engineering, labor, materials, tools, equipment, appliances and services required to engineer, design, deliver, and furnish all items necessary for the proper execution and completion of the work as shown on the Contract Documents, as specified herein and/or as required by job conditions. Detailed design of the FRP system is included with the installation of the FRP system by the installer selected by the Owner or General Contractor. All items not shown or specified, but which are necessary for the proper execution and completion of the Work shall be provided by the FRP Contractor.

D. The product shall be capable of making both structural and non-structural repairs in varying lengths as dictated by field conditions and indicated on the drawings and contract documents.

E. The product shall use glass and/or carbon fiber fabrics combined with suitable resins to make a repair.

F. The product shall be capable of bonding to existing sewer pipe and correcting defects including leaking joints, cracked pipes, and other internally repairable defects. The result should be a water tight, repaired defect that is capable of withstanding all hydrostatic and structural loadings.

G. The product shall be capable of relining complete sections from manhole to manhole, including watertight connections to the manhole structure.

H. The extent of the FRP system covered shall be as defined herein and as shown on the plans.

I. The FRP Contractor shall cooperate and coordinate with all other trades in executing the work described in the contract documents.

J. Specific design thickness for the individual repair locations shall be calculated and provided by FRP contractor. Design shall be based on ACI 440.7R and ACI 440.2R-17. Calculations shall be performed by an Engineer registered in the state of Georgia and shall be based on industry standard design methodologies. Calculations shall be based on design loads to include:

1. Earth load based on site specific conditions.
2. Groundwater assumed to be at ground surface.
3. Live Loads where appropriate from traffic loading.
4. Other design loads as appropriate.

K. Design calculations stamped by engineer registered in Georgia shall be provided for each repair location documenting that the proposed installed product and thickness is suitable for each specific location.

L. Detailed information on all materials, products, (including all resins and curing procedures) shall be submitted.

M. Detailed installation procedures including QA/QC shall be submitted by FRP contractor.

N. The FRP contractor shall have their own QA/QC procedures and inspection and provide copies of all QA/QC information to Owner. The FRP contractor's QA/QC shall be independent of any QA/QC field inspection that may be provided by the Owner through their own or third-party inspection services.

O. All work is to be conducted in compliance with all applicable Federal, State, and Local requirements and Laws. Particular attention is drawn to the Health and Safety requirements for excavations and Confined Space regulations.

1.02 REFERENCES

A. ACI—American Concrete Institute

1. 116R-00: Cement and Concrete Terminology.
2. 117-90: Specifications for Tolerances for Concrete Construction and Materials, and Commentary.
3. 224.1R-07: Causes, Evaluation, and Repair of Cracks in Concrete Structures.
4. 224R-01: Control of Cracking in Concrete Structures.
5. 440R-07: State-of-the-Art Report on Fiber Reinforced Plastic Reinforcement for Concrete Structures

6. 440.2R-17: Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening of Concrete Structures.
7. 503R-93: Use of Epoxy Compounds with Concrete.
8. 503.4-R92: Standard Specifications for Repairing Concrete with Epoxy Mortars.
9. 503.5R-92: Guide for the Use of Polymer Adhesives in Concrete.
10. 503.6R-97: Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes.
11. 546R-04: Concrete Repair Guide.

B. ASTM- American Society for Testing and Materials

1. D3039: Test Method for Tensile Properties of Polymer Matrix Composite Materials.
2. D3418: Test Method for Transition Temperatures of Polymers by Differential Scanning Calorimetry.
3. D5687: Guide for Preparation of Flat Composite Panels with Processing Guidelines for Specimen Preparation.
4. D7565: Standard Test Method for Determining Tensile Properties of Fiber Reinforced Polymer Matrix Composites Used for Strengthening of Civil Structures.
5. D7234: Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
6. D7522: Standard Test Method for Pull-Off Strength for FRP Bonded to Concrete Substrate.
7. D7290: Standard Practice for Evaluating Material Property Characteristic Values for Polymeric Composites for Civil Engineering Structural Applications.
8. D638: Standard Test Method for Tensile Properties of Plastics.
9. D695: Standard Test Method for Compressive Properties of Rigid Plastics.
10. D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

C. ICRI- International Concrete Repair Institute

1. No. 03732: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
2. No. 03733: Guide for Selecting and Specifying Materials for Repairs of Concrete Surfaces.

1.03 QUALIFICATIONS OF INSTALLER

A. The repairs to the gravity sewer line shall be made using an internally bonded fiber reinforced polymer (FRP) product. The product shall be PipeMedic by Quakewrap, inc. (Tucson, Arizona) or approved equal. The product shall have at a minimum 10-years documented experience along

with a minimum of 500,000 square feet of rehabilitation history. The product shall have documented a minimum of 5,000 LF of 54-inch and larger of pipeline rehabilitation experience.

1.04 SUBMITTALS

A. Submit stamped design calculations for each repair location stamped by Georgia registered Professional Engineer as required and detailed in the specifications.

B. Submit detailed installation procedures for product.

C. Submit detailed QA/QC plan for the product, installation, and field testing.

D. Submit certifications of applicator with written consent from the FRP manufacturer that the Contractor has been trained in proper application of manufacturer's systems.

E. Submit complete product information, including resins, fabrics, installation procedures and general recommendations regarding each material to be used. Must receive approval by the Engineer of Record (EOR) 10 days prior to the bid date.

F. Submit test results conducted per the ASTM standards as applicable to the project.

G. Submit FRP Safety Data Sheets (SDS) for all materials to be used. Must be approved by EOR.

H. For the products of alternative manufacturers, submit FRP manufacturer's Product Data Sheets (PDS) indicating physical, chemical, and mechanical characteristics of all materials used in the FRP system. Must be approved by EOR 10 days prior to the bid date.

PART 2 – PRODUCTS
ACCEPTABLE MANUFACTURERS & COMPOSITE STRENGTHENING SYSTEM

2.01 GENERAL

A. Materials for the FRP system must be suitably qualified, compliant with industry standards, and supplied by a reputable manufacturer approved by the Owner. Before FRP materials are ordered or work is performed, Contractor must identify which materials are proposed to be utilized and from which manufacturer(s) Contractor proposes to obtain the materials.

B. The FRP pipe rehabilitation system shall be PipeMedic by QuakeWrap, Inc. (Tucson, Arizona) or approved equivalent.

C. Quality Control Testing and Certification: Manufacturer shall certify that every batch or lot of material conforms to this specification, and shall submit

recent test results for every specified system according to the manufacturer's quality control plan.

D. Labeling, packaging and storage shall include any health hazard warnings, precautions for handling and recommended first aid procedures in case of contact.

E. All materials used shall conform to this specification and other specifications referenced within and subject to the approval of the Engineer.

2.02 DESIGN LOADS

A. For fully (standalone) or semi-structural (composite system with the host conduit), the FRP system shall be designed for the following loads for gravity sewer systems:

B. External pressure from ground water calculated at pipe invert (a long-term loading), Pgw,

C. Earth load (a long-term loading), We,

D. Live load (a short-term loading, usually will not occur simultaneously with other short-term loads), Wr,

E. Water weight (a long-term loading), Ww,

F. Host pipe weight plus the weight of FRP laminae (a long-term loading), Wp

2.03 GLASS FABRIC

A. Glass fabric shall be high-strength unidirectional or biaxial, white in color, weighing at least 20 oz/yd2 and impregnated using a two-component high strength epoxy resin.

B. A lighter weight chopped mat shall be used in conjunction with the unidirectional or biaxial glass fabric to improve impermeability.

C. Glass fabric shall be supplied in rolls with a minimum width of 24" shall have the following physical and mechanical (minimum) properties:

Glass Fabric and Laminate Properties	
Dry Fiber Properties	
Tensile Strength	470 ksi
Tensile Modulus	10.5 ksi
Ultimate Elongation	4.50%
Density	0.092 lb/in^3
Aerial Weight Fabric Only	20 oz/yd2

Longitudinal (0^0) Direction	
Tensile Strength	63.7 ksi
Tensile Modulus	2,940 ksi
Ultimate Elongation	2.20%
Breaking Force	2,365 lb/in.
Transverse (90^0) Direction (if applicable)	
Tensile Strength	52.0 ksi
Tensile Modulus	2,700 ksi
Ultimate Elongation	1.90%
Breaking Force	1,560 lb/in.

2.04 3D CORE LAYER

A. To enhance the FRP stiffness against deflection and buckling due to external loads (e.g., soil pressure, groundwater pressure, traffic loads) in an economical manner, a proprietary sandwich structure (e.g., StifPipe®) can be applied with a core (3D) layer. The core layer shall be a nonwoven polyester compatible with vinyl ester, polyester, and epoxy resins.

B. The nonwoven core polyester fabric shall have the following physical and mechanical (minimum) properties:

Thickness	4 mm
Roll Width	3 ft
Resin Uptake	0.7 oz/yd^2
Density (impregnated)	33.7 lb/ft^3
Compressive Strength (ISO 844)	1,450 psi
Shear Strength (ASTM C273)	435 psi
Shear Modulus (ASTM C273)	3,625 psi
Flexural Strength	1,160 psi

2.05 CARBON FABRIC

A. For structural design, carbon fiber laminae may be included in the FRP system for enhanced resistance against bending and buckling.

B. Fabric shall be composed of high strength, high modulus carbon fibers. The fibers shall be primarily oriented in the longitudinal (00) direction or in the 00 and 900 direction for biaxial fabrics. The fabric shall be black in color and impregnated using two component high strength epoxy resin. The fabric total weight shall be no less than 27 oz/yd2.

C. Carbon fabrics shall be supplied in rolls no less than 24” in width.

D. Carbon fabric shall conform to the minimum physical and mechanical properties indicated below.

Carbon Fabric and Laminate Properties		***Carbon Laminate Strip Properties***	
Dry Fiber Properties		**Dry Fiber Properties**	
Tensile Strength	550 ksi	Tensile Strength	710 ksi
Tensile Modulus	33,500 ksi	Tensile Modulus	33,400 ksi
Ultimate Elongation	1.64%	Ultimate Elongation	2.10%
Density	0.065 lb/in^3	Density	0.065 lb/in3
Aerial Weight	27.8 oz/yd^2		
Laminate Properties		**Laminate Properties**	
Tensile Strength	135 ksi	Tensile Strength	400 ksi
Tensile Modulus	13,000 ksi	Tensile Modulus	24,000 ksi
Ultimate Elongation	0.98%	Ultimate Elongation	1.70%
Breaking Force	6,800 lb/in	Breaking Force	18,800 lb/in
Ply Thickness	0.0490 in	Ply Thickness	0.0472 in

2.06 SATURATING RESIN – POLYMER

A. Fabric shall be impregnated with a two component, high strength, and low viscosity structural epoxy. The resin shall have low viscosity and long pot life, with a fast cure time designed for high volume saturation of heavy reinforcement fabrics using an impregnator machine or hand tools as per project requirements to thoroughly and uniformly saturate the fabric.

B. The resin system shall be resistant to service environment conditions, including but not limited to moisture, elevated temperature, and chemicals in the fluid conveyed by the pipe.

C. The resin system shall not be diluted with any organic solvents such as a thinner.

D. The resin system shall not be used outside of the manufacturer's specified pot life.

E. The resin system shall not be applied on frozen surface.

F. Only moisture tolerant resins (e.g., J333 by QuakeWrap) shall be allowed to be applied on wet surfaces.

G. Temperature and moisture range for application shall be within the manufacturer's specified values.

2.07 Primer

A. For systems requiring a primer, the primer shall have sufficiently low viscosity to penetrate the concrete substrate and provide an adhesive bond for the thickened resin applied.

2.08 Thickened Resin

A. A thickened resin system, which consists of the saturating resin and silica fume supplied by the manufacturer as premixed or mixed at the site according to the manufacturer's recommended procedure, shall be used to provide a smooth surface for the application of the FRP laminate. The thickened resin system shall be used to fill in surface voids and even out the concrete substrate. It is permissible to use thin coat of thickened epoxy between laminae to enhance adhesion.

2.09 Saturating Resin

A. Saturating resins shall be 100% solids formulation with low odor conforming to the following physical properties:

Epoxy Resin Properties

Viscosity Mixed at 770 °F (250 °C)	1,500 – 1,600 cps
Pot Life at 770 °F (250 °C)	3 – 4 hrs (thin film set time)
Full Cure time	48 hrs
Density at 392 ºF (200 ºC)	Part A: 70.5 lb/ft^3 (1.13 kg/L) Part B: 62.4 lb/ ft^3 (1.00 kg/L)
Tensile Strength (ASTM 638) Tensile Modulus (ASTM 695)	7,150 psi (49.3 MPa) 289,000 psi (1,992.6 MPa)
Flexural Strength (ASTM D-790) Flexural Modulus (ASTM D790)	11,140 psi (76.8 MPa) 252,400 psi (1,740.2 MPa)
Water Absorption (% gain) in 24 hours	< 1%
Expansion Coefficient [-37.40 – 40.10 ºC] Expansion Coefficient [1,200 – 2,220 ºC]	78 ×10-6 m/m ºC 151.8 ×10-6 m/m ºC

Color – Part “A” is pigmented syrup, Part “B” is amber liquid

2.10 OTHER MATERIALS

A. Contractor to provide compatible primer, filler and other materials recommended by the manufacturer as needed for the proper installation of the complete surface bonded FRP composite system.

PART 3 – EXECUTION

3.01 GENERAL PROCEDURES

A. The FRP installation shall be performed in accordance with the manufacturer's specified procedure, which should be validated through past experience. The design of the FRP reinforcement shall conform to the design provisions given in the contract documents as well as ACI 440.7R and ACI 440.2R-17.

B. Contractor can propose alternative installation techniques and design improvements to meet the project goals and design requirements outlined in the drawings and technical specifications. Such proposed changes will be submitted as a Performance Work Statement (PWS) 30 days before the start of construction, and is subject to the approval of Owner and EOR.

3.02 SURFACE PREPARATION

A. The FRP Contractor shall expose and inspect the interior of the pipe to be reinforced with FRP. Inspection shall check the location and inspect cracks and existing conditions of the concrete.

B. All necessary repair and restoration of a concrete section shall be approved by the Engineer prior to surface preparation. In these specifications, contact-critical applications are treated in the same way as bond-critical applications.

C. The Contractor shall examine the existing conditions to identify potential obstructions and constraints; shall verify dimensions, geometry and access locations; and shall map all visible voids and cracks in the concrete core.

D. An adhesive bond with adequate strength shall always be provided between FRP and concrete. Surface preparation shall also promote continuous

intimate contact between FRP and concrete by providing a clean, and smooth surface.

3.03 Surface Grinding/Blasting:

A. All irregularities, unevenness, and sharp protrusions in the surface profile shall be ground away to a smooth surface with CSP 3/CSP 2 surface profile. Disk grinders, abrasive blasting, hydro blasting or other similar devices shall be used to remove stain, paint, or any other surface substance that may affect the bond. Voids or depressions with diameters larger than 1 ½ in. or depths greater than 1/8 in., when measured from a 12-in. straight edge placed on the surface, shall be filled according to Section 3.05.

3.04 Crack Injection:

A. All interior cracks in the surface of concrete or the substrate that are wider than 0.010 in. and all exterior cracks wider than 0.006 in. shall be filled by injecting epoxy according to ACI 224R-01 and 224.1R-07. The FRP system shall be installed no earlier than 12 hours after crack injection. Any surface roughness caused by injection shall be removed as per Section 3.05. The limit of crack injection shall be as indicated on the plans.

3.05 Surface Profiling:

A. After surface grinding, any remaining unevenness in the surface greater than that specified in Section 3.03, fins, protrusions, bug holes, eroded surfaces shall be filled and smoothed over by using putty made of epoxy resin mortar or polymer cement mortar with strength equal to or greater than the strength of the original concrete.

3.06 Surface Cleaning:

A. Substrate concrete and finished surface of concrete shall be cleaned prior to application of the FRP. Cleaning shall remove any dust, laitance, grease, oil, curing compounds, wax, stains, coatings (as necessary), surface lubricants, foreign particles, weathered layers, or any other bond-inhibiting material. If power wash is used, the surface shall be allowed to dry thoroughly before installing the FRP system. The cleaned surface shall be protected against redeposit of any bond-inhibiting materials.

3.07 STORAGE, HANDLING, AND DISPOSAL

A. **Storage Requirements:**

All components of the FRP system must be delivered and stored in the original factory-sealed, unopened packaging or in containers with proper labels identifying the manufacturer, brand name, system identification number, and date. Catalysts and initiators should be stored separately. All components must be protected from dust, moisture, chemicals, direct

sunlight, physical damage, fire, and temperatures outside the range specified in the system data sheets. Any component that has been stored in a condition different from that stated above must be disposed of, in compliance with as specified in Section 3.07 G..

B. **Shelf Life:**

All components of the FRP system, especially resins and adhesives, that have been stored longer than the shelf life specified on the system data sheet shall not be used and must be disposed of in compliance with all Federal, State, Local requirements and as specified in Section 3.07 G.

C. **Handling:**

All components of the FRP system, especially fiber sheets, must be handled with care according to the manufacturer recommendations to protect them from damage and to avoid misalignment or breakage of the fibers by pulling, separating, or wrinkling them or by folding the sheets. After cutting, sheets shall be either stacked dry with separators or at a radius no tighter than 12 in. or as recommended by the manufacturer.

D. **Safety Hazards:**

All components of the FRP system, especially resins and adhesives, must be handled with care to avoid safety hazards, including but not limited to skin irritation and sensitization and breathing vapors and dusts. Mixing resins shall be monitored to avoid firming and inflammable vapors, fire hazards, or violent boiling. The Contractor is responsible for ensuring that all components of the FRP system at all stages of work conform to the local, state, and federal environmental and worker's safety laws and regulations. The Contractor is advised that a forced ventilator system may be required inside enclosed sections and that provision for ventilation, if any, shall be included in the cost of the work.

E. **Safety Data Sheets:**

The SDS for all components of the FRP system shall be accessible to all at the project site. Specific handling hazards and disposal instructions shall be specified in the SDS section entitled Personnel and Workplace Protection. The Contractor is responsible for providing the proper means of protection for safety of the personnel and the workplace. The Contractor shall inform the personnel of the dangers of inhaling fumes of primer, putty, or resin and shall take all necessary precautions against injury to personnel. The resin mixing area shall be well vented to the outside.

F. **Clean-Up:**

The Contractor is responsible for the cleanup of the equipment and the project site from hazardous and aesthetically undesirable FRP

components using appropriate solvents, as recommended in the system data sheet.

G. **Disposal:**
Any component of the FRP system that has exceeded its shelf life or pot life or has not been properly stored in accordance with the manufacturers instructions, and any unused or excess material that is deemed waste shall be disposed of in a manner amiable to the protection of the environment and consistent with the SDS and all Federal, State, and Local requirements.

3.08 WET LAY-UP INSTALLATION

This section specifies general installation procedures for the wet lay-up of FRP systems.

A. **Environmental Conditions:**
Environmental conditions for installation shall be examined before and during installation of the FRP system to ensure conformity to the contract documents and manufacturer's recommendations. Do not apply primers, putty, saturating resins, or adhesives on cold, frozen, damp, or wet surfaces, unless the resin is moisture tolerant. Ambient and concrete surface temperatures shall be within 45-95 ºF. Moisture level on all contact surfaces shall be less than 10 percent at the time of installation of the FRP system, as evaluated according to ACI 503R-93. Moisture restrictions may be waived for resins that have been formulated for wet applications.

The work area is a confined space that will require an entry permit in accordance with OSHA regulations. The Contractor is responsible for the training of all personnel, air testing, safety equipment and complying with the requirements of OSHA

B. **Moisture Vapor Transmission:**
Application of bonded FRP systems shall not proceed if any moisture vapor transmission is present. Concrete dryness is necessary when using elevated temperature cure. Any bubble that develops from moisture vapor transmission can effectively be injected with the same adhesive material used for the FRP system following the procedure specified in Section 3.10.B.

C. **Applications in Inclement Weather:**
When inclement weather does not allow installation of the FRP system, as specified in Section 3.08 A, auxiliary measures may be employed to correct the conditions. An auxiliary heat source may be used in cold weather to raise the ambient and concrete surface temperatures to

acceptable levels, as recommended by the manufacturer, but not higher than the glass transition temperature (Tg). Pressurized air may be used to dry the surface dampness.

D. **Equipment:**
The Contractor shall provide all necessary equipment in sufficient quantities and clean operating conditions for continuous uninterrupted FRP installation.

E. **Mixing of Resin Components:**
All resin components, including the main agent and hardener, shall be mixed at the proper temperature using the appropriate weight ratio and for a duration specified by the manufacturer until thorough mixing with uniform color and consistency is achieved. Resins shall not be diluted with any organic solvents such as a thinner. Electrically powered mixing blades shall be used for mixing. Resin shall be mixed in quantities sufficiently small to ensure that it can be used within its pot life. Any mixed resin that exceeds its pot life or begins to generate heat or shows signs of increased viscosity shall not be used and shall be disposed of according to the SDS. Mixing of some resins may be accompanied by noxious fumes. Precautions must be taken regarding the resin's impact on the environment, including emission of volatile organic compounds.

F. **Primer and Putty:**
When necessary, apply one or two coats of primer on the concrete surface to penetrate its open pores. Ambient and concrete surface temperatures must be within the range specified in Section 3.08 A. The putty shall be applied prior to full cure of the primer; otherwise, the primer- coated surface shall be roughened with sandpaper or a similar tool. The resulting surface shall be cleaned according to Section 3.06 before applying the putty. Apply 40-mil (1 mm) thick coat of putty in one layer, and smooth over the surface to fill in any small voids, cracks, or uneven areas. Any swelling on the surface after applying the putty shall be corrected to meet surface profile as specified in Section 3.05. The surfaces of primer and putty shall be protected from dust, moisture, and any other contaminants before applying the FRP.

G. **Saturant:**
The saturant shall have sufficiently low viscosity to ensure full impregnation of the fiber sheets prior to curing. To maintain proper viscosity of the saturant, the ambient and concrete surface temperatures must be within the range specified in Section 3.08 A. Any mixed saturant that exceeds its pot life shall be disposed of according to Section 3.07 G.

H. **Applying Fiber Sheet and Saturant:**

The fabric will be uniformly saturated with the saturant using the saturating machine or hand saturated, where site conditions are not favorable for using the machine. The fabric will be cut to the length specified in the contract documents and shall be installed in place and gently pressed onto the wet putty. Any entrapped air between the fiber sheet and the concrete surface shall be released or rolled across the sheet in the direction parallel to the fibers while allowing the resin to impregnate the fibers and achieve intimate contact with the substrate. Rolling perpendicular to the fiber direction is not allowed. In bi-directional fabrics, rolling shall be initially in the 90° (transverse) direction end to end and then in the 0° (longitudinal) direction. Subsequent layers of fabric (if called for in the design) shall be properly saturated with saturant and applied on top of the first sheet of fabric with no interruption.

I. **Multiple-Fiber Plies:**
In multiple-ply installations, subsequent layers of fabric (if called for in the design) shall be properly saturated with saturant and applied on top of the first sheet of fabric with no interruption. A minimum of 20 mils overcoat shall be applied on top of each layer to provide adequate adhesion between the laminae. Follow the contract documents for the fiber orientation and ply stacking sequence. Each ply shall be applied before the onset of complete gelation of the previous layer. The number of plies that can be applied in a single day shall be based on the manufacturer's recommendation and the approval of the Engineer. Multiple plies can also be applied in several days. When previous layers are cured, interlayer surface preparation, such as light sanding and filling with putty, may be required, as specified in Section 3.05.

J. **Overlapping:**
A lap joint shall be constructed when an interruption occurs in the direction of the fibers. The length of the lap splice shall be as specified by the contract documents, but must be at least 12 in. Staggering of lap splices on multiple plies and adjacent strips shall be required unless permitted by contract documents. For unidirectional fabrics, no lap joint is necessary in the transverse direction unless specified in the contract documents.

K. **Alignment of FRP Materials:**
The fiber plies shall be aligned on the host pipe according to the contract documents. Any deviation in the alignment more than 5 degrees (approximately 1 in./ft) is not acceptable. Once installed, the fibers shall be free of kinks, folds, and waviness.

L. **Termination Points**
The termination points of the FRP liner shall be designed such that internal water is not allowed to seep under the FRP liner. A termination

detail shall be provided in the drawings along with the pertinent notes. Elastomeric internal joint seals (Weko or approved equivalent) can be used at the termination points with the appropriate details included in the drawing set.

M. **Curing:**
The FRP system shall be allowed to cure for 24 hours. Elevated cure temperature may be used, as specified in Section 3.08 C, if rapid curing is necessary. Cure of installed plies shall be monitored before placing subsequent plies. In case of any curing irregularity, installation of subsequent plies shall be halted. Unless otherwise noted in the contract documents and approved by the Engineer, the full load shall not be applied until curing is complete. Protect the FRP system while curing, as specified in Section 3.08. N.

N. **Protective Coating and Finishing**
It is required to use a top coat to the FRP laminate for abrasion resistance. The top coat shall be compatible with exposure conditions including moisture, salt water, elevated temperature, abrasion, UV exposure, and chemical exposure. Applicability of the top coat to the FRP laminate in corrosive environments shall be verified by testing.

O. **Protective Coating Field Application:**
Surface preparation shall be as recommended by the manufacturer. Solvent wipes shall not be used to clean the FRP surface unless approved by the FRP manufacturer. If abrasive cleaning is necessary, air pressure shall be limited to avoid any damage to fibers. Ambient and surface temperatures shall be within the range specified in Section 3.08 A, prior to applying the protective coating.

3.09 INSPECTION & QUALITY ASSURANCE

A specific QA plan shall be developed from the tests identified in this section. All inspections and tests in this section will be performed by a trained inspector acting on behalf of Owner for QA of the project in the presence of the Contractor and Engineer. The Contractor may have its own inspector for QC.

A. **Inspection of Materials:**
The manufacturer’s certifications for all delivered and stored FRP components will be inspected for conformity to the contract documents before starting the project. Materials testing will be conducted on samples if specified in the contract documents. Any material that does not meet the requirements of the contract documents will be rejected. Additional

inspection measures may be taken during the installation process if specified in the contract documents.

B. **Daily Inspection:**
Daily inspection will include date and time of repair; relative humidity; general weather conditions; surface dryness per ACI 503.4-92; surface preparation and surface profile using ICRI surface profile chips; qualitative description of surface cleanliness; type of auxiliary heat source, if any; widths of cracks not injected with epoxy; fiber or procured laminate batch numbers and their locations in the structure; batch numbers, mixture ratios, mixing times, and qualitative descriptions of the appearance of all mixed resins, primers, putties, saturants, adhesives, and coatings; observations of the progress of the cure of resins; conformance with installation procedures; adhesion test results of bond strength, failure mode, and location; FRP properties from tests of field sample panels or witness panels, if required; location and size of any delaminations or air voids; and the general progress of work.

C. **Inspection for Fiber Orientation:**
Fiber or ply orientation, fiber kinks, and waviness will be examined by visual inspection for conformity to the contract documents. Tolerances will follow Installation of the FRP System (Section 3.08 K). Any nonconforming FRP area will be removed and required as per Repair of Defects (Section 3.10).

D. **Inspection for Debonding:**
After at least 24 hours for the initial curing of the resin, a visual inspection of the surface will be performed for any swelling, bubbles, voids, or delamination. If an air pocket is suspected, an acoustic tap test will be carried out with a hard object to identify delaminated areas by sound, with at least one strike per one ft^2 (0.1 m^2). Defects smaller than .5 in. (12 mm) in diameter will require no corrective action, unless as specified in Section 3.7.2. Defects larger than .5 in. (12 mm) but smaller than 2 in. (50 mm) in diameter will be repaired as per Section 3.10. B. Defects larger than 2 in. (50 mm) but smaller than 6 in. (150 mm) in diameter, and with a frequency of less than 5 per any unit surface area of 10-ft (3 m) length or width, will be repaired as per Section 3.10 C. Larger defects will be repaired as per Section 3.10 D.

E. **Inspection for Cure of Resin:**
If specified in the contract documents, the relative cure of resin in FRP systems will be examined by visual inspection or by third party laboratory testing of resin-cup samples using ASTM D3418. Follow recommendations of the resin manufacturer for acceptance criteria. If the cure of resin is found unacceptable, the entire area will be marked and repaired as per Section 3.10 D.

F. **Tests:**

Specimens from the installed FRP system or samples representative thereof, shall be tested for tensile and adhesive strengths.

1. **ADHESION TEST** Refer to ASTM D7234 for adhesion to concrete and ASTM D4541 for adhesion to steel. In order to validate the adequacy of the surface preparation and the adhesion strength of the carbon fiber strengthening system, the Contractor shall perform random adhesion tests on the prepared concrete and steel substrate of pipe segments adjacent to repair pipes as directed by the Engineer and witnessed by the Owner's inspector. The Owner's inspector should designate the areas for trial adhesion tests prior to the surface preparation activities. These areas shall be cleaned, prepared, and covered with two-ply FRP system test patches with minimum dimensions of 2 ft x 2 ft for adhesion test to concrete substrate and minimum dimensions of 4 in. x 4 in. for adhesion to steel substrate. The patch shall consist of two orthogonal plies of FRP laminae, with a layer of GFRP first applied on any steel substrate. Adhesion test shall be performed and reported in accordance with ASTM D7234 for adhesion to concrete. Three adhesion tests shall be performed on each test patch. The remaining adhesion test patches shall be finish coated and remain in place for future testing purposes as needed. The Contractor shall log the location of the adhesion test and report the test results to the Owner.

2. **Tensile Strength Test (ASTM D3039):** Test panels shall be field fabricated using the FRP fabric, resins and saturation equipment used in the production runs for the field-installed FRP strengthening system. Tensile test panels shall be approximately 12 in. by 24 in. single ply laminate with carbon/glass fiber oriented in the same direction. The test panel shall be prepared on a smooth flat surface overlaid with plastic (polyethylene or vinyl) sheeting. Saturating resin shall be used to prime the surface, followed by the saturated FRP system, and finally topped with more saturating resin. A cover of plastic sheeting shall be placed over the panel and the panel squeegeed to remove any bubbles and other surface irregularities to insure a smooth flat surface. The panel shall be labeled with time, date, and sample panel number, fabric lot numbers, and resin batch numbers, and stored in an environment representative of the pipeline inside condition to cure until collected for lab testing.

   The test lab will perform a minimum of ten tensile tests with the fibers oriented in the strong direction for each tensile test panel in accordance with ASTM D3039, and report certified tests results for tensile strength, tensile modulus, related specimen dimensions, and percent elongation. For projects where multiple test panels with the same fabric batch are prepared, it is permissible to perform 5 tension tests per panel instead of 10 tests per panel, subject to review and approval by the Engineer.

   The FRP system will be unacceptable if the average tensile strength is below that specified in the contract documents. If required, the minimum

compressive strength values used for design shall be less than 60% percent of the average tensile strength of the FRP system.

3.10 REPAIR OF DEFECTS

This section specifies the conditions and types of defects that require repair and the acceptable methods of repair. Defects are of different types and may be generally classified as aesthetic, short-term critical, or long-term critical. Repair procedure depends on the type, size, and extent of defects. Repair procedures for any conditions not addressed in these specifications or in the contract documents shall be submitted by the Contractor and approved by the Engineer prior to proceeding with the work.

A. Repair of Protective Coating:

Defects in protective coating can be of three types: small hairline cracks, blistering, and peeling. In all cases, moisture content of the substrate should be below 0.05% before applying a new coating. Prior to any repair of protective coating, the FRP system shall be examined visually or otherwise to ensure that no defect exists within or on the surface of the FRP. Defects in FRP, if found, shall be repaired as per Section 3.10. If protective coating appears to show small areas with cracks, the local surface shall be lightly sanded. Then, a new coating with appropriate primer shall be applied according to the manufacturer's recommendations. At the minimum, the coating shall be applied over an area extending 1 in. on either side of the defect. If the protective coating shows signs of blistering, the entire area of blisters as well as the surrounding area to a distance of at least 12 in. shall be carefully scraped clean. In no case should a blistered surface be recoated without complete removal of the existing coating. The area shall be wiped clean and dried thoroughly. Once dry, the area can be recoated after application of the primer coat if required by the manufacturer. If the surface shows signs of excessive peeling, the entire coating shall be scraped off and the surface lightly sanded, wiped clean, and thoroughly dried before applying a new coat according to the manufacturer's recommendations.

B. Epoxy Injection of Small Defects:

Small entrapped voids or surface discontinuities no larger than 2 in^2 (1,300 mm^2) in diameter shall not be considered defects and require no corrective action unless they occur next to edges or when there are more than five such defects in an area of 10 ft^2 (0.1 m^2). Small defects shall be repaired using low-pressure epoxy injection as long as the defect is local and does not extend through the complete thickness of the laminate in case of multiple-ply FRP systems. If any delaminations growth is suspected between the FRP plies due to injection, the procedure shall be halted, and repair shall follow Section 3.10 C.

C. Patching of Minor Damage:

Minor defects are those less than 25 in^2 (16,000 mm^2). The area surrounding the defects to an extent of at least 1 in. (25 mm) on all sides shall be carefully

removed. The area shall be wiped clean and thoroughly dried. The area shall then be patched by adding an FRP patch of the same type as original laminate and extending at least 1 in. (25 mm) on all sides of the removed area. Depending on the size and quantity, some delaminations can be repaired by resin injection upon approval of the Engineer.

D. **Replacement of Large Defects:**
Defects larger than 25 in^2 (16,000 mm^2) in diameter shall be carefully marked and scarfed out extending to a minimum of 1 in. (25 mm) on all sides. Scarfing shall be progressing through the layers in the case of multiple-ply FRP systems until past the defective area. In case the defect extends to the first FRP ply adjacent to the concrete, the entire thickness of the FRP and primer shall be removed. The substrate shall be appropriately prepared and primer reapplied after ensuring that the surface and FRP are clean and dry. Application of a new FRP system within the scarfed area shall follow procedures for the original FRP system, except that an additional layer extending a minimum of 6 in. (150 mm) on all sides of the scarfed area shall be added as a patch. Depending on the size and quantity, some delaminations can be repaired by resin injection upon approval of the Engineer. Once cured, the protective coating shall be applied over the entire area.

3.11 PROJECT CLOSE-OUT AND MAINTENANCE

A. **Documentation of the work.**

The Owner may provide specification language requiring documentation of the work be prepared and submitted by the Contractor on completion of the work. The documentation shall include the following:

Information on the products and installation method used
Pre- and post-inspection results
Test results
Any changes or deviations from the contract documents and possible corrective work

B. **Owner's Inspector may also prepare documentation of the project and include the following:**
Purchaser's Inspector's tests and reports
Material test reports
Field test reports
As-built drawings of the renewed or strengthened segments

C. **Verification/Basis for Rejection**

Materials not complying with the requirements of this specification shall be rejected. Repairs, replacements, and retesting shall be accomplished in accordance with the Owner's documents.

D. **Affidavit of Compliance**

The Owner may require an affidavit from the Manufacturer or Contractor, as applicable, that the material provided or the installation performed complies with the applicable requirements of the specifications provided herein.

3.12 WARRANTY

The Contractor shall provide a 10-year warranty on the material and up to two years on the labor used for installation of the FRP system. Any defects affecting structural and hydraulic performance of the FRP system shall be repaired by the Contractor at no cost to the Owner. The methods to repair such defects include, but are not limited to those outlined in Section 3.10. Cosmetic defects such as discoloration and minor undulations do not need to be repaired or included in the warranty. Any damage caused by direct impact or loads that are substantially higher than the normal operation is not covered by the warranty. The Owner will provide all required access to the area to be repaired.

END OF SECTION

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SECTION 01500

Temporary Control of Construction Operations

PART 1 – GENERAL

1.01 SCOPE

A. The work covered by this Section includes furnishing all labor, equipment, and materials required for temporary control of construction operations.

1.02 RELATED SECTIONS

A. The Work of the following Sections specifically apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of Work.

1. Section 02112: Route Clearing
2. Section 02125: Erosion and Sediment Controls
3. Section 02140: Dewatering
4. Section 02491: Rehabilitation of Sanitary Sewer Manholes
5. Section 02575: Removing and Replacing Pavement
6. Section 02730: Sewers and Accessories
7. Section 02750: Wastewater Flow Control

1.03 PUMPING

A. The Contractor shall furnish and operate pumping and appurtenant piping for dewatering, flow rerouting, or any similar purposes.

B. Standard Pumping equipment (as opposed to Reduced Noise Emitting Pumps ex. Quiet Zone, etc.) that could disturb the public shall be operated only during a standard workday or as approved in writing by the Engineer.

C. No discharge of raw sewage will be permitted to area watercourses under any circumstances. The Contractor shall be held responsible for any such discharge including, but not limited to, fines, legal fees, and any other cost associated with such a discharge.

1.04 TEMPORARY FACILITIES

A. The Contractor shall provide all temporary facilities for water, heat, electric light, and power as required for the work during the entire period of operations. Contractor shall be responsible for payment of utility costs for the duration of construction.

B. The Contractor shall provide temporary toilets as required and shall maintain them in a sanitary condition for the duration of the work and remove them at completion.

C. On or before the completion of the work, the Contractor shall remove all temporary facilities, together with all rubbish and trash, as directed by the Engineer.

1.05 STORAGE

A. The Contractor shall secure adequate storage to accommodate the required equipment, vehicles, and materials for the period of performance of the Contract.

1.06 USE OF PREMISES

A. The Contractor shall not load nor permit any part of any structures to be loaded with a weight that will endanger its safety.

B. The Contractor shall confine his apparatus, the storage of materials and the operations of his workers to the limits defined by laws, ordinances, permits, or directions of the Engineer and shall not unduly encumber the premises with his materials.

C. The Contractor shall enforce the instructions of the Engineer regarding signs, advertisements, fire and smoking.

1.07 FLOW CONTROLS

A. During the entire span of the construction, including inspection, the Contractor shall be responsible to maintain flow in the sewerage system and service to all properties.

B. Any line plugging or flow restriction shall be with equipment designed specifically for such purpose. A sewer line plug shall be inserted into the line at a manhole upstream from the section being worked on.

C. Care shall be taken to prevent sewage from backing into buildings, ponding, flooding, or otherwise damaging public or private property.

D. Controls shall be utilized to prevent sewage from entering surface drainage facilities or water courses, either directly or as a result of overflow from drainage structures.

E. When bypass pumping is required and ordered by the Engineer, the Contractor shall supply the necessary pumps, conduits, and other equipment to divert the flow of sewage around the manhole section in which work is to be performed into a downstream section. The bypass system shall be of sufficient capacity to handle all existing flows.

F. No flows shall be diverted from the sewerage system unless a schedule has been approved by the Georgia Environmental Protection Division.

G. See Specification Section 02750 – Wastewater Flow Control, for additional requirements.

1.08 MAINTENANCE OF EXISTING OPERATION

A. The Contractor shall schedule all demolition and construction and maintain continuous operation of the existing wastewater system facilities.

B. Piping to be abandoned shall be plugged with concrete in a manner approved by the Engineer, so as to be made watertight. All active utilities traversing the site shall be preserved in operating condition.

1.09 MAINTENANCE DURING CONSTRUCTION

A. The Contractor shall maintain, at his expense, the work during construction and until final acceptance of all work under the Contract. Continuous and effective work shall be prosecuted day by day, with adequate equipment and forces as required to keep the backfill, pavement, structures, pipe lines and other features in satisfactory and acceptable condition at all times.

B. In the event the Contractor fails to remedy any unsatisfactory situation, within twenty-four hours after receipt of written notice from the Engineer describing the unsatisfactory conditions, the City may immediately proceed with adequate forces and equipment to maintain the project; and the entire cost of this maintenance will be deducted from the monies otherwise due the Contractor under the Contract.

C. As an alternative to the above specified maintenance, the cost of all of the items, which are not properly maintained, may be deducted at the Contract Prices from the current partial payment request even if such items have been paid for in previous estimates.

1.10 CLEAN-UP AND DISPOSAL

A. At the end of each day's operation, the Contractor shall thoroughly clear the work site of all dirt or debris, and generally restore the site to an acceptable condition. Upon completion of the work, all excess material and rubbish shall be removed from the job site and disposed of. The surrounding construction area shall be left in as good a condition as that which existed prior to construction.

B. The Contractor shall transport and expeditiously dispose of all materials removed from the construction site. Disposal shall be at a site approved by the Engineer at no additional cost to the City and in a manner consistent with all-applicable codes and regulations.

1.11 CONSTRUCTION ALONG HIGHWAYS, STREETS, AND ROADWAYS

A. Install pipe lines and appurtenances along highways, streets and roadways in accordance with the applicable regulations of, and permits issued by, the Georgia Department of Transportation and City of Atlanta, with reference to construction operations, safety, traffic control, road maintenance and repair.

B. Traffic Controls:

1. The Contractor shall provide, erect, and maintain all necessary barricades; suitable and sufficient lights and other traffic control devices; provide qualified flagmen where necessary to direct traffic; take all necessary precautions for the protection of the work and the safety of the public. Flagmen shall be certified by a Georgia DOT-approved flagman training program.

2. Construction traffic control devices and their installation shall be in accordance with the current Manual on Uniform Traffic Control Devices for Streets and Highways.

3. Placement and removal of construction traffic control devices shall be coordinated with the Georgia Department of Transportation and City a minimum of 48 hours in advance of the activity.

4. Placement of construction traffic control devices shall be scheduled ahead of associated construction activities. Construction time in street right-of-way shall be conducted to minimize the length of time traffic is disrupted. Construction traffic control devices shall be removed immediately following their useful purpose. Traffic control devices used intermittently, such as "Flagmen Ahead," shall be removed and replaced when needed.

5. Existing traffic control devices within the construction work zone shall be protected from damage. Traffic control devices requiring temporary relocation shall be located as near as possible to their original vertical and horizontal locations. Original locations shall be measured from reference points and recorded in a log prior to relocation. Temporary locations shall provide the same visibility to affected traffic as the original location. Relocated traffic control devices shall be reinstalled in their original locations as soon as practical following construction.

6. Construction traffic control devices shall be maintained in good repair, and shall be clean and visible to affected traffic for daytime and nighttime operation. Traffic control devices affected by the construction work zone shall be inspected daily.

7. Construction warning signs shall be black legend on an orange background. Regulatory signs shall be black legend on a white background. Construction sign panels shall meet the minimum reflective requirements of the Georgia Department of Transportation and City of Atlanta. Sign panels shall be of durable materials capable of maintaining their color, reflective character and legibility during the period of construction.

8. Channelization devices shall be positioned preceding an obstruction at a taper length as required by the current Manual on Uniform Traffic Control Devices for Streets and Highways, as appropriate for the speed limit at that location. Channelization devices shall be patrolled to insure that they are maintained in the proper position throughout their period of use.

C. Construction Operations:

1. Perform all work along highways, streets and roadways to minimize interference with traffic.

2. Stripping: Where the pipe line is laid along road right-of-way, strip and stockpile all sod, topsoil and other material suitable for right-of-way restoration.

3. Trenching, Laying and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

4. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

5. Construction operations shall include cleanup and utility exploration.

D. Excavated Materials: Do not place excavated material along highways, streets and roadways in a manner that obstructs traffic. Sweep all scattered excavated material off the pavement in a timely manner.

E. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.

F. Landscaping Features: Landscaping features shall include, but are not necessarily limited to, fences, property corners, cultivated trees, and shrubbery, man-made improvements, subdivision signs, and other signs within the right-of-way and easement. The Contractor shall take extreme care in moving landscape features and promptly re-establishing these features.

G. Maintaining Highways, Streets, Roadways and Driveways:

1. Maintain streets, highways, roadways and driveways in suitable condition for movement of traffic until completion and final acceptance of the work.

2. During the time period between pavement removal and completing permanent pavement replacement, maintain highways, streets, and roadways by the use of steel running plates. The edges of running plates shall have asphalt placed around their periphery to minimize vehicular impact. The backfill above the pipe shall be compacted, as specified elsewhere up to the existing pavement surface to provide support for the steel running plates.

3. Furnish a road grader or front-end loader for maintaining highways, streets, and roadways. Make the grader or front-end loader available at all times.

4. Immediately repair all driveways that are cut or damaged. Maintain them in a suitable condition for use until completion and final acceptance of the work.

1.12 ACCESS ROADS

A. Streets, road and drives used by the Contractor for access to and from the site of the work shall be protected from damage caused by the normal traffic of vehicles used for or in connection with construction work. Any such damage done shall be repaired immediately and left in good condition at the end of the construction period. Any new access road construction shall be “all weather” and have drainage structures placed as shown or as required.

END OF SECTION

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SECTION 01532E

Smoke Testing

PART 1 – GENERAL

1.01 WORK OF THIS SECTION

A. The objective of smoke testing of the City sewers is to locate specific sources of direct inflow to the City's sanitary sewers, such as storm sewer cross-connections, roof leaders, yard and basement drains, fountain drains, and abandoned building sewers, and to locate system defects which contribute inflow and/or infiltration to the City's sewers, including broken sewer pipe and service laterals and areas subject to ponding.

B. Smoke testing work shall be conducted on all pipes selected by the Engineer.

C. It is the responsibility of the Contractor to comply with OSHA regulations, the City's Safety Guidelines, and the City's Confined Space Guidelines as applicable. The Contractor shall submit written documentation that all workers have received the training required under these regulations and guidelines by qualified persons or organizations.

D. The Contractor shall provide all labor, material, supplies, equipment, and transportation necessary to complete the smoke testing work.

E. Smoke testing may affect residences and/or business in the area being tested. Therefore, public and emergency response notification is an important aspect of this testing procedure. Such notification shall be conducted as specified herein and is a prerequisite for initiating smoke testing.

1.02 EXPERIENCED WORKERS

A. Supervisor of the field crews shall have received proper training in this function and have a minimum of three years experience in performing smoke testing including safe working practices, access to and decent into confined spaces, etc.

B. Crew Leaders/Field Supervisors assessing the condition of manholes shall have received proper training in this function and have a minimum of one year experience in performing smoke testing including safe working practices and access to and decent into confined spaces, etc. No crew members shall enter confined spaces without the necessary certified training and at least one year experience.

C. The Contractor shall provide the designated Engineer with written documentation that all crew members responsible for smoke testing have received the proper training and where required the requisite experience.

D. The Contractor shall provide a detailed reference list of Smoke Testing experience during the last three years. References shall include contact (name and position), agency, telephone number, address, date of work, and length of sewer inspected.

1.03 SUBMITTALS

A. The Contractor shall provide to the Engineer the following information in writing prior to the set deadline, or at the indicated frequency, whichever is applicable.

Type of Submittal	Time/Frequency of Submittal
Contractor's Record of Smoke Testing Experience	At Pre-Construction Meeting
Worker's Confined Space Certification	At commencement
Manufacturer's data and literature on the smoke proposed for use in smoke testing, including the MSDS sheet	At commencement

B. Daily reports (by 9.00 a.m. on day following survey) and weekly reports (by 9.00 a.m. on Monday following week of survey) shall be e-mailed to the designated Engineer. A copy of the fire department notification of daily smoke testing schedule, advising area of start time and ending time, shall also be e-mailed to the designated Engineer.

C. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work, which were incidental to the contract. The Contractor shall include in his daily record, reference to:

1. Delays: e.g. Dense traffic, lack of information, sickness, labor or equipment shortage

2. Weather: conditions, e.g. rain, etc.

3. Equipment: on site, e.g. specialist cleaning, by-pass equipment, etc.

4. Submittals: to the designated engineer representative

5. Personnel: on site by name, e.g., all labor, Specialist Services, etc.

6. Accident: report, e.g. all injuries, vehicles, etc.

7. Incident: report, e.g. damage to property, property owner complaint, etc.

8. Major defects encountered, including collapsed pipe, if any: e.g. cave-ins, sink holes, etc.

9. Visitors: on site

The designated Engineer Representative on site shall certify receipt of the daily record noting any items and adding any observations with reference to claims for payment to the Contractor. The Engineer Representative may at his discretion, for which the Contractor must receive direction in writing, an exception to this requirement for weekly submission of progress rather than for daily submission.

1.05 RELATED SECTIONS

A. The Work of the following Sections apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

1.06 DATA QUALITY

A. Data must be of a quality that accurately represents conditions found in the field and provided in form that matches valid criteria of the City's maintenance Management System. Contractor must implement a Quality Assurance/Quality Control (QA/QC) Program that follows a written procedure. The written procedure must be submitted for approval by the Engineer. Written documentation must be provided, each time that data is submitted, indicating results of the QA/QC check.

B. The Contractor’s data quality control program shall include routine outside auditing of the work completed by a qualified subcontractor. The qualified subcontractor shall meet the minimum specified Contract requirements for the performance of the work and shall be approved in writing by the Engineer. The accuracy of the Contractor’s data shall be based on the percentage of the data confirmed correct by the subcontractor. The minimum acceptable accuracy of the data shall be 85%. The general sequence of the auditing shall be as follows:

1. The Engineer shall randomly select one day per month, typically in the first week of the month, and the work performed during this day shall be reviewed and/or repeated by the qualified subcontractor.

2. If the work is greater than or equal to 85% accurate, no further outside auditing will be required for the month unless requested by the Engineer at his sole discretion. The cost for this audit is included in the allowances specified in the Bid Form.

3. If the work is less than 85% accurate, the Contractor shall at his own expense repeat and/or correct the work and have the work re-audited by the qualified subcontractor.

4. If this work is still less than 85% accurate, the Contractor shall repeat and/or correct and have the work re-audited, at his own expense, until the work is greater than or equal to 85% accurate.

5. When this re-audited work is found to be greater than or equal to 85% accurate, the Contractor shall have the work of another randomly selected day in the same month reviewed and/or repeated by the qualified subcontractor at the Contractor's own expense.

6. Steps 2 through 5 shall be repeated at the Contractor's own expense until the selected day is 85% accurate on the initial audit.

7. The occurrence of five randomly selected days not achieving 85% accuracy on initial subcontractor review will constitute cause for dismissal.

8. If the Contractor successfully meets the 85% accuracy requirement for the initial randomly selected day for two consecutive months (Step 2 above), the Contractor may subsequently audit one day every other month. The Contractor may continue auditing one day every other month until the initial randomly selected day does not meet 85% accuracy, at which time it must resume auditing one day every month.

PART 2 – PRODUCTS

2.01 SMOKE BOMBS & BLOWERS

A. Smoke Bombs or high grade mineral oil shall be used to generate the smoke required for testing. Smoke shall be dense, non-toxic, odorless, and non-staining. Smoke bombs or canisters shall have a minimum of a 3-minute continuous duration and shall be equal to those manufactured by Superior Signal Company.

B. Blowers and, where required, double blowers, shall be used to force smoke into the sewer and shall be portable, custom-mounted to be installed over an open manhole casting, and shall have a maximum capacity of 4,500 cfm each and a minimum capacity of 2,000 cfm.

PART 3 – EXECUTION

3.01 METHODOLOGY

A. Intensified smoke testing techniques shall be employed in all cases. Intensified techniques shall include at least one blower capable of a free air delivery of at least 2,000 cfm and smoke generation for a minimum of nine minutes. Up to three line legments but no more than 1,000 feet of sewer main may be tested at one time. However, a separate Smoke Test Report must be filled out for each line segment even if no defect is found. Line sections shall be adequately isolated if necessary by using sandbags, baffles, or other methods approved by the designated Engineer Representative. Smoke emanating from vents on building or adjacent manholes will determine the extent of successful smoke testing. Only clearly visible, dense smoke will qualify the sewer main tested for acceptance up to 1,000 feet of sewer main.

B. Additional measures describing methodologies and products to smoke test larger diameter pipes shall be submitted for prior approval before smoke testing commences on all sewers greater than 18-inches diameter and all sewers greater than 15-feet in depth.

C. Restrictions: Smoke testing shall not be conducted on rainy days, on cloudy days following rain, or when saturated soil conditions exist. Rainy days are defined as days where greater than 0.2 inches of rain fall in any consecutive twelve-hour period. Testing shall be closely monitored on windy days. If smoke coming out of the ground is blown away so quickly as to escape accurate detection and/or photo documentation, testing shall cease until such time that weather conditions permit an accurate record of smoke testing results.

D. The perimeter of each residence or commercial building shall be completely inspected, front and back, for sources of smoke. The roofs of each building shall be visually inspected for evidence of roof drains connected to sanitary drains.

3.02 DOCUMENTATION

A. The following data will be recorded on a paper form and entered into a database by the Contractor, using the required file format in Microsoft ACCESS ®. Data, where specified, will be recorded using CODES provided by the Engineer. A hard copy and electronic diskette shall be submitted to the Engineer. The smoke test database shall include the following information at a minimum:

1. Description of the smoke return (“leak”), including intensity code and amount (i.e. equivalent gpm)

2. Date and time

3. Location, including reference to the relevant manhole segment (upstream and downstream manhole incorporating the City manhole numbering system) and the nearest street address

4. Area and type of surface drained by the smoke return (“leak”)

5. Testing personnel

6. Digital color photographs filenames of the results of each smoke test

B. Schematic layout of the manholes and sewer lines under testing (including address and location, photo number and direction taken, dimensional ties and offsets to the documented smoke returns (“leaks”), and area and type of surface drained. Note geographical orientation relative to north)

C. Example Smoke Testing Report Form is provided at the end of this section to illustrate the content intended to be received.

3.03 PHOTOGRAPHIC DOCUMENTATION PROCEDURES

A. The Contractor shall document each smoke leak or series of leaks by high-resolution digital photograph. Digital photographs shall be provided in jpeg (.jpg) format. The resolution of the photographs shall be a minimum of 72 dpi x 72 dpi and minimum dimensions of 640 X 480 pixels. The photographs shall be referenced in the database by filename along with the location of the smoke defect using the 90-degree laser measurement system.

B. Photographs will be taken in such a way that the smoke leak is clearly visible in the foreground and a distinct fixed reference is visible in the background. For example, if the smoke leak is on a private service line in front of a house, the photograph should include a sufficient image of the house so that someone can go back to the site and place himself/herself near the smoke leak, with nothing more that the photograph and an address. This method of referencing something fixed will support QA/QC to ensure that smoke leaks, and their associated data, can be confirmed by someone other than the original smoke crew.

C. Groups of digital photographs orientated so that the long side of the photograph is horizontal and that 3"x 5" printed copies can be incorporated in the hard copy of the smoke testing report, shall be supplied on a CD-ROM(s) incorporated for each work order issued by the Engineer unless otherwise directed.

D. The digital photographs shall incorporate annotated references superimposed on the image to upstream manhole number and date when the photograph was taken. The annotation shall be clearly visible and shall have a 12pt (uppercase) font size. Each photograph shall have a clearly labeled frame number. The frame number shall include the upstream manhole number then the letter S followed by the three- character right justified photo sequence number (e.g., 12340145601S003). Reference to location of each photograph shall be indicated on the sketches at the end of the report. A dot shall be drawn on the sketch to indicate the position of the photographer, with an arrow pointing in the direction that the photograph was taken

E. Example photographs are provided at the end of this section to illustrate the content intended to be received.

3.04 PUBLIC NOTIFICATION

Refer to Specification Section 01351: Public Notification.

3.05 TRAFFIC CONTROL

A. Refer to Specification Section 01500: Temporary Control of Construction Operations for requirements.

3.06 DELIVERABLES

A. Electronic database with defect locations, along with at least one digital photograph of each smoke leak shall be submitted to the designated Engineer. An official transmittal letter shall accompany all deliverables. The electronic database, using the required file format in Microsoft ACCESS ® Version 2003, shall be tied to the City GIS sewer maps through the manhole numbers. A separate database shall be submitted for each sewershed. A cumulative corrected database submittal must accompany any corrected hard copy submittals, and must properly reflect corrections made to the hard copy.

B. A binder with hard copies of the smoke test reports including smoke testing photos and smoke locations shall be submitted to the Engineer – see example at end of section. Data for each sewershed must be submitted separately - each submittal must contain data for only one sewershed. The first submittal for each sewershed must be delivered in a 4-inch binder. The binder must be labeled on the spine, as well as the front cover, with company name, sewershed, date, investigation method, submittal number, and Clean Water Atlanta logo. All subsequent data submittals for each sewershed must be submitted in properly labeled envelopes. Corrected data must be submitted separately from preliminary (new) data, and must be clearly labeled as such. All data submittals must be organized in

ascending order of upstream manhole numbers. A summary sheet listing each sewer line segment for which data is being submitted must be included with each submittal. Smoke testing data must be submitted separately from CCTV data and dye testing data.

C. All photographs shall be digital pictures in both hard copy and electronic format.

D. Data Collection Methods: Electronic data must be delivered in the prescribed method for uploading to the City's Maintenance Management System. However, the Contractor may use whatever method he chooses to collect the data. The data tables to be populated are described in detail at the end of this section. Electronic copies of blank data tables will be provided to Contractor at the Pre Construction Conference.

E. The Smoke Testing Form must be delivered in the format given at the end of this section.

Date Visited:_____

City of Atlanta
Department of Public Works

Notice To Residents

Smoke Testing of Sewer Lines

"Contractors Name" represented by "personnel involved in the smoke testing" under contract with the City of Atlanta, will be conducting smoke tests within your neighborhood as part of an ongoing program to detect leaks within the sewer collection system in the next few days. Smoke that you may see is **non-toxic, creates no fire hazard, and will not harm children, pets, or plants**. Persons with severe asthma should avoid breathing any smoke to avoid irritation. Please help us notify shut-ins in your area that may not receive this notice.

If smoke enters your house, you should report it to the crews conducting the test so we can help you locate the source while the test is still in progress. Repairs to your internal plumbing are at your own discretion, we are only testing for problems on the sewer lines outside.

Please accept our apologies for any inconvenience this may cause and thank you for your assistance. If you should have any questions regarding these tests, please call the

Department of Public Works Information Offices at (404) 330-6980.

Under normal circumstances, the smoke will not enter your home if the plumbing is working properly. You will see smoke coming from vents on the roof of your home which is a normal occurrence. In most cases, entrance of smoke in a dwelling is through fixtures that are not routinely used; therefore we would request that you run water at all of your fixtures to ensure that all of the drain traps are full of water. **Please fill the traps immediately upon receiving this notice with approximately one quart of water.** The testing will occur within the next few days so that the water will not have time to evaporate before we have completed our work. It is not necessary that you be home during these tests. If smoke gets in while you are out, it will dissipate without leaving any odors. The smoke used is manufactured specifically for this application and is, therefore, non-toxic and non-staining.

(EXAMPLE)

SMOKE TESTING REPORT **SERIAL #**

UPSTREAM MANHOLE: . . . . . **PROJECT:**

DOWNSTREAM MANHOLE: . . . . . **SEWERSHED:**

DATE: **LENGTH:** **SMOKE TEST TEAM:** ----------

SN	SOURCE ADDRESS /LOCATION	GPS ID	RESULTS	STATUS	SOURCE	SMOKE	AREA FT	AREA FT	RUN OFF	CCTV Y/N	PHOTO NO.#
1											
2											
3											
4											
5											
6											
7											
8											

RESULTS CODES
1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES
1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES
ABS ABANDONED SERVICE
AD AREA DRAIN
BCO BROKEN CLEANOUT
CBX CATCH BASIN
DEP DEFECTIVE PLUMBING
DWD DRIVEWAY DRAIN
EXP EXPOSED PIPE
FCL FRAME COVER LEAKS
FDD FOUNDATION DRAIN
HOL SOIL FISSURES
HSD FISSURES IN STORM DITCH
MCC MISSING CO COVER
MFC MANHOLE FRAM COVER
MHS MANHOLE STRUCTURE
MLK MULTIPLE SOIL FISSURES
RLD ROOF LEADER CONNECT
SMH STORM MANHOLE
SWD STAIRWELL DRAIN
WWD WINDOW WELL DRAIN

SMOKE CODES / INTENSITY
1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES
1. NO PAVING
2. 25% PAVING
3. 50% PAVING
4. 75% PAVING
5. 100% PAVING

* NOTE: Defect Position established using GPS coordinates/ID

N

COMMENTS

(EXAMPLE)
SMOKE TESTING PHOTOS **SERIAL #**

UPSTREAM MANHOLE		
DOWNSTREAM MANHOLE		
DATE	**CONTRACTOR .**	**CREW.**

COMMENTS

END OF SECTION

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SECTION 01532F

Dye Testing

PART 1 – GENERAL

1.01 WORK OF THIS SECTION

A. The objective of dye water testing, when used in conjunction with CCTV is to pinpoint specific points of entry of inflow into the sanitary sewer system, such as direct and indirect connections of storm drains, yard drain inlets and pipes, sinkholes, leaking manholes in unpaved areas and leaking manhole covers and rings. Dye water testing shall also be used to trace line segments during sewer map updating, and co-relationship of individual properties to sewer lines.

B. Dye Testing shall be conducted at sites recommended by the Contractor or designated Engineer Representative, based upon the findings of other source detection methods, as approved by the Engineer.

C. It is the responsibility of the Contractor to comply with OSHA regulations, the City's Safety Guidelines, and the City's Confined Space Guidelines as applicable. The Contractor shall provide written documentation that all workers have received the training required under these regulations and guidelines by qualified persons or organizations.

D. The Contractor shall provide all labor, material, supplies, equipment, and transportation necessary to complete the dye testing.

E. Dye Testing may affect residences and/or business in the area being tested. Therefore, notification of affected property owners is an important aspect of this testing procedure, and such notification shall be conducted as specified herein as a prerequisite for conducting dye testing.

1.02 EXPERIENCED WORKERS

A. Supervisor of the field crews shall have received proper training in this function and have a minimum of three years experience in performing such Dye Tests including safe working practices, access to and decent into confined spaces, etc.

B. Crew Leaders/Field Supervisors performing Dye Testing shall have received proper training in this function, including safe working practices and access to and decent into confined spaces, etc. No crew members shall enter confined spaces without the necessary certified training.

C. The Contractor shall provide the designated Engineer with written documentation that all crew members responsible for Dye Testing have received the proper training and where required the requisite experience.

D. The Contractor shall provide a detailed reference list of Dye Testing experience. References shall include contact (name and position), agency, telephone number, address, date of work, and number of manholes inspected.

1.03 SUBMITTALS

A. The Contractor shall provide to the Engineer the following information in writing prior to the set deadline, or at the indicated frequency, whichever is applicable.

Type of Submittal	Time/Frequency of Submittal
a) Contractor's Record of Dye Testing Experience	At Pre-Construction Meeting
b) Workers Confined Space Certification	At commencement
c) Manufacturer's data and literature on the dye proposed for use in smoke testing	At commencement

B. Daily reports (by 9.00 a.m. on day following survey) and weekly reports (by 9.00 a.m. on Monday following week of survey) shall be e-mailed to the Engineer's representative.

C. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the contract. The Contractor shall include in his daily record, reference to:

1. Delays: e.g. dense traffic, lack of information, sickness, labor or equipment shortage

2. Weather: conditions, e.g. rain etc.

3. Equipment: on site, e.g. specialist cleaning, bypass equipment, etc.

4. Equipment: downtime, e.g. pump out of fuel, CCTV camera lights broken, etc.

5. Personnel: on site by name, e.g. all labor, specialist services, etc.

6. Submittals: to the designated Engineer, e.g. daily report, Dye Testing Report, etc.

7. Accident: report, e.g. all injuries

8. Incident: report, e.g. damages to property, property owner complaints, etc.

9. Major defects encountered, including collapsed pipe, if any: e.g. cave in, sink holes, etc.

10. Visitors: on site

D. The designated Engineer Representative on site shall certify receipt of the daily record noting any items and adding any observations with reference to claims for payment to the Contractor. The Engineer Representative may at his discretion, for which the Contractor must receive direction in writing, an exception to this requirement for weekly submission of progress rather than for daily submission.

1.04 RELATED SECTIONS

A. The Work of the following Sections apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

1. Section 02752: Internal Sewer Condition Assessment

1.05 DATA QUALITY CONTROL

A. Data must be of a quality that accurately represents conditions found in the field and provided in form that matches valid criteria of the City's Maintenance Management System. Contractor must implement a Quality Assurance/Quality Control (QA/QC) Program that follows a written procedure. The written procedure must be submitted for approval by the Engineer. Written documentation must be provided each time that data is submitted indicating results of the QA/QC check.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 METHODOLOGY

A. The Contractor shall propose in writing the methodology to be used for dye

testing and submit the proposed methodology to the Engineer for approval prior to commencement of work together with the corresponding schedule. The proposed methodology shall include taking digital color photographs of the results of all dye testing.

B. As a minimum, Contractor flood the area over the leak with dyed water and check for dye at 15 minute intervals for up to one hour, noting positive or negative each time checked. Two photographs will be taken: one when dyed water is applied and a second when positive results are noted, or at the one-hour check if results are negative.

3.02 DOCUMENTATION

A. The following data shall be recorded by the Contractor, using the required file format in Microsoft ACCESS® on a paper form and entered into a database. Data, where specified, will be recorded using codes provided by the Engineer. A hard copy and electronic diskette shall be submitted to the Engineer. The dye test database shall include the following information at a minimum:

1. Date and time

2. Location, including reference to the relevant manhole segment (upstream and downstream manhole incorporating the City manhole numbering system) and the nearest street address

3. Testing personnel

4. Schematic layout of the manholes and sewer lines under test – noting location of sandbags and/or plugs

5. Precise location of the site of confirmed source of inflow or leak, as determined by the dye testing, keyed to the relationship to appropriate manhole and pipe numbers from the City's GIS mapping system and street address, and confirmation of any negative results of dye testing

6. Digital color photographs filenames of the results of each dye test

B. Example Dye Testing Report Form is provided at the end of this section to illustrate the content intended to be received.

3.03 PHOTOGRAPHIC DOCUMENTATION PROCEDURES

A. Digital photographs shall be provided in jpeg (.jpg) format. Resolution of photographs shall be a minimum of 72 dpi x 72 dpi and minimum

dimensions of 640 X 480 pixels. The Contractor shall document each dye leak or series of dye tests by high-resolution digital photograph. The photographs shall be included in the database along with the location of the dye test defect.

B. Groups of digital photographs orientated so that the long side of the photograph is horizontal and that 3"x 5" printed copies can be incorporated in the hard copy of the dye testing report, shall be supplied on a CD-ROM(s) incorporated for each work order issued by the Engineer unless otherwise directed.

C. The digital photographs shall incorporate annotated references superimposed on the image to upstream manhole number and date when the photograph was taken. The annotation shall be clearly visible and shall have a 12pt (uppercase) font size. Each photograph shall have a clearly labeled filename incorporating the upstream manhole ID followed by the letter “D” and the three character sequence number assigned by the digital camera (e.g. 12341211401D113). Reference to location of each photograph shall be indicated on the sketches at the end of the report.

D. Example photographs are provided at the end of this section to illustrate the content intended to be received.

3.04 PUBLIC NOTIFICATION

A. Refer to Specification Section 01531: Public Notification.

3.05 TRAFFIC CONTROL

A. Refer to Specification Section 01500: Temporary Control of Construction Operations for requirements.

3.06 DELIVERABLES

A. Electronic database of dye test data and digital photographs of results shall be submitted to the designated Engineer. An official transmittal letter shall accompany all submittals. The electronic database using the required file format in Microsoft Access® version 2003, shall be tied to the City GIS sewer maps through the manhole numbers. A separate database shall be submitted for each sewershed. A cumulative corrected database submittal must accompany any corrected hard copy submittals, and must properly reflect corrections made to the hard copy.

B. A binder with hard copies of the dye test reports, location sketch and digital photographs shall be submitted to the designated Engineer – see example at end of section. Data for each sewershed must be submitted separately - each submittal must contain data for only one sewershed. The binder must

be labeled on the spine, as well as the front cover, with company name, sewershed, date, investigation method, submittal number, and Clean Water Atlanta logo. Dye testing data must be submitted separately from CCTV data and smoke testing data.

C. The photographs shall be digital pictures in both hard copy and electronic format.

D. Data Collection Methods: Electronic data must be delivered in the prescribed method for uploading to the City's Maintenance Management System. However, the Contractor may use whatever method he chooses to collect the data. The data tables to be populated are described in detail at the end of this section. Electronic copies of blank data tables will be provided to Contractor at the Pre Construction Conference.

E. The Dye Testing Form must be delivered in the format given at the end of this section.

(EXAMPLE)
DYE TESTING REPORT

SERIAL NUMBER_____.

1. UPSTREAM MANHOLE
2. DOWNSTREAM MANHOLE
3. DATE _____/_____/_____. DYE TESTING TEAM

PERSONNEL

COMMENTS

(EXAMPLE)
DYE TESTING PHOTOS

SERIAL NUMBER_____.

1. UPSTREAM MANHOLE
2. DOWNSTREAM MANHOLE
3. DATE _____ / _____ / _____. DYE TESTING TEAM

COMMENTS _____

END OF SECTION

SECTION 01540

Security and Safety

PART 1 – GENERAL

1.01 COMPLIANCE WITH CITY'S SECURITY REQUIREMENTS

A. Contractor must comply with City's security requirements for all job sites and Department of Watershed Management (DWM) facilities. The City shall provide copies to the Contractor.

B. Contractor must cooperate with City on all security matters and must promptly comply with any project security arrangements established by the City.

C. It is the Contractor's obligations to comply with all applicable governmental requirements and regulations and to undertake reasonable actions to establish and maintain secure conditions at any jobsite.

1.02 SECURITY PROGRAM

A. The Contractor shall comply with the site security program at all times on City facilities.

B. The Contractor shall maintain the security program throughout the Contract duration.

C. The Contractor and his subcontractors are wholly responsible for the security of their employees, work areas, and for all their material, equipment and tools at all times.

D. The Contractor shall provide the City with a list of 24-hour emergency phone numbers including chain of command.

1.03 ENTRY CONTROL

A. The Contractor shall restrict entry of unauthorized personnel and employees and vehicles onto the Project site.

B. The Contractor shall allow entry only to authorized persons with proper City-approved identification.

1. All Contractors/Subcontractors will be required to have their personnel working at these facilities photographed for an identification (I.D.) badge before they start work.

C. The Contractor shall maintain a current Employee Log of employees performing work on site, as well as a Visitor Log, and make the log available to the City upon request. This log shall be available to the City upon request and submitted to the City as necessary.

D. The Contractor shall require all employees performing activities on site to sign the "Employee Acknowledgment of Project Site Rules Log" included at the end of this Section. All employees, subcontractor employees and lower tier contractor employees will attend a new employee orientation session. Signature of the Employee Log by the employee certifies that the orientation training has been received.

E. The City has the right to refuse access to the site or request that a person or vehicle be removed from the site if found violating any of the safety, security, or conduct rules as outlined.

1.04 BARRICADES, LIGHTS AND SIGNALS

A. The Contractor shall furnish and erect such barricades, fences, lights, danger signals and other precautionary measures for the protection of persons or property and of the work as necessary.

B. The Contractor will be held responsible for all damage to the work and any negligence resulting in injuries due to his failure of erecting adequate barricades, signs, lights and safety provisions as required. Whenever evidence is found of such damage, the Contractor shall immediately remove the damaged portion and replace it at the Contractor's cost and expense.

C. The Contractor's responsibility for the maintenance of barricades, signs and lights shall not cease until the City has been accepted in writing the Project.

1.05 RESTRICTIONS

A. The Contractor shall not allow cameras on site or photographs to be taken, except those that are required to perform the Work in accordance with the Contract Documents or otherwise approved by the City.

1.06 CONTRACTOR SAFETY/HEALTH AND SECURITY PLAN

A. Prior to the performance of any work, the Contractor will prepare and submit a Safety/Health and Security Plan which includes the following minimum requirements:

1. Basic pre-employment background checks for criminal convictions, veracity of previous employment and education statements, driving record and financial responsibility as applicable to the position.

2. Security Education and Awareness training applicable to the job.

3. Standard operating procedures (SOPs) for safeguarding City equipment, supplies and property.

4. Certification requested under the SAFETY Act, Homeland Security Act of 2002, if applicable. Provide date and result as requested.

5. Established process for identification of employees and emergency notification procedures.

6. If applicable, procedures for entry permits and badges. Procedures for returning badges upon termination of employment.

7. Anti-terrorism training provided to employees including the state of national alert with appropriate procedures.

8. Emergency evacuation procedures including accounting for employees at a safe haven.

9. Procedures for reporting post-contract criminal convictions and traffic accidents to the Contract Officer or DWM project manager.

10. SOPs for protecting employees when performing required duties off-site including training for reporting accidents, calling for immediate assistance, job reporting procedures and personal duress codes or alarms.

11. Contact information for the person(s) responsible for implementation and enforcement of Safety/Health and Security rules and regulations for this contract.

12. Safe work procedures for the activities within the Contractor's scope of work.

13. New employee orientation program, which addresses job and site specific rules, regulations and hazards.

14. The Contractor's Drug Free Work Place Policy including substance abuse prevention and testing program.

15. Provisions to protect all of the Contractor's employees, other persons and organizations that may be affected by the work from injury, damage or loss.

16. Demonstration of compliance with current Fed/OSHA, Safety/Health and Security Plan, facility safety program (when applicable), and locally accepted safety codes, regulations and practices.

17. A site-specific emergency action and evacuation plan.

18. Hazard Communication/Right To Know Program.

19. Security procedures for the Contractor's work, tools, and equipment.

20. Capability of providing the Engineer with documentation to show compliance with their plan, plus accidents and investigation reports.

21. Any other contract specific requirements.

B. It is not the City's responsibility to verify the Contractor's safety plan for the adequacy and compliance of the plan.

C. Provide a Job Safety Analysis (JSA) for the scope of work, prior to the start of work.

D. Review of the Contractor's Safety Plan by the City shall not impose any duty or responsibility upon the City for the Contractor's performance of the work in a safe manner.

E. The Contractor shall be fully responsible for the safety and health of its employees, its subcontractors and lower tier contractors during performance of its work.

F. The Contractor shall provide the City with all safety reports, training records, competent person list, and accident reports prepared in compliance with Fed/OSHA and the Project Safety/Health and Security Plan as requested.

1.07 PROJECT SAFETY COORDINATOR

A. The Contractor shall be responsible for the safety of the Contractor's and Engineer's employees, the City's personnel and all other personnel at the site of the work caused by their operations.

B. The Contractor shall have a Project Safety Coordinator, as required by Section GC-18 of the General Conditions.

C. The Project Safety Coordinator shall ensure compliance with all applicable health and safety requirements of all governing legislation.

1.08 PROJECT SAFETY/SECURITY REQUIREMENTS OF THE CONTRACTOR

A. It is the responsibility of the Contractor to ensure that all articles of possible personal or monetary value found by Contractor's employees are turned in to the appropriate City Project Manager.

B. The Contractor shall be responsible for maintaining satisfactory standards of employees' competency, conduct, courtesy, appearance, honesty, and integrity, and shall be responsible for taking such disciplinary action with respect to any employee, as may be necessary.

C. Should the Contractor dismiss employees who have been given access to DWM facilities while the contract is in force, the Contractor will advise the DWM Security office.

D. The City may request the Contractor to immediately remove from the premises and/or dismiss any employee found unfit to perform duties due to one or more of the following reasons:

1. Neglect of duty, absenteeism, security or safety problems and sleeping on the job.

2. Disorderly conduct, use of abusive or offensive language, quarreling, intimidation by words or actions or fighting.

3. Theft, vandalism, immoral conduct of any other criminal action.

4. Selling, consuming, possessing, or being under the influence of intoxicants, alcohol, or illegal substances, which produce similar effects while on duty.

5. Vehicle accident while on City property or driving City equipment. No employee, Contractor, or Subcontractor will be extended privileges to drive City equipment on City property if driving privileges have been withdrawn by the State of residence.

E. All employees shall be required to sign in and out on a designated log sheet.

F. All employees shall be required to wear at all times in an observable location, above the waist, on outer clothing, appropriate photo I. D. badges to be furnished by the Contractor and approved by the City.

G. No one under age sixteen is permitted at work sites after normal working hours. Contractor's employees are allowed on work sites only during the specified hours and only when working on this contract. No Contractor employee will be allowed on work sites when not specifically working on this Contract Ft predetermined times and dates.

1.09 EMPLOYEE ACKNOWLEDGEMENT OF THE PROJECT SITE RULES

A. All employees and agents of the Contractor must read and sign a form to acknowledge understanding of project site rules. A sample log is attached to this Section.

B. By Signing this Employee Log, I acknowledge that I understand and agree to abide by the project rules outlined below. I further acknowledge that I have been briefed on specific hazards, hazardous substances that are on-site and the site emergency action procedure.

C. PROHIBITED ACTIVITIES:

1. Unauthorized removal or theft of CITY property
2. Violation of safety or security rules or procedures
3. Possession of firearms or lethal weapons on jobsite
4. Acts of sabotage
5. Destruction or defacing CITY property
6. Failure to use sanitary facilities
7. Failure to report accidents or job related injuries
8. Being under the apparent influence of drugs, alcohol or other intoxicants or in possession of drugs, alcohol or other intoxicants on the property
9. Wearing shorts or tennis shoes on the jobsite
10. Failure to wear a hardhat/safety glasses as required by law.
11. Gambling at any time on the project
12. Fighting, threatening behavior, or engaging in horseplay on the project
13. Smoking in unauthorized areas on the project
14. Open fire cooking or making unauthorized fires on project property
15. Selling items or raffles without authorization
16. Use of unauthorized cameras on the project
17. Use of radio or television in the construction area
18. Failure to park personal vehicle in authorized parking area
19. Failure to wear designated identification [Site Specific]
20. Failure to use designated gates
21. Use or storage of unauthorized chemicals or substances on site.

D. I have read, understand and agree to abide by the PROJECT SITE RULES. Furthermore, I understand failure to abide by these rules is

grounds for being denied access to the project site. I have received a personal copy for my use and reference.

1.10 OFFICE, MATERIAL AND EQUIPMENT SECURITY

A. The Contractor is solely responsible for the security of any offices or any temporary staging areas utilized by the Contractor. The Contractor is also responsible for the security of his materials, tools, vehicles and equipment on-site at all of the various work locations throughout the City.

EMPLOYEE LOG

BY SIGNING THIS LOG I ACKNOWLEDGE THAT I HAVE READ, UNDERSTAND AND AGREE TO ABIDE BY THE PROJECT RULES OUTLINED ABOVE AND ALL LOCAL, STATE, FEDERAL, AND/OR ANY OTHER CONTRACT OBLIGATIONS THAT MAY APPLY. I FURTHER ACKNOWLEDGE THAT I HAVE BEEN ORIENTATED BY A REPRESENTATIVE OF THE COMPANY AS TO THE SITE SPECIFIC HAZARDS, ANY HAZARDOUS SUBSTANCES THAT I MAY BE EXPOSED TO WHILE ON THE SITE AND THE SITE/COMPANY EMERGENCY ACTION PROCEDURES.

EMPLOYEES (PRINT)	SIGNATURE	COMPANY NAME	DATE
Signature of Company Representative		Date Signed	

VISITOR LOG

BY THE SIGNING OF THIS LOG I ACKNOWLEDGE THAT I HAVE READ, UNDERSTAND AND AGREE TO ABIDE BY THE PROJECT RULES OUTLINE ABOVE. THIS IS NOT FOR A VEHICLE ACCESS PERMIT.

VISITOR'S NAME PRINT	SIGNATURE	COMPANY VISITED	DATE	IN	OUT

END OF SECTION

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SECTION 01580

Project Identification and Signs

PART 1 – GENERAL

1.01 SCOPE

A. The work under this Section requires the Contractor to furnish, utilize and maintain project signage and custom vinyl magnetic vehicle signs throughout the duration of the project.

1.02 DESIGN

A. The Contractor shall submit to the Engineer for approval a scale drawing showing the graphic design, style of lettering, and colors, configured to match the design issued by the City Public Involvement (PI) Office. The PMT and/or PI Office will provide the art ready templates for all CWA signage at the Public Information Kick-off Meeting described in Section 01351.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Project Signs

1. All building and graphic materials shall be exterior grade and suitable for environmental exposure without any visible fading, warping or delaminating.

2. All lumber shall be pressure treated number 2 grade with a minimum of 0.25 pounds per cubic foot wood preservative.

3. All fasteners shall be hot dip galvanized.

4. Each project sign shall be painted white with color sign graphic as indicated on Attachment 1.

5. The minimum sign size shall be 96 inches wide by 48 inches high.

B. Magnetic Vehicle Signs

1. Each sign shall be durable nylon having a 100% magnetic surface with strong magnetic cling.

2. The minimum sign size shall be 24 inches wide by 12 inches high.

3. The magnetic sign graphic shall have a professional appearance with fade resistant color printed layout.

C. Yard Signs

1. Yard signboards shall be made of corrugated plastic panel suitable for exterior use with color graphic print on both sides.

2. Each signboard shall be securely attached to a single metal wire stand frame. The wire frame shall be zinc coated or galvanized surface to resist corrosion.

3. The minimum sign size shall be 36 inches wide by 24 inches high.

PART 3 – EXECUTION

3.01 GENERAL

A. Project Signs

1. The Contractor shall construct each project signboard to accommodate the minimum dimensions per Attachment 1 herein.

2. Each sign shall have a minimum of two end post securely anchored to a minimum depth of 2 feet below grade. Each post shall be sufficient length to provide a finished bottom edge signboard elevation 4 feet above grade without splices or other wood joints unless otherwise directed by the City.

3. All fasteners shall be flush with surface with smooth wood edges in a constructed in a neat manner free of irregular cuts, tear out or other undesirable visible defects.

4. The project sign shall be located at the project entrance as directed by the City Public Information officer.

B. Magnetic Vehicle Signs

1. Contractor shall utilize the magnetic signs for all vehicles performing work under this Contract while the vehicles are on the site or otherwise engaged in the Contract Work.

2. Contractor shall place the magnetic signs on each vehicle in a high visibility location. If the signs are to be placed on the sides of vehicles, two signs shall be utilized per vehicle (one sign per side). If

the signs are to be placed on the rears of vehicles, one sign per vehicle shall be acceptable.

3. Contractor shall replace the signs during the project as necessary or as directed by the Engineer.

B. Yard Signs

1. Contractor shall install and maintain yard signs as directed by the City Public Information Officer (PIO).

3.02 MAINTENANCE

A. Contractor shall periodically inspect and maintain all signage in good condition throughout the Contract period at no additional cost to the City.

END OF SECTION


96"
48"
CITY OF ATLANTA
Kasim Reed, Mayor
Project Name
Contract ?
Project Cost: $0.00
CLEAN WATER ATLANTA
drinking water, stormwater, wastewater
Clean Water Atlanta Project Number
404-529-9211
www.cleanwateratlanta.org
"Ensuring clean water today and for future generations."
Atlanta City Council
Ceasar C. Mitchell Council President
Carla Smith District 1
Kwanza Hall District 2
Ivory Lee Young, Jr. District 3
Cleta Winslow District 4
Natalyn Mosby Archibong District 5
Alex Wan District 6
Howard Shook District 7
Yolanda Adrean District 8
Felicia A. Moore District 9
C.T. Martin District 10
Keisha Lance Bottoms District 11
Joyce Sheperd District 12
Michael Julian Bond Post 1 At-Large
Aaron Watson Post 2 At-Large
H. Lamar Willis Post 3 At-Large
Department of Watershed Management
Dexter C. White
Interim Commissioner

END SECTION

SECTION 01590

Field Offices

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide all temporary facilities and necessary staff personnel for the proper completion of the Work as specified.

B. Maintain temporary facilities in proper and safe condition through the progress of the Work. In the event of loss or damage, immediately make all repairs and replacements necessary subject to approval of the Engineer and at no additional cost to City. At completion of the Work remove all such temporary facilities or as directed by the Engineer.

1.02 REQUIREMENTS

A. General

1. The materials, equipment, and furnishings provided under this Section shall be new, and shall meet all the applicable codes and regulations.

2. Make all provisions, and pay all costs of furnishing, installation, maintenance, professional services, permit fees, property leases, and site work including all utilities for the temporary facilities.

B. Field Personnel

1. The Contractor's administrative field office shall be maintained at a staffing level sufficient to plan, coordinate and have authority to promptly execute the Work on site with the corresponding City personnel. At a minimum, the Contractor's project manager, public information officer, safety officer, superintendent and one administrative support person shall occupy and be available at the field office each workday.

C. Field Office Construction

1. Temporary mobile/modular field office buildings shall be structurally sound, weather tight, with floors raised above ground. Mobile/modular buildings shall comply with GA-DCA/SBCC/ADA requirements, and shall be G E – Modular Space, Williams-Scottsman or equal.

2. Temporary field office buildings shall have temperature transmission resistance compatible with occupancy and storage requirements. The office buildings shall be properly skirted as approved by the Engineer.

1.03 CONTRACTOR'S FACILITIES

A. Contractor shall submit a plan of the temporary field offices buildings layout to Engineer for approval within 15 days of the Notice to Proceed. Contractor's facilities, for purposes of this Section, is defined to include but is not limited to its administrative field office located in the City's Area Compound and its Contractor's operational field office to be located within a five (5) mile radius of the administrative field office Area Compound. Both field offices shall have a first aid station and be centrally located to the Work. The Contractor's operational field office shall have a storage facility (for both materials and equipment). Insufficient, inadequate, improper facilities or equipment shall be brought to acceptable condition or shall be removed from either site.

B. The Contractor's administrative field office shall include a dedicated meeting/conference room for hosting bi-weekly progress or other meetings with City and Engineer representatives. Size the room to comfortably seat a minimum of ten (10) people. Proper ventilation, temperature control and lighting are required, and shall be provided to the satisfaction of the Engineer.

C. The location of stationary and mobile equipment shall be subject to the Engineer's approval.

D. First Aid Station: Contractor shall provide a suitable first aid station at the administrative field office and the Contractor's operational field office. Each station shall be equipped with all facilities and medical supplies necessary to administer emergency first aid treatment. Contractor shall have standing arrangements for the removal and hospital treatment of any injured person. The information reflecting this arrangement shall be clearly posted for easy visibility. All first aid supplies and emergency ambulance service shall be made available by the Contractor to the Contractor's, City's and Engineer's personnel.

1.04 ENGINEER'S FACILITIES (Not Used)

1.05 COMMUNICATIONS SERVICES

A. General

1. Make all necessary arrangements for outside telephone and internet access service to Contractor's administrative field office

and Contractor's operational field office. All portions of the communication system shall be maintained in good working condition.

2. At a minimum, furnish two telephone lines to the Contractor's administrative field office and Contractor's operational field office. One will be used for a dedicated facsimile machine.

3. All expenditures for installation costs of hardware, lines, line extensions, service charges, and recurring service charges for telephone and internet access service shall be included in the unit price for the Contractor's temporary facilities item.

1.06 PARKING FACILITIES

A. General

1. Provide parking, either graveled or paved, adjacent to Contractor's administrative field office and Contractor's operational field office, without necessitating jockeying of cars, for a minimum of 2 cars for the use of City's or Engineer's personnel when visiting the Contractor's administrative field office or Contractor's operational field office. The parking surfaces shall be promptly and adequately maintained by the Contractor for the duration of the Contract.

2. Additional parking facilities required by the Contractor shall be the Contractor's responsibility.

1.07 FACILITIES FOR PROJECT CONTROL TOOLS

A. The Contractor shall have adequate computer system capability in its administrative field office and Contractor's operational field office facilities to connect to and use the City's Project Control Tools (refer to Section 01350). The connection method shall be based upon the physical connections availability at the various field and office locations. The priority preference for these connections is: DSL, Cable Modems, and if necessary T1 connections. No dial-up modems will be allowed. The monthly charges for these services shall be paid by the Contractor for the duration of the contract. Costs shall be included in the unit price item for the Contractor's temporary facilities.

B. The Contractor's connection computer(s) must have a minimum operating system of Windows 2000 or greater, 1.8 Hz speed with 256mb RAM. The Internet Explorer web browser must be version 5.5 or greater. The Contractor's printers must not be USB connection printers. The printer(s) must be a dedicated printer, HP LaserJet compatible.

C. No partial payment for the Contractor's temporary facilities unit price item will be approved until all connections are provided and installed to the satisfaction of the City's Project Controls Support Group.

1.08 SECURITY AND MAINTENANCE

A. General

1. Provide periodic indoor and outdoor maintenance and cleaning for temporary structures, furnishings, equipment and services as specified herein above.

2. Provide racks and files for Project Record Documents to be turned over to the City at the completion of the project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PREPARATION

A. Fill and grade sites for temporary structures to provide surface drainage.

3.02 INSTALLATION

A. Construct temporary administrative field office, Contractor's operational field office, first aid station, and storage facilities on proper foundations and complete connections for utility all services.

B. Locate temporary administrative field office facilities at an Area Compound location provided by the City and locate Contractor's operational field office within a five (5) mile radius of the administrative field office Area Compound, as approved by the Engineer.

C. Determine the need for temporary utility services, including utility services for Contractor's administrative field office, Contractor's operational field office and first aid station, and make all arrangements with utility companies and governmental agencies to secure such services. Temporary utility services shall be furnished, installed, connected, and maintained by Contractor in a workmanlike manner, and shall be removed in like manner prior to final project acceptance.

3.03 MAINTENANCE AND CLEANING

A. At a minimum, repair and clean the offices, parking areas and access routes and provide complete professional janitorial services, including toilet paper and paper towels, in the Contractor's administrative field office and Contractor's operational field office. Contractor's administrative field office and Contractor's operational field office cleaning shall be done to the satisfaction of the Engineer. These services shall include sweeping, vacuuming, dusting, emptying of trash, cleaning of washbasins, bathroom

and shower facilities, mopping and waxing of all floors. Contractor shall also provide for exterminating services of the offices if requested by the Engineer.

3.04 REMOVAL

A. Remove or discontinue temporary field offices, contents and services at a time when no longer needed.

END OF SECTION

SECTION 01610

TRANSPORTATION AND HANDLING

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide transportation of all equipment, materials, and products furnished under these Contract Documents to the Work site. In addition, the Contractor shall provide preparation for shipment, loading, unloading, handling and preparation for installation and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the Work.

B. All equipment, materials, and products damaged during transportation or handling shall be repaired or replaced, prior to being incorporated into the Work, by the Contractor at no additional cost to the City

1.02 TRANSPORTATION

A. All equipment shall be suitably boxed, crated, or otherwise protected during transportation.

B. Where equipment will be installed using existing cranes or hoisting equipment, the Contractor shall ensure that the weights of the assembled sections do not exceed the capacity of the cranes or hoisting equipment.

C. Small items and appurtenances such as gauges, valves, switches, instruments, and probes that could be damaged during shipment shall be removed from the equipment prior to shipment, packaged, and shipped separately. All openings shall be plugged or sealed to prevent the entrance of water or dirt.

1.03 HANDLING

A. All equipment, materials, and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation.

B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice.

C. Under no circumstances shall equipment or products such as pipe, structural steel, castings, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.

D. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.

END OF SECTION

SECTION 01611

Storage and Protection

PART 1 – GENERAL

1.01 SCOPE

A. The work under this Section includes, but is not necessarily limited to, the furnishing of all labor, tools and materials necessary to properly store and protect all materials, equipment, products and the like, as necessary for the proper and complete performance of the Work.

B. The Contractor shall store materials, supplies, and equipment at the site in such orderly fashion and in such locations as approved by the Engineer that will not unduly interfere with the progress of the Work or the work of any other contractors, or the activities of City personnel.

1.02 STORAGE AND PROTECTION

A. Storage:

1. Maintain ample space for foot traffic at all times, except as otherwise approved by the Engineer.

2. All property damaged by reason of storing of material shall be properly replaced at no additional cost to the City.

3. Packaged materials shall be delivered in original unopened containers and so stored until ready for use.

4. All materials shall meet the requirements of these Specifications at the time that they are used in the Work.

5. Store products in accordance with manufacturer's instructions.

B. Protection:

1. Use all means necessary to protect the materials, equipment, and products of every section before, during and after installation and to protect the installed work and materials of all other trades.

2. All materials shall be delivered, stored, and handled to prevent the inclusion of foreign materials and damage by water, breakage, vandalism, or other causes.

3. Substantially constructed weathertight storage sheds, with raised floors, shall be provided, and maintained as may be required to adequately protect those materials and products, which may require protection from damage by the elements, stored on the site.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary for the approval of the Engineer and at no additional cost to the City.

D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel and sheet construction products shall be stored with one end elevated to facilitate drainage.

E. Unless otherwise permitted in writing by the Engineer, building products, and materials such as cement, grout, plaster, gypsum board, particleboard, resilient flooring, acoustical tile, paneling, finish lumber, insulation, wiring, etc., shall be stored indoors in a dry location. Building products such as rough lumber, plywood, concrete block, and structural tile may be stored outdoors under a properly secured waterproof covering.

F. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

1.03 EXTENDED STORAGE

A. In the event that certain items of major equipment such as air compressors, pumps, and mechanical aerators have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities that are acceptable to the Engineer. The Contractor shall provide all special packaging, protective coverings, protective coatings, power, nitrogen purge, desiccants, lubricants, and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage.

END OF SECTION

SECTION 01720

Record Documents

PART 1 – GENERAL

1.01 SCOPE

A. The work under this Section includes, but is not necessarily limited to, the compiling, maintaining, recording, and submitting of project record documents as herein specified.

B. Record documents include, but are not limited to:

1. Drawings

2. Specifications

3. Change orders and other modifications to the Contract

4. Engineer field orders or written instructions, including Requests for Information (RFI) and Clarification Memorandums

5. Reviewed shop drawings, product data and samples

6. Test records

7. As-built drawings and/or maps, indicating the locations and types of work performed (manhole asset ID numbers clearly shown where appropriate). Position survey coordinates, top of manhole and invert elevations shall be indicated on the drawing for all manholes and/or sewers which are newly constructed, replaced or adjusted to grade. Where service laterals are rehabilitated or replaced (whether partial or complete to property line) indicate approximate location on drawing, as well as method of rehabilitation/repair. As-built pipe diameters and materials shall also be indicated.

8. Map corrections - printed map marked up illustrating the approximate position of any unmapped manholes and sewers discovered (no survey required).

9. Geographic Information System (GIS) data – updated GIS data set indicating the as-built position and attributes for all replaced and rehabilitated sewer mains, manholes and lateral piping.

C. The Contractor shall maintain a current set of Record Drawings and GIS data on the Project site throughout the Contract Time.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Storage:

1. Store documents and samples in the Contractor's field office, apart from documents used for construction

2. Provide files and racks for storage of documents

3. Provide locked cabinet or secure storage space for storage of samples

B. File documents and samples in accordance with format of these Specifications

C. Maintenance:

1. Maintain documents in a clean, dry, legible condition and in good order.

2. Do not use record documents for construction purposes.

3. Maintain one copy of all record documents at the site.

D. Make documents and samples available at all times for inspection by Engineer.

E. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding payment.

1.03 QUALITY ASSURANCE

A. Unless noted otherwise, Record Drawings and corresponding GIS data shall provide dimensions, distances, coordinates to the nearest 0.1 foot in North American Datum of 1983 (1986 adjustment) Georgia State Plane West 1002 System format. All coordinate values shall be provided as grid coordinates in US Survey Feet.

B. Unless noted otherwise, Record Drawings and corresponding GIS data shall provide elevations to the nearest 0.01 foot referenced to the North American Vertical Datum of 1988 (NAVD88) format. All coordinate values shall be provided as grid coordinates in US Survey Feet.

C. GPS data shall be collected using eGPS Solutions or equivalent internet-based real time GPS network. The network shall provide continuous error

correction and accuracy which meets or exceeds the requirements of Section 1.07 Data Accuracy.

D. Any transformation or adjustment necessary to reproject surveyed coordinates to the Reference Coordinate System will be the responsibility of the Contractor.

E. The Contractor shall employ a Professional Land Surveyor (PLS) licensed in the State of Georgia to prepare the Record Drawings from a post-construction, field survey of all manholes or sewers newly constructed, replaced or otherwise adjusted in position or elevation. Additionally, the contractor shall submit the corresponding GIS data accordingly to indicate the as-built condition and GIS data attributes of these structures and pipelines. Replacement methods include open cut, pipe-bursting, push-bursting and horizontal directional drilling. Lining, point repairs, abandonment and removal of sewer mains or manholes is considered rehabilitation work. A post construction survey is not required for these types of rehabilitation; however, the GIS data attributes shall be updated to indicate the physical as-built condition.

1.04 DATA ACCURACY

A. High Resolution: For all sanitary sewer structures, the equipment and means used by Contractor must generate the position of points with a minimum accuracy of three (3) centimeters horizontal and three (3) centimeters vertical. To determine the accuracy obtained, Contractor's GPS system will be calibrated daily against a known point (monuments) prior to beginning work and when the work is completed. The Contractor shall submit a report to the Engineer certifying calibration was accomplished and indicating the reference system. Data delivered to the Engineer arising from the GPS survey shall be certified by a Professional Land Surveyor. When the GPS equipment cannot be set directly on the point, conventional surveying methods will be used to establish the position to the stated level of accuracy.

B. Calibration shall be carried out at least on a daily basis in accordance with the GPS equipment manufacturer's instructions. Additional calibrations may be required during the course of the working day for large fluctuations of temperature and/or humidity, also in accordance with the manufacturer's instructions and tolerances. The Contractor shall submit a report to the Engineer certifying calibration was accomplished and indicating the reference system.

1.05 INTERFERENCE

A. A GPS position is required for all newly constructed, replaced or adjusted sanitary point structures regardless of the overhead conditions or other nearby obstructions which may interfere with satellite signals, at no

additional cost. In the event coverage conditions do not allow all positions to be obtained by setting directly over the point, rangefinders or other conventional surveying methods may be used to obtain the position of the point(s).

1.06 RECORDING

A. Label each document "PROJECT RECORD" in neat, large printed letters.

B. Recording:

1. Record information concurrently with construction progress.

2. Do not conceal any work until required information is recorded.

1.07 RECORD DRAWINGS

A. Record Drawings shall be reproducible, shall have a title block indicating that the drawings are Record Drawings, the name of the company preparing the Record Drawings, and the date the Record Drawings were prepared. The Contractor will be provided paper sepias of the Drawings, or it may elect to provide reproducible drawings via another method. Reproducible shall be defined as being translucent so as to allow a blueline print to be produced.

B. Legibly mark drawings to record actual construction, including:

1. All Construction:

a. Changes of dimension, diameter, or material and detail

b. Location and type of work performed on each manhole or sewer segment (indicate asset ID numbers)

c. Changes made by Requests for Information (RFI), field order, clarification memorandums or by change order

d. Details not on original Drawings

e. The distance (length) between manhole covers on pipe segments where work was performed.

2. Structures:

a. Position coordinates, as well as invert and top elevations of manholes where manholes or sewers have been newly constructed, replaced or adjusted/raised to grade.

1.08 SPECIFICATIONS

A. Legibly mark each section to record:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed

2. Changes made by Requests for Information (RFI), field order, clarification memorandums, or by change order

1.09 GIS DATA

A. Coordinate and attribute data shall be provided in both electronic and hard copy format at the completion of each sewer-shed, but not less than monthly. The hard copy data must be submitted for approval by the Engineer. Electronic data will not be accepted without hard copy data. Each submittal must be numbered according to the numbering system outlined in Specification Section 01350.

B. The hard copy data shall include a cover letter and printed spreadsheet that corresponds to the electronic data submitted. If the survey work is performed by a subcontractor, the cover letter shall provide certification of data accuracy by a Professional Land Surveyor (PLS) licensed in the State of Georgia. If the survey work is performed by the prime Contractor, the cover letter shall provide certification of data accuracy by a Professional Land Surveyor (PLS) licensed in any State in the United States of America. The hard copy data must be bound, with the PLS seal placed on the cover letter; OR, the hard copy data may be submitted unbound, with the PLS seal placed on each and every sheet of unbound data submitted.

C. The attached GPS Certification Form shall be signed and sealed by a Registered Land Surveyor in Georgia and submitted for each sewershed.

D. The electronic data table submittal shall include four completed worksheets to form a workbook in Microsoft Excel format containing position survey data and physical attributes of the replacement and rehabilitation work. All pipe material, pipe shape and pipe liner code values shall be provided in accordance with in Section 02752 - Attachment C. Numerical value measurement data precision shall be 1/1000 or three decimal places. Each data worksheet shall include individual data records arranged in template formats and header values conforming to examples provided below;

Manhole Replacement or Rehabilitation Worksheet:

PointGISID	X_Coord_US	Y_Coord_US	Z_Elev_US	REHAB_METH	Comments	Install Date	Scope Status

23040113201	2204663.500	1349506.320	859.950	Replace MH Frame and Cover	Replaced Vented Cover & Installed Solid Cover	mm/dd/yyyy	Original scope completed as designed

Pipeline Rehabilitation Worksheet (Use for sewer main open cut replacement, pipe-bursting, push-bursting, horizontal directional drilling or lining):

PipeGISID	PipeDia	PipeWidth	PipeHeight	PipeGuage	PipeShape	PipeUSDpth	PipeDSDpth
23040113201T23040116501	12.000	0.000	0.000	1.125	C	8.600	15.840

Cont'd

PipeMatl	X_Coord_US	Y_Coord_US	Z_Elev_US	US_Pipe_Elev	X_Coord_DS	Y_Coord_DS	Z_Elev_DS
PE	2204663.500	1349506.320	859.950	851.350	2204313.580	1349469.870	864.350

Cont'd

DS_Pipe_Elev	Length	Slope	REHAB_METH	COMMENTS	Install Date	Scope Status
848.510	351.813	0.008072	PB		mm/dd/yyyy	Original Scope completed as designed

Point Repair Rehabilitation Worksheet:

PipeGISID	PipeDia	PipeWidth	PipeHeight	PipeGuage	PipeShape	PipeMatl

23040113201T23040116501	12.000	0.000	0.000	1.125	C	VC
23040113301T23040113401	0.000	8.000	10.000	0.000	C	CO

Cont'd

REHAB_METH	DISTFRMUSMH	PR_LENGTH	PR_MATERIAL	COMMENTS	Install Date	Scope Status
External	12.700	4.500	VC		mm/dd/yyyy	Rehab scope method revised from original scope
Internal	13.000	6.000	PVC		mm/dd/yyyy	Original scope completed as designed

Lateral Rehabilitation Worksheet:

PipeGISID	Address	ZIP	Pipe Matl	DIST FRM USMH	Clock Pos	REHAB METH	New CO	Comments	Install Date	Scope Status
23040113201T23040116501	31 Honour Circle, NE	30305	PVC	189.000	9.000	REP	N		mm/dd/yyyy	Work added to original scope
23040113301T23040113401	400 Atlanta Avenue, SW	30309	CPP	13.000	3.000	Lining	Y		mm/dd/yyyy	Original scope completed as designed
13040113901T13044011801	230 Peachtree Street, NE	30303	CPP	89.000	9.000	Top Hat	N		mm/dd/yyyy	Original scope completed as designed

1.08 SUBMITTAL

A. At work assignment or contract closeout (whichever comes first), the Contractor shall submit two copies of Record Documents to the Engineer.

B. The submittal shall include a transmittal letter, in duplicate, containing;

1. date

2. project title and number

3. contractor's name and address

4. title and number of each record document and

5. signature of Contractor or Contractor's authorized representative.

C. Additionally, the Contractor shall edit the digital PDF(s) files furnished for each sewershed to include all changes based upon actual field conditions. The Contractor shall submit marked up map(s) showing the position of unmapped and incorrectly positioned manhole(s) and/or pipelines discovered during the work. All map(s) shall be marked up with red text and delivered to the Engineer upon the completion of each sewershed. Supplemental sketches shall also be provided in red text, as necessary to clearly depict the actual site conditions including, but not limited to congested areas and established access roads. A legend shall be added to the title block indicating the symbology, color coding and descriptions. The date, the words “As-Built” and company name shall also be included in the title block.

END OF SECTION

ATTACHMENT A

CLEAN WATER ATLANTA

GPS CERTIFICATION FORM

The purpose of this form is to provide the City of Atlanta with additional GPS/Survey information necessary to maintain the GIS system. This form should be completed for each sewershed and submitted with the Certified GPS.

Name of Sewershed:	Contractor Name: Contact Number:	Surveyor Name: Contact Number:
Brief description of survey equipment used: (Manufacturer, Model No., Age)		

Reference Coordinate System used

a. Horizontal

- Datum _____
- Adjustment _____
- Coordinate System _____
- Unit of Measure _____

b. Vertical

- Datum _____
- Geoid Model _____
- Unit of Measure _____

c. Geodetic monuments used or name of network RTK service _____

d. Scale factors for Conventional Survey _____

e. If calibration or transformation was applied, list parameters _____

f. Are coordinates Grid or Ground? _____

_____ _____

Signature and Seal of Surveyor Date

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SECTION 02112

Route Clearing

PART 1 – GENERAL

1.01 SCOPE

A. The extent of route clearing is that minimum degree of clearing necessary to carry out construction activities such as pipe bursting, pipe repairs and other pipeline renewal processes including construction of appurtenances, as well as other additional clearing needed for access purposes.

B. The Contractor shall endeavor to minimize disruption to the neighborhood and shall adjust route-clearing plans to avoid important landscaping features where practicable.

C. Route clearing operations include, but are not limited to, the following:

1. All coordination, permitting, plan development and submittals, and other associated items in accordance with the City of Atlanta's Tree Protection Ordinance and Greenway requirements.

2. Notification of the One Call Center for location and marking of existing utilities within the work zone

3. Erosion control of disturbed areas

4. Protecting trees, plants, buffers, and above-grade and underground improvements

5. Removal and disposal of debris, trees and other vegetation

6. Clearing

7. Removing above-grade improvements

8. Removing underground improvements

9. Restoring damaged improvements

1.02 QUALITY ASSURANCE

A. The Contractor shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state or federal authorities having jurisdiction over the Project. All required permits of a temporary nature,

including coordination with local officials, plans development and approval, submittals, etc., shall be obtained for construction operations by the Contractor.

B. Burning of cleared materials on site is not permitted. The Contractor shall allow in rates for complete removal of all material arising from any necessary clearing and grubbing.

C. Protection of Existing Improvements:

1. Provide barricades, coverings, or other types of protection necessary to prevent unnecessary damage to existing improvements.

2. Protect improvements on adjoining properties as well as those on the project site. Restore improvements damaged by this work to their original condition, as acceptable to the Owners or other parties or authorities having jurisdiction. Replace property line monuments (such as iron pins) removed or disturbed by clearing operations. This work shall be performed by a Land Surveyor licensed in the State of Georgia.

D. Protection of Existing Trees and Vegetation:

1. Protect existing trees and other vegetation against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip lines, excess foot or vehicular traffic, or parking of vehicles or equipment within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing.

2. Provide protection for tree roots over 1-1/2 inches diameter that are cut during any construction operation. Coat the cut faces with emulsified asphalt, or other acceptable coating, especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots of trees with wet burlap to prevent roots from drying out; provide earth cover as soon as possible.

3. Repair or replace unnecessarily damaged trees and vegetation, as determined by the Engineer/City Arborist and/or Planning Department, resulting from any construction operation, in a manner acceptable to the property owner and the Engineer. A qualified nurseryman shall perform tree damage repair. Replace unnecessarily damaged trees that cannot be repaired and restored to full-growth status, as determined by the tree surgeon. Replace felled trees in accordance with the approved plan.

E. Protection of Adjacent Property:

1. Protect improvements, trees and vegetation on adjoining property as well as those on property requiring route-clearing work.

2. Execute work so as not to create a nuisance to any person including persons utilizing adjacent property.

3. Use work methods and provide temporary facilities as necessary to prevent washing, erosion, siltation or dust damage, or hazard to persons and property, within and off the work area.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. The Contractor shall furnish equipment of the type normally used in clearing and grubbing operations including, but not limited to, tractors, trucks, loaders, mowers and clippers.

PART 3 – EXECUTION

3.01 CLEARING

A. Route clearing operations shall begin no more than seven days before beginning construction work for any area.

B. Materials to be cleared, grubbed and removed from the project site include but are not limited to vegetation, trees, stumps, roots, lawns, shrubbery, gardens, paving, miscellaneous structures, debris, and abandoned utilities to the minimum practicable extent to complete the work. Limit clearing to a single lane work route without provision for construction vehicles to pass utility operation. Accurately determine limitations of construction easement or right-of-way, and keep construction activity within such limits.

C. Grubbing shall consist of completely removing roots, stumps, trash and other debris from all graded areas so that topsoil is free of roots and debris. Topsoil is to be left sufficiently clean so that further picking and raking will not be required.

D. All stumps, roots, foundations and planking embedded in the ground shall be removed and disposed of. Piling and butts of utility poles shall be removed to a minimum depth of two feet below the limits of excavation for

structures, trenches and roadways or two feet below finish grade, whichever is lower.

E. Landscaping features shall include, but are not necessarily limited to: fences, cultivated trees, cultivated shrubbery, property corners, man-made improvements, subdivision and other signs shall be moved off the easement. The Contractor shall take extreme care in moving landscape features and shall re-establish these features as directed by the Engineer.

F. Surface rocks and boulders shall be grubbed from the soil and removed from the site if not suitable as Rip Rap.

G. Where tree limbs interfere with utility wires, or where the trees to be felled are in close proximity to utility wires, the tree shall be taken down in sections to eliminate the possibility of damage to the utility.

H. Any work pertaining to utility poles shall comply with the requirements of the appropriate utility.

I. All fences adjoining any excavation or embankment that, in the Contractor's opinion, may be damaged or buried, shall be carefully removed, stored and replaced. Any fencing that, in the Engineer's opinion, is significantly damaged shall be replaced with new fence material of equal or better quality and construction.

J. Stumps and roots shall be grubbed and removed to a depth not less than two feet below grade. All holes or cavities which extend below the subgrade elevation of the proposed work shall be filled with crushed rock or other suitable material, compacted to the same density as the surrounding material.

K. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, etc. situated within the limits of any temporary easements, but not directly within the permanent easements. The Contractor shall be held liable for any damage the Contractor's operations have inflicted on such property.

L. The Contractor shall be responsible for all damages to existing improvements outside the permanent easement resulting from Contractor's operations.

M. Remove lawn sod by cutting into maximum size which can be handled without tearing, stripping sod and underlying topsoil, and stockpiling for use in restoring the surface area. Water sod and otherwise maintain sod in viable, growing condition. Alternative means of lawn sod replacement may be considered by the Engineer.

N. Remove above-grade structures only where specifically authorized.

O. Remove conflicting fences and provide effective, temporary measures to prevent domestic animals from wandering to other lands. Reconstruct fences promptly.

P. Remove abandoned underground facilities such as utilities and structures, walls, footings, basements, wells, septic tanks, cisterns, underground pipe, and other items which conflict with construction.

3.02 HOLES AND DEPRESSIONS

A. Fill holes, depressions and voids created or exposed by clearing operations with non-organic soil material, unless further excavation or earthwork is indicated.

B. Place fill material in horizontal layers not exceeding six inches loose-depth and thoroughly compact to a density at least equal to adjacent original ground.

3.03 DISPOSAL OF WASTE MATERIALS

A. Disposal General Requirements: Accomplish disposal of cleared matter daily so as to maintain site in a safe and neat condition throughout the contract period. Owners of the property may remove merchantable timber, buildings or other items of value from the work site before the Contractor begins operations, and no assurance exists that any such material will be on the work site when the Contractor begins work.

B. On-Site Disposal:

1. On undeveloped property, grind trees, limbs and brush into mulch and distribute within the work area from which cut, in such a way as not to be objectionable to the property owner. Properly dispose of all materials not utilized for mulch off-site. On developed property, remove all such clearing waste and properly dispose of it off-site.

3.04 DISPOSAL OF DEBRIS

A. The debris resulting from the clearing and grubbing operation shall be hauled to a disposal site secured by the Contractor and shall be disposed of in accordance with all requirements of federal, state, county and municipal regulations. Except that debris utilized as mulch, no debris of any kind shall be deposited in any stream or body of water, or in any street or alley. No debris shall be deposited upon any private property except with written consent of the property owner. In no case shall any material or debris of

any kind be left on the Project, shoved onto abutting private properties or buried on the Project.

3.05 CONSTRUCTION ACCESS ROUTE ON EASEMENT

A. When directed by the Engineer, a construction access route shall be built on the sewer easement for the purpose of accessing manholes and performing all other necessary work within the easement.

B. Construction access route shall be cut (10) ten feet wide, minimum, and (6) six inches deep below existing grade. Filter fabric shall be placed at the bottom of the cut, and surge stone shall be placed on top of the fabric, filling the six inch depth along the roadway.

C. The filter fabric for use under the stone shall be as specified in Section 02125.

D. Surge stone shall be 4” to 6” size (4X6) rip rap type stone, or equivalent. Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or greater. Stones shall have less than 66 percent wear when tested in accordance with AASHTO T-96.

3.06 TREE REMOVAL ON EASEMENTS

A. The contractor shall conform to the requirements of the City of Atlanta’s Tree Protection Ordinance before work commences

B. The Engineers approval shall be obtained prior to the removal of any trees from the easement. Such concurrence shall be obtained in writing.

C. The approval of the Engineer concerning the method and location of disposal of materials must be agreed with the owner and engineer before work commences.

D. All trees that need further processing (wood chips) on-site or disposal off-site must be processed or disposed of in conformance with Federal, State, and local rules and regulations.

E. Contractor shall ensure all utilities are located prior to the commencement of any clearing or construction work in the easement.

F. Contractor must acquire any necessary permits prior to commencement of any type of work done in the easement especially for the removal of trees and crossing of waterways.

G. Trees shall be felled into the cleared construction area or areas to be cleared and not onto vegetation to be preserved.

H. Trees that have fallen into water bodies, or beyond the construction area, shall be removed immediately.

END OF SECTION

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SECTION 02125

Erosion and Sedimentation Control

PART 1 – GENERAL

1.01 SCOPE

A. The work specified in this Section consists of providing, maintaining and/or removing temporary erosion and sedimentation controls and providing and installing permanent erosion control measures, all as shown on the Contract Drawings and specified herein

B. Erosion and sediment controls include all appropriate techniques and materials as described in Chapter 6 of the "Manual for Erosion and Sediment Control in Georgia", published by the Georgia Soil and Water Conservation Commission (4310 Lexington Road, Athens, GA 30603, also available for free download on line at www.gaswcc.org) and as modified or enhanced in the Contract Specifications and Drawings.

C. All erosion and sediment control facilities shall be designed based on a 25-year, 24-hour rainfall event unless otherwise noted or directed by the Engineer.

1.02 RELATED SECTIONS

A. This Section references the following related Specification Sections:

02270 – Vegetative Erosion Control
02271 – Gabions
02273 – Riprap
03300 - Cast-In-Place Concrete

1.03 SUBMITTALS AND PERMITS

A. Furnish submittals in accordance with General Conditions Section GC-28, Working Drawings, Shop Drawings, Data on Material and Equipment, Samples and Licenses, and Manual for Erosion And Sediment Control in Georgia.

B. Submittals and Permits:

Within 15 days after the date of the Notice to Proceed, the Contractor shall submit a written description, drawings and schedule for typical applications of proposed temporary erosion and sedimentation controls through City of Atlanta's Bureau of Buildings to acquire a blanket Land Disturbance Permit (via the Site Development Department of the City of Atlanta's Department of

Watershed Management), and shall submit the documents to the Engineer for review. The description, drawings and schedule shall meet the requirements of the Georgia Erosion and Sedimentation Act of 1975 (OCGA 12-7-1), as amended, (available from the Environmental Protection Division of the Georgia Department of Natural Resources at 4244 International Parkway, Suite 114, Atlanta, GA 30354, also available for free download on line at http://www.gadnr.org/), the Rules of Georgia Department of Natural Resources Environmental Protection Division, Chapter 391-3-7 "Erosion and Sedimentation Control" (available from the Environmental Protection Division of the Georgia Department of Natural Resources at 4244 International Parkway, Suite 114, Atlanta, GA 30354, also available for free download on line at http://www.gadnr.org/) and the City of Atlanta's Code of Ordinances, Part II, Chapter 74, Article II "Land Disturbing Activities" (available from the City of Atlanta at 55 Trinity Avenue, Suite 4100 Atlanta, Georgia 30303, also available for free download on line at www.atlantaga.gov/), and NPDES Permit GAR 100002, effective 8/1/2008, which is available on the GA DNR website above. The Contractor shall pay any required fees for the Land Disturbance Permit. Land disturbance activity shall not commence until the Land Disturbance Permit is issued. The Engineer will provide reproducible plan sheets to the Contractor for Contractor's use. The reproducible plan sheets will not bear the Engineer's seal or logo and is provided only for the Contractor's convenience in obtaining the land disturbance permit. The Contractor shall be responsible for submitting to the Bureau of Buildings necessary and sufficient documentation to enable issuance of a permit. All fines imposed for violating the terms of the permit shall be paid by the Contractor at no additional cost to the Owner.

C. The written description, drawings and schedule shall indicate typical erosion and sediment controls for typical land disturbing activities that will ensure stormwater and site drainage from the temporarily disturbed areas shall be filtered or otherwise managed to minimize impacts on receiving waters and/or existing storm drain systems.

D. The description, drawings and schedule shall include both temporary and permanent seedings. The submittal shall include selection of grass species (minimum of two cool season and two warm season for temporary and permanent stabilization), planting dates and rates of application for seed, agricultural lime, fertilizer and mulching.

E. The contractor shall designate a Level 1-A certified worksite erosion control supervisor (WECS). The WECS shall be available on a 24-hour basis, 7-days per week and shall be available on site at all times during land disturbing activities, have the responsibility and authority to coordinate all equipment, personnel, and materials needed to maintain project site erosion control in accordance with the management practices and standards established in Chapter 6 of the "Manual for Erosion and Sediment Control for Georgia", relevant permits, and the Contract Specifications and Drawings.

Within 15 days after the date of Notice to Proceed, the Contractor shall submit the name and contact phone number(s) of its appointed WECS.

1.04 IMPLEMENTATION

A. Erosion and sedimentation control measures shown on the Contract Drawings are minimum requirements. The Contractor's methods of operation may dictate additional erosion and sedimentation control measures above and beyond those which are shown on the Contract Drawings and it shall be the Contractor's responsibility to determine and install such measures. The Contractor's failure to stabilize disturbed areas immediately following intermediate or final grading may dictate additional erosion and sedimentation control measures not shown on the Drawings and it shall be the Contractor's responsibility to determine and install such measures.

B. The Contractor shall notify the Engineer of any changes and/or additions to the erosion and sedimentation control plan necessary to accommodate the Contractor's methods of operation. No additional payment shall be made for erosion and sedimentation control measures made necessary by the Contractor's methods of operation.

C. The Contractor shall be solely responsible for control of erosion and sediment production within the project area boundaries and prevention of sedimentation of any adjacent waterways.

D. The Contractor shall install controls that will ensure that stormwater and drainage from the disturbed area of the Project site shall be filtered or otherwise managed to minimize impacts on receiving waters and/or existing storm drain systems. Discharged waters shall, upon visual inspection, be reasonably free of soil particles and shall meet all applicable permit turbidity requirements. The Contractor shall be responsible for all water quality testing mandated by applicable permits.

E. The Contractor shall be responsible for keeping the project site sufficiently moist to control dust.

1.05 QUALITY ASSURANCE

A. General: Perform all work under this Section in accordance with all pertinent rules and regulations including, but not necessarily limited to, those stated in the applicable permits and the Contract Specifications.

B. Conflicts: Where provisions of pertinent rules and regulations conflict with each other or these Specifications, the more stringent provisions shall govern. PART 2 – PRODUCTS

2.01 GENERAL

A. All materials shall be as described in Chapter 6 of the "Manual for Erosion and Sediment Control in Georgia" (referenced above) and as modified herein.

B. See Specification Section 02270 - Vegetative Erosion Control for additional vegetative materials and techniques used for erosion and sediment control. Materials and techniques covered by Section 02270 include mulching, seeding, sodding, and erosion control blankets and matting as well as other stablilzation methods.

C. Netting shall be 1/2-inch mesh, galvanized steel, chicken wire.

D. Geotextile for use under gabions, riprap, or other stone structures not designed for vehicle traffic shall be Mirafi "Filterweave 403" or approved equal.

E. Geotextile for use under construction exits or other stone structures designed for vehicle traffic shall be Mirafi "600X" or approved equal

F. Plywood shall be 3/4-inch thick exterior type.

G. Grout, where required, shall be composed of 1 part Portland Cement and 3 parts sand and mixed with water to a workable consistency.

2.02 SEDIMENT BARRIER

A. Types A, B, and C silt fences shall meet the corresponding requirements of Section 171 - Temporary Silt Fence of the Department of Transportation, State of Georgia, Standard Specification Construction of Roads and Bridges, latest edition, as referenced in the "Manual for Erosion and Sediment Control in Georgia" (Standard Specification Book available at: GDOT, 2 Capitol Square, Room 215 – Contracts Administration, Atlanta, GA, 30334, 404-656-5293)

B. Silt fence fabric for Type A and B fences shall be Mirafi "FF 100" or approved equal. Silt fence fabric for Type C fences shall be Mirafi "Filterweave 402" or approved equal.

C. Hay bales shall be clean, weed-free cereal hay 80 to 100 pounds or larger.

2.03 RIP RAP

A. See Specification Section 02273 - Riprap for riprap material requirements.

B. Unless otherwise shown or noted riprap shall be Type 3, as defined in Section 02273.

2.04 GABIONS

A. See Specification Section 02271 – Gabions for gabion material requirements.

2.05 CONCRETE

A. See Specification Section 03300 – Cast-In-Place Concrete for concrete material requirements.

PART 3 – EXECUTION

3.01 BASIC PRINCIPLES

A. Conduct the earthwork and excavation activities in such a manner to follow existing contours and consider soil type and condition.

B. Minimize the disturbed area and the duration of exposure to erosion elements.

C. Stabilize disturbed areas immediately with the most efficient and effective erosion control measures..

D. Safely convey run-off from the site to an outlet such that erosion will not be increased off site.

E. Retain sediment on site that was generated on site.

F. Minimize encroachment upon watercourses.

3.02 GENERAL

A. Provide all materials and promptly take all actions necessary to achieve effective erosion and sedimentation control in accordance with the Georgia Erosion and Sedimentation Act of 1975, as amended, Rules of Georgia Department of Natural Resources Environmental Protection Division, Chapter 391-3-7 “Erosion and Sediment Control”, and the City of Atlanta’s Code of Ordinances, Part II, Chapter 74, Article II “Land Disturbing Activities”. The Contractor shall follow the Best Management Practices as

described in Chapter 6 of the “Manual for Erosion and Sediment Control in Georgia” and as modified in these Specifications.

B. Silt dams, silt fences, traps, barriers, check dams, appurtenances and other measures and devices shall be installed as indicated on the Contract Drawings and as required by applicable permits, shall be maintained until no longer needed, and shall then be removed. Deteriorated hay bales and dislodged filter stone shall be replaced with new materials. Detention ponds, if constructed, shall be maintained in a condition ensuring that unfiltered water will not leave the pond.

C. Where the Contractor's erosion and sedimentation control practices are inadequate, the Engineer may direct the Contractor to provide temporary vegetative cover with fast growing seedings. Such temporary vegetative cover shall be provided by the Contractor in compliance with the Manual for Erosion and Sedimentation Control in Georgia, specifically in the selection of grass species, planting dates and application rates for seed, fertilizer, agricultural lime, and mulching, with the exception that kudzu shall not be permitted.

D. All erosion and sedimentation control devices, including check dams, shall be inspected by the Contractor at least weekly and after each rainfall occurrence and cleaned out and repaired by the Contractor as necessary.

E. Temporary erosion and sedimentation control devices shall be installed and maintained from the initial land disturbance activity until the satisfactory completion and establishment of permanent vegetation. At that time, temporary devices shall be removed. Removal of sediment and erosion control measures shall be approved by the Engineer and shall not disturb established vegetation.

F. Permanent erosion control measures shall be implemented as soon as practical after the completion of pipe installation or land disturbance for each site. In no event shall implementation be postponed when no further construction activities will impact that portion or segment of the Project. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.

G. If a location is indicated or noted on the Contract Drawings, dispose of all excess sediment removed from temporary erosion and sediment control devices on site as indicated. Where no on-site disposal is indicated or suitable, the sediment shall be hauled off site to an appropriate disposal location arranged by the Contractor and at its sole expense.

H. See Specification Section 02270 - Vegetative Erosion Control for vegetative erosion and sediment control methodology including mulching, seeding, sodding, and erosion control blankets and matting as well as other stablilzation methods.

I. All excess materials and removed materials shall be removed from the site immediately after they are no longer in use.

3.03 CHECK DAM

A. Install and maintain check dam as indicated in the Manual for Erosion and Sediment Control in Georgia, and as modified in these specifications and as shown on the Drawings.

B. Check dams shall be constructed to be stable throughout their planned life. The dam shall be constructed well into the abutment so that water cannot run around the dam.

C. Haybale check dams may be used as temporary check dams in concentrated flow areas while vegetation is becoming established. Haybale check dams shall not be used where the drainage area exceeds 1 acre. The haybales shall be embedded a minimum of 4 inches on its upslope side.

D. Periodic inspection of check dams is necessary. Repair shall be made as soon as possible to minimize damage and expense of repair. Sediment shall be removed when it reaches a depth of one-half the original dam height.

E. Whenever check dams are removed, care shall be taken to minimize disturbance to the remainder of the watercourse. The area where the check dam was removed shall be immediately shaped and smoothed to watercourse dimensions, seeded and mulched.

3.04 SILT FENCE

A. Install and maintain silt fence as indicated in the Manual for Erosion and Sediment Control in Georgia, and as modified in these specifications and as shown on the Drawings.

B. The filter fabric shall have an approved color mark yarn woven into the fabric or the manufacturer label and fabric name printed on the fabric every 100 feet.

C. Post installation shall start at the center of the low-point (if applicable) with the remaining posts spaced 6 feet apart for Type A and B silt fences and 4 feet apart for Type C silt fence. Wood and steel post may be used with Type A and Type B silt fences. Only steel post shall be used with Type C silt fence. For post size requirement see the latest edition of the Manual for Erosion and Sediment Control in Georgia.

D. Securely fasten geotextile to each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads. The filter fabric shall be securely fastened to the fencing with staples or nails or other fasteners made for this purpose. The bottom of the filter fabric shall be installed in a toe trench. The toe trench shall then be filled with the soil and compacted.

E. Install geotextile fabric in one piece or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.

F. Along stream buffers and other sensitive areas, two rows of Type C silt fence or one row of Type C silt fence backed by haybales shall be used.

G. Silt fences shall be inspected immediately after each rainfall and at least weekly during normal construction activities and daily during prolonged rainfall. Any needed repairs shall be made immediately. Promptly repair or replace silt fence that becomes damaged, unfastened or slumps.

H. Sediment deposits shall be removed when the deposits reach one-half the original height of the silt fence. Any sediment deposits remaining after the sediment barrier is no longer required shall be smoothed to conform to the natural topography and the area restored.

3.05 HAY BALES

A. Install and maintain hay bales as indicated in the Manual for Erosion and Sediment Control in Georgia, and as modified in these specifications and as shown on the Drawings.

B. Bales shall be placed lengthwise on the contour in a single row and embedded in the soil a minimum depth of 4 inches. Bales shall be securely anchored in place by stakes, bars or other acceptable means. Stakes for hay bale barriers shall be nominal 2 inch by 2 inch wood. The wood shall be sound with a minimum length of 3 feet. The stakes shall be driven into the ground 18 to 24 inches. Equivalent metal rods or steel bars may be used.

C. Hay bales shall be inspected immediately after each rainfall and at least weekly during normal construction activities and daily during prolonged rainfall. Any needed repairs shall be made immediately.

D. Sediment deposits shall be removed when the deposits reach one-half the original height of the hay bales. Any sediment deposits remaining after the sediment barrier is no longer required shall be smoothed to conform to the natural topography and the area restored as specified in the Contract Documents.

3.06 INLET SEDIMENT TRAP

A. Install and maintain inlet sediment traps as indicated in the Manual for Erosion and Sediment Control in Georgia, and as modified in these specifications and as shown on the Drawings.

B. Sediment traps shall be constructed on natural ground surface, on an excavated surface, or on machine compacted fill provided they have a non-erodible outlet.

C. Fabric Frame Inlet Sediment Traps: Filter fabric fitted around a supporting frame shall be used for inlet protection where the inlet drains a relatively flat area (slope no greater than 5 percent) and the inlets do not receive concentrated flows. The frame shall be constructed from Type C silt fence filter fabric supported by steel posts. Stakes shall be spaced evenly around the perimeter of the inlet a maximum of 3 feet apart and securely driven into the ground approximately 18 inches deep. The fabric shall be entrenched 12 inches and backfilled with crushed stone or compacted soil. Fabric shall be securely fastened to the posts, and fabric ends shall be overlapped a minimum of 18 inches or wrapped together around a post.

D. Baffle Box: A baffle box inlet sediment trap shall be used for inlets receiving runoff with a higher volume or velocity. The baffle box shall be constructed of 2” x 4” boards spaced a maximum of 1 inch apart or of plywood with weep holes. The weep holes shall be 2 inches in diameter spaced approximately 6 inches on center vertically and horizontally. The entire box shall be wrapped in Type C silt fence filter fabric. The filter fabric shall be entrenched 12 inches and backfilled. Gravel shall be placed outside the box, all around the inlet, to a depth of 2 to 4 inches.

E. Block and Gravel Drop Inlet Sediment Traps: Block and gravel drop inlets shall be used where heavy flows are expected and where an overflow capacity is necessary to prevent excessive ponding around the structure. On each side of the structure one block, in the bottom row, shall be placed on its side to allow the pool to drain. The foundation shall be excavated at least 2 inches below the crest of the storm drain. The bottom row of blocks shall be placed against the edge of the storm drain for lateral support and to avoid washouts when overflow occurs. When needed, lateral support shall be provided to subsequent rows by placing 2” x 4” wood studs through the block openings. To hold gravel in place, hardware cloth or comparable wire mesh with ½ inch openings shall be carefully fitted over all block openings. Clean gravel shall be placed to a height of 2 inches below the top of the block on a 2:1 slope or flatter and smoothed to an even grade. Georgia DOT #57 washed stone is recommended.

F. Gravel Drop Inlet Sediment Traps: Gravel drop inlet protection shall be used where heavy concentrated flows are expected. The slope toward the inlet shall be no steeper than 3:1. To prevent gravel from entering the inlet, an area of level stone, that is a minimum of 1 foot wide, shall be placed between the structure and around the inlet. Stone that is 3 inches or larger in diameter shall be used on the slope toward the inlet. On the slope away from the inlet, #57 (½" to ¾" diameter) washed stone shall be placed in a layer at least one foot (1') thick.

G. Sod Inlet Protection: Sod inlet protection shall be used at the time of permanent seeding to protect inlets from sediment and mulch material until the permanent vegetation becomes established. The sod shall be placed to form a turf mat covering the soil for a distance of 4 feet from each side of the inlet structure. Sod strips shall be staggered so that adjacent strip ends are not aligned.

H. Sediment traps shall be inspected daily and after each rain. Repairs shall be made as needed. Sediment shall be removed when the sediment has accumulated to one-half the height of the trap. For excavated inlet sediment traps, sediment shall be removed when one-half the storage capacity has been lost due to sediment accumulation. Sediment that is removed from sediment traps shall be properly disposed of and stabilized so that it will not enter the inlet or any waters bodies. Sediment shall not be washed into the inlet. Sod inlet protection shall be maintained as specified in the latest edition of the Manual for Erosion and Sediment Control in Georgia.

I. Sediment traps shall be removed when the contributing drainage area has been adequately stabilized. All materials and any unstable soil shall be salvaged or properly disposed of. The disturbed area shall be brought back to proper grade then smoothed and compacted. All bare areas around the inlet shall be permanently stabilized.

3.07 TEMPORARY STREAM CROSSING

A. Install and maintain temporary stream crossings as indicated in the Manual for Erosion and Sediment Control in Georgia, and as modified in these specifications and as shown on the Drawings.

B. The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat. To facilitate cleanout, the pool area shall be cleared.

C. Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment shall be compacted in 8-inch layers by traversing with construction equipment.

D. The earthen embankment shall be seeded with temporary or permanent vegetation within 7 days of construction.

E. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.

F. All cut and fill slopes shall be 2:1 or flatter.

G. Temporary sediment traps shall be inspected after each period of significant rainfall. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one-half the design depth of the trap. The sediment removed shall be placed in the designated disposal area. The contaminated part of the gravel facing shall be replaced.

H. The structure shall be checked for damage from erosion or piping. The depth of the spillway shall be checked periodically to ensure it is a minimum of 1.0 ft below the low point of the embankment. Any observed settlement of the embankment shall be filled immediately to slightly above design grade. Any riprap displaced from the spillway shall be replaced immediately.

I. After all sediment-producing areas have been permanently stabilized, the structure and all unstable sediment shall be removed. The area shall be smoothed to blend with the adjoining areas and restored as specified in the Contract Documents.

3.08 RIP RAP

A. Refer to Specification Section 02273 - Riprap for general riprap requirements.

B. Install and maintain riprap for all erosion and sediment control methodologies as indicated in the Manual for Erosion and Sediment Control in Georgia and as specified or modified in the Contract Documents.

3.09 GABIONS

A. Refer to Specification Section 02271 - Gabions for general gabion requirements

B. Install and maintain gabions for all erosion and sediment control methodologies as indicated in the Manual for Erosion and Sediment Control in Georgia and as specified or modified in the Contract Documents.

3.10 CONCRETE

A. Refer to Specification Section 03300 - Cast-In-Place Concrete for general concrete requirements.

B. Install concrete for all erosion and sediment control methodologies as indicated in the Manual for Erosion and Sediment Control in Georgia and as specified or modified in the Contract Documents.

3.11 CONSTRUCTION EXIT

A. Construction exits will be constructed and maintained in accordance with the Manual for Erosion and Sediment Control in Georgia as a minimum and/or as specified or modified in the Contract Documents.

END OF SECTION

SECTION 02140

Dewatering

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall dewater trench and structure excavations, in accordance with the Contract Documents. The Contractor shall secure all necessary permits to complete the requirements of this Section of the Specifications.

B. Design, construct and maintain all wells, pumps, vacuum systems, sumps, dikes, levees, cofferdams and diversion and drainage channels as necessary to maintain the areas free from water and to protect the areas to be occupied by permanent work from water damage. Remove temporary works after they have served their purpose.

C. The Contractor shall be responsible for the stability of all-temporary and permanent slopes, grades, foundations, materials and structures during the course of the Contract. Repair and replace all slopes, grades, foundations, materials and structures damaged by water, both surface and subsurface, to the lines, grades, and conditions existing prior to the damage, at no additional cost to the City.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 CARE OF WATER

A. Except where the excavated materials are designated as materials for permanent work, material from required excavation may be used for dikes, levees, cofferdams and other temporary backfill.

B. Furnish, install, maintain, and operate necessary pumping and other equipment for dewatering the various parts of the work and for maintaining the foundation and other parts free from water as required for constructing each part of the work.

C. Install all drainage ditches, sumps, and pumps to control excessive seepage on excavated slopes, to drain isolated zones with perched water tables and to drain impervious surfaces at final excavation elevation.

D. Dewater by means that will insure dry excavations, preserve final lines and grades, do not disturb, or displace adjacent soil.

E. All pumping and drainage shall be done with no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic or the work of other contractors, and in accordance with all pertinent laws, ordinances and regulations.

F. All dewatering activities shall comply with Specification Section 02125 – Erosion and Sediment Control.

G. Do not overload or obstruct existing drainage facilities.

H. After they have served their purpose, Contractor shall remove all temporary protective work at a satisfactory time and in a satisfactory manner. All diversion channels and other temporary excavations in areas where the compacted fill or other structures will be constructed shall be cleaned out, backfilled and processed under the same Specifications as those governing the compacted fill. Fill or grout all temporary-dewatering wells unless otherwise directed by the Engineer.

I. When the temporary works will not adversely affect any item of permanent work or the planned usage of the Project, the Contractor may be permitted to leave such temporary works in place. In such instances, breeching of dikes, levees, and cofferdams may be required.

3.02 DEWATERING

A. By the use of well points, pumps, tile drains, or other approved methods, the Contractor shall prevent the accumulation of water in excavated areas. Should water accumulate, it shall be promptly removed.

B. Excavations shall be continuously dewatered to maintain a ground water level no higher than three to four feet below the lowest point in the excavation. Dewatering systems shall be designed to allow for localized variations in the depth of excavations required to reach a suitable foundation. Dewatering shall be accomplished well enough in advance of excavation to ensure that groundwater is already lowered prior to completing the final excavation to finish subgrade.

C. All destabilized subgrade conditions caused by inadequate or untimely dewatering operations shall be undercut and backfilled with suitable backfill material at no additional cost to the City.

D. Piezometric observation wells are required to monitor the ground water level to insure proper dewatering prior to excavation below the static water table. The number of wells required will vary depending on the size and depth of structures.

END OF SECTION

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SECTION 02200

Earthwork

PART 1 – GENERAL

1.01 REQUIREMENTS

A. This Section includes earthwork and related operations, including, but not limited to: excavating all classes of material encountered; trenching, handling, storage, transportation, and disposal of all excavated and unsuitable material; construction of fills and embankments; backfilling around structures and pipe; backfilling all trenches and pits; compacting; all sheeting, shoring, and bracing; preparation of subgrades; surfacing and grading; and any other similar, incidental, or appurtenant earthwork operation which may be necessary to properly complete the Work.

B. The Contractor shall provide all services, labor, materials, and equipment required for all earthwork and related operations necessary or convenient to the Contractor for furnishing complete Work as shown on the Drawings or specified in the Contract Documents.

1.02 RELATED SECTIONS

B. The Work of the following Sections specifically apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of Work.

1. Section 01410: Testing Laboratory Services
2. Section 02125: Erosion and Sedimentation Control
3. Section 02140: Dewatering
4. Section 02575: Removing and Replacing Pavement

1.03 GENERAL

A. Safety: Comply with local regulations and with the provisions of the “Manual of Accident Prevention in Construction” of the Associated General Contractors of America, Inc., Occupational Safety and Health Act (OSHA) and all other applicable safety regulations.

B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.

C. All excavated and filled areas for structure, trenches, fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the City. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material at no cost to the City.

D. The Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can flow uninterrupted in existing open ditches or channels, other surface drains, or temporary drains.

E. No classification of excavated materials will be made, except for rock excavation. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the Work, regardless of the type, character, composition or condition thereof.

F. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations, and shall be conducted in a manner acceptable to the Engineer.

1.04 CONTRACTOR SUBMITTALS

A. The Contractor shall submit samples of all materials proposed to be used in the work in accordance with the requirements in Section GC-28 – Working Drawings, Shop Drawings, Data on Material and Equipment, Samples and Licenses. Sample size shall be as determined by the testing laboratory.

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B. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

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1. Copies of permits obtained by the Contractor for the work.

2. Test results, certification of compliance, source, and sample for all imported materials.

3. Samples of fill materials to be used: Samples shall be submitted in 2 weeks in advance of use and shall consist of 0.5 cubic feet of each type of material.

1.05 QUALITY ASSURANCE

A. Reference Standard: Comply with all federal, state and local laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

1.	ASTM C136-84a	Standard Method for Sieve Analysis of Fine and Course Aggregates.
2.	ASTM D1556-82	Test Method for Density of Soils in Place by the Sand-Cone Method.
3.	ASTM D698-78	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (250-kg) Rammer and 12-in. (305-mm Drop).
4.	ASTM D3017-88	Test Method for Moisture Content of Soil and Rock Aggregate in Place by Nuclear Methods (Shallow Depth).

PART 2 – PRODUCTS

2.01 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General: Fill, backfill, and embankment materials shall be suitable selected or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other vegetation.

B. Fill and backfill materials to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.

C. Suitable Materials: Materials not defined as unsuitable in Section 2.02 are defined as suitable materials and may be used in fills, backfilling, and embankment construction in **unpaved areas**. In addition, when acceptable to the Engineer, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite. All backfill within the public right of way which impacts the existing asphalt or concrete pavement of streets or sidewalks **(paved areas)** shall be Graded Aggregate Base material in compliance with Appendix F - Department of Public Works Public Right of Way Manual.

D. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported. If imported materials are required by this Section, or to meet the quantity requirements of the project, the Contractor shall provide the imported materials at no additional expense

to the City, unless a unit price item is included for imported materials in the bidding schedule.

E. Earthwork Materials:

1. Controlled Fill Soils:

a. Proposed fill soils shall be laboratory tested prior to construction use to determine their suitability. All material shall be subject to the approval of the Engineer. Testing shall be paid for separately by the City directly to the testing laboratory.

b. Notification: For approval of imported fill material, notify the Engineering and Testing Laboratory at least three (3) weeks in advance of intention to import material, designate the proposed borrow area, and permit the Testing Laboratory to sample as necessary from the borrow area for the purpose of making acceptance tests to prove the quality of the material. Test results shall be submitted to the Engineer for approval.

c. All fill material shall be soil exclusive of organic matter, frozen lumps, or other deleterious substances.

d. It shall contain no rocks or lumps over 3-inches maximum in dimension.

e. Fill material shall be low to moderate plasticity soil (PI less than 30).

2. Structural Fill and Structural Backfill:

a. Select on site materials may be suitable. Testing and recommendation of suitability shall be made by the Testing Laboratory and submitted by the Contractor to the Engineer for approval. Testing shall be paid for separately by the City directly to the testing laboratory.

b Imported material shall be sand, uniformly graded crushed stone or other select material recommended by the Testing laboratory and submitted by the Contractor to the Engineer for approval. Graded aggregate base material as specified in Section 02575, Removing and replacing pavement, is acceptable.

c. Crushed Stone: Crushed s used for pipe bedding and drain stone shall conform to the Georgia Department of Transportation Standard Specifications for Construction of

Road and Bridges, 800.01 for No. 57 Stone. For concrete, cast iron, steel and galvanized iron pipe less than 12-inch, use ¾ inch gravel, crushed gravel or crushed stone. For plastic pipe use ¼ -inch pea gravel.

3. Top Soil: Dark organic weed free loam free of muck.

4. Coarse Aggregate: Coarse aggregate shall conform to the Georgia Department of Transportation Standard Specifications for construction of Road and Bridges, 800.01 for No. 57 Stone, Group II, and shall have the following gradation:

Sieve Size	Percent Passing	
1-1/2 inch	100	-
1 inch	95	100
¾ inch	-	-
½ inch	25	60
#4	0	10
#8	0	5

F. Sheeting, Bracing, and Timbering: The Contractor shall furnish, place and maintain all sheeting, bracing and timbering required to properly support trenches and other excavations in open cut and to prevent all movements of the soil, pavement, structures, or utilities outside of the trench or pit.

1. General:

a. Sheeting, bracing and timbering shall be so placed as to allow the Work to be constructed to the lines and grades shown on the Drawings and as ordered by the Engineer.

b. If at any time the method being used by the Contractor for supporting any material or structure in or adjacent to any excavation is not reasonably safe in the opinion of the Engineer, the Engineer may require and the Contractor shall provide additional bracing and support necessary to furnish the added degree of safety required by the Engineer. The Contractor shall provide bracing and support by such methods accepted by the Engineer as Contractor may elect to use, but the taking of such added precautions shall in no way relieve the Contractor of sole and final responsibility for the safety of lives, work, and structures.

c. All sheeting in contact with the concrete or masonry shall be removed or cut off and left in place as instructed by the Engineer.

2. Timber:

a. Timber may be substituted for steel sheet piling when approved by the Engineer. Timber for shoring, sheeting and bracing shall be sound and free of large or loose knots and in good condition. Size and spacing shall be in accordance with OSHA regulations.

b. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the work and adjacent property. Leave sheeting in place when, in the opinion of the Engineer, it cannot be safely removed. Cut off sheeting left in place below the finished ground surface as instructed by the Engineer.

3. Steel Sheet Piling:

a. Steel sheet piling shall be the continuous interlock type. The weight, depth and section modulus of the sheet piling shall be sufficient to restrain the loads if earth pressure and surcharge from existing foundations. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral or vertical movements at all times. In addition to the drawings and computations, the Contractor shall provide closure and sealing details between sheet piling and existing facilities, as well as method of excavation within sheet pilling to the Engineer for review before commencing construction operations. Contractor shall be responsible for all damage to existing utilities and structures resulting from installation of sheet piling. Damage to existing utilities and/or structures resulting from installation of sheet piling shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

G. Other Materials: All other materials, not specifically described but required for proper completion of the work of the Section, shall be as selected by the Contractor subject to prior approval of the Engineer.

2.02 UNSUITABLE SOIL MATERIAL

A. Unsuitable materials include the materials listed below:

1. Soils, which, when classified under ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil

Classification System), fall in the classifications of Pt, OH, CH, MH, or OL;

2. Soils that cannot be compacted sufficiently to achieve the density specified for the intended use;

3. Materials that contain hazardous or designated waste materials, including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations;

4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing on-site soils;

5. Topsoil except as allowed below.

2.03 MATERIALS TESTING

A. All soils testing of samples will be done by a testing laboratory selected by the City in accordance with Section 01410. Testing shall be paid for by the City. At its discretion, the Engineer may request that the Contractor supply samples for testing of any material used in the Work.

B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.

C. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. Unified Soil Classification System: References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

E. The testing for chloride, sulfate, resistivity, and pH will be done in accordance with ANSI/AWWA C-105/A21.5 Standard.

2.04 ROCK EXCAVATION

A. Mechanical rock excavation shall include removal and disposal of the following:

1. All boulders measuring 1/3 of a cubic yard or more in volume;

2. All rock material in ledges, bedding deposits, and un-stratified masses which cannot be removed without systematic drilling and jack-hammering or blasting.

3. Conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and jack-hammering or blasting.

B. Blasting – See Specification Section 02405.

PART 3 – EXECUTION

3.01 EXCAVATION - GENERAL

A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

B. Removal and Exclusion of Water: The Contractor shall remove and exclude water, including stormwater, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, wellpoints, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least two feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing have been completed.

C. Topsoil:

1. Remove all topsoil to a depth at which subsoil is encountered, from all areas that are to be cut to lower grades or filled.

2. Topsoil to be used for finish grading may be stored on the site. It shall be piled properly, sloped to drain, and covered.

3. Other topsoil may be used for fill in non-critical areas with prior approval of the Engineer

D. Bracing and Sheeting:

1. Furnish, install, and maintain all sheeting, bracing, and shoring as may be required to properly support the sides of all excavations and to prevent all movement of earth that could in any way injure the work, adjacent property, or workers.

2. Properly support all trenches for piping and duct bank installation so as to conform to all pertinent rules and regulations and these Specifications. All trenches deeper than 5 feet shall be shored unless cut to the angle of repose of the excavated soils.

3. Exercise care in the removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of the excavation faces being supported and damage to the work and adjacent property.

4. Do not leave any sheeting or bracing in the trench or excavation after completion of the work, unless approved or instructed by the Engineer.

5. All sheeting in contact with concrete or masonry shall be removed or cut off and left in place as instructed by the Engineer.

E. Obstructions:

1. Remove and dispose of all trees, stumps, roots, boulders, pavement, pipes, and the like, as required for the performance of the work.

2. Exercise care in excavating around catch basins, inlets, manholes, piping, duct banks, underground vaults, etc.

3. Avoid removing or loosening castings or pushing dirt into structures.

4. Damaged or displaced casting shall be repaired and replaced, and dirt entering the structures during the performance of the work shall be removed at no additional cost to the City.

F. Utilities to be Abandoned:

1. When piped, conduits, sewers or other structures are removed from the trench leaving dead ends in the ground, such ends shall be fully plugged and sealed as indicated on the Drawings.

2. Abandoned structures such as manholes, catch basins, or chambers shall be entirely removed unless otherwise specified or indicated on the Drawings.

3.02 HEAVE MONITORING AND CONTINGENCY PLANNING

A. Prior to excavation, pipe bursting or directional drilling, the Contractor shall identify any permanent structure, all buried utilities, all natural gas/petroleum pipelines, and any additional structures, which are within a horizontal distance 1.1 times the depth of any excavation deeper than the structure, utility, or natural gas pipeline. This Section does not limit the Contractor's choice of construction methods based on the site conditions.

B. The Contractor shall perform, at a minimum, daily visual inspections of the perimeter of the pipe burst, drill path or excavation to identify any signs of excessive heave or movement. The results from visual inspections shall be recorded with the daily survey log. Any area, which appears to be excessively deformed or damaged, shall immediately be brought to the attention of the Engineer and be corrected.

C. The Contractor shall prepare a contingency plan to mitigate the effects of excessive heave, settlement or movement of existing site features. The contingency plan is not to restrict the Contractor from using the best construction methods available to meet the conditions, but is required to demonstrate a reasonable preparedness to mitigate the effects of excessive heave movement or settlement. The following are minimum requirements for a contingency plan:

1. The Contractor shall prepare a contingency plan, outlining steps to be taken to protect structures, utilities, or gas pipes and stop excessive heave movement or settlement identified by the heave/settlement monitoring program.

2. The Contractor shall have all material, manpower, equipment, and other items identified in the contingency plan available at all times while excavations are ongoing or excavated areas are open.

3.03 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

A. Excavation Beneath Structures and Embankments: Except where otherwise indicated for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where indicated or ordered, areas beneath structures or fills shall be over-excavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such over-excavation is indicated both over-excavation and subsequent backfill to the

required grade shall be performed by the Contractor. When such over-excavation is not indicated, but is ordered by the Engineer, such over-excavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise, payment will be made in accordance with a negotiated price. After the required excavation or over-excavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 98 percent of maximum density.

B. Excavation Beneath Paved Areas: Excavation beneath paved areas shall be provided at minimum dimension shown on the drawings to minimize the disrupted area and volume of backfill required. All backfill material beneath paved areas shall be graded aggregate base material in accordance with Appendix F – Department of Public Works Public Right of Way Manual. The graded aggregate base surface elevation shall be depressed to receive the final pavement surface course as indicated on the Drawings. Controlled low strength flowable fill material may be provided in lieu of graded aggregate base if directed by the Engineer to provide backfill around sensitive or congested utilities or confined excavations where mechanical compaction is not practical.

C. Notification of Engineer: The Contractor shall notify the Engineer at least 3 days in advance of completion of any structure excavation and shall allow the Engineer a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.04 PIPELINE AND UTILITY TRENCH EXCAVATION

A. Exploratory Excavation:

1. The Contractor shall excavate and expose buried points of connection to existing utilities as required by Engineer.

2. Data, including dates, locations excavated, and sketches, shall be submitted to the Engineer within one week of excavation.

3. Damage to utilities from excavation activities shall be repaired by the Contractor at no charge to the City.

B. General: Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.

C. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding. Excavations for pipe bells and welding shall be made as required.

D. Minimum Width of Trench: The minimum width of pipe trenches, measured at the crown of the pipe, shall not be less than 24-inches greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width, measured at the invert of the piping, of such trench shall be not less than 24-inches greater than the exterior diameter of the pipe, exclusive of special structures or connections, and such minimum width shall be exclusive of all trench supports.

E. Maximum Width of Trench: The maximum allowable width of trench for all pipelines measured at the top of the pipe shall be the outside diameter of the pipe (exclusive of bells or collars) plus 24-inches, and such maximum shall be inclusive of all timbers and/or trench boxes, shoring, etc. A trench wider than the outside diameter plus 24-inches may be used without special bedding if the Contractor, at his expense, will furnish pipe of the required strength to carry the additional trench load. Such modifications shall be submitted to the Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded for any reason, except as provided for on the Drawings or in the Specifications or by the written instruction of the Engineer, the Engineer shall, at his discretion, require that the Contractor, at its own expense for all labor and materials, cradle the pipe in Class “B” concrete, or other approved pipe bedding.

F. Maximum length of Open Trench: Except by special permission by the Engineer, only that amount of pipe construction will be permitted, including excavation, construction of pipelines, and backfill in any one location, which can be completed in one day; however, maximum length of open trench shall never exceed 100 feet. This length includes open excavation, pipe laying and appurtenant construction and backfill that had not been temporarily resurfaced.

G. Trench Side Slopes:

1. Temporary trench excavation shall at all times conform to the safety requirements of OSHA.

2. Loose cobbles or boulders shall be removed form the sides of the trenches before allowing workers into the excavation, or the trench slopes must be protected with screening or other methods. Trench side slopes shall be kept moist during construction to prevent local sloughing and raveling. Surcharge loads due to construction equipment shall not be permitted within 5 feet of the top of any excavated slope.

3. If the Contractor elects to shore or otherwise stabilize the trench sides, he shall file with the Engineer for review, copies of drawings for same prepared and signed by a Civil Engineer duly registered in the State Georgia before commencing excavation.

H. Trench Over-Excavation: Where trenches are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade of the bottom of the pipe bedding.

I. Over-Excavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be over-excavated beyond the depth and/or width shown or specified. Such over-excavation shall be to the dimensions ordered. The trench shall then be backfilled to the grade of the bottom of the pipe bedding. Over-excavation less than the limits on the Drawings or less than specified shall be done at no increase in cost to the City. When the over-excavation ordered by the Engineer is greater than the limits shown, additional payment will be made to the Contractor. Said additional payment will be made under separate unit price bid items for over-excavation if such bid items have been established; otherwise, payment will be made in accordance with a negotiated price.

J. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

K. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3.05 OVER-EXCAVATION NOT ORDERED OR INDICATED

A. Any over-excavation beyond the limits shown on the drawings or specified which was not ordered by the City, shall be backfilled to the required grade with the specified material(s) at no additional cost to the City.

3.06 EXCAVATION IN LAWN AREAS

A. Where excavation occurs in lawn areas, the sod shall be carefully removed, dampened, and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn, provided that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced and lightly rolled in a manner so as to restore the lawn as near as possible to its original condition. Contractor shall provide new sod if stockpiled sod has not been replaced within 72 hours.

3.07 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations according to the Tree Protection Plan. No tree roots over 2 inches in diameter shall be cut without express permission of the Engineer. Trees shall be supported during excavation by any means previously reviewed by the Engineer.

3.08 ROCK EXCAVATION

A. When rock is encountered in trenches, it shall be removed to a minimum depth of six inches (6”) below the bell of the pipe.

B. The rock shall be stripped and measured by the Engineer at five foot (5 ft.) intervals, and the quantity calculated as the actual length multiplied by the average depth multiplied by the average trench width. Trench width shall be a minimum of twenty-four inches (24”), and a minimum of three inches (3”) wider on each side of the pipe bell.

3.09 DISPOSAL OF EXCESS EXCAVATED MATERIAL

A. The Contractor shall remove and dispose of all excavated material in excess of that required to backfill the excavation and to create necessary fills. This shall be done immediately after the backfill is completed to the satisfaction of the Engineer. All materials removed shall become the property of the Contractor, and he shall make his own arrangements satisfactory to the Engineer for their disposition.

B. All surplus material and such other materials as the Engineer may deem unfit for use as backfill, shall be disposed of by the Contractor so as to give a minimum of inconvenience to the public. In case of settlement after backfill, the Contractor shall supply sufficient material satisfactory to the Engineer to make up for the deficiency.

C. When so ordered by the Engineer, the Contractor shall immediately remove all excavated materials from the site and dispose of the same.

D. Any material, which may spill or drip from vehicles by hauling in the streets, shall be removed and the streets cleaned by the Contractor, to the satisfaction of the Engineer, or the proper officials of the municipality in which the hauling or work is being done.

E. The surface of all graded and spoil areas shall be left in a smooth and level or evenly sloped condition, free from stones, rubbish, or other debris.

3.10 SOIL BACKFILL – GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around nor upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to moisture content suitable for compaction.

C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally, The Contractor shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

3.11 SOIL BACKFILL AND FILL PLACEMENT

A. Fill shall be placed in loose lifts not exceeding 8-inches in depth and shall be thoroughly compacted as herein specified.

B. All fill placements may be subject to fill density and moisture tests, which shall be performed to verify that the specified degree of compaction is being achieved. Testing shall be paid for separately by the City directly to the testing laboratory.

C. Prior to placement of any material in embankments, the area within embankment limits shall be stripped of topsoil and all unsuitable materials removed as described under Excavation. Area to receive fill shall then be scarified to a depth of at least 6-inches.

D. Fill materials shall be placed in continuous approximately horizontal layers extending the full width of the embankment cross-section and the full dimension of the excavation where practicable.

E. Fill materials shall be placed within 2 percent of the optimum moisture content Optimum moisture shall be maintained by sprinkling the layers with water as placed or by allowing material to dry before placement.

F. Compaction:

1. Fill material shall be compacted to dry densities as determined by the Standard Proctor Compaction Test performed in accordance with ASTM D698. Testing shall be paid for separately by the City directly to the testing laboratory.

2. Structural fill material supporting structures and pavement and other areas indicated on the Drawings shall be compacted to 95 percent of the maximum dry density. The upper 8" of fill shall be compacted to 95 percent of the maximum dry density.

3. Controlled fill for general site grading shall be compared to 90 percent of the maximum dry density.

4. Compaction of embankments shall be by sheepsfoot rollers with staggered uniformly spaced knobs and suitable cleaning devices. The projected area of each knob and the number and spacing of the knobs shall be such that the total weight of the roller and ballast when distributed over the area of one (1) row of knobs shall be 250 psi. Placement and compaction of materials shall extend beyond the final contours sufficiently to insure compaction of the material at the resulting final surface. Final contours shall then be achieved by a tracked bulldozer or grader shaping the face of the embankment.

5. Compaction of backfill around the structures shall be accomplished by power tamping equipment approved by the Engineer.

6. If tests indicate that density of backfill is less than that specified, the area shall be re-compacted or undercut, filled, and compacted until specified density is achieved.

G. Final Grading: Upon completion of construction operations, the area shall be graded to finish contour elevations and grades shown on the Drawings. Graded areas shall be made to blend with remaining ground surfaces. All surfaces shall be left smooth and free to drain

H. Moisture:

1. All fill shall be compacted with the moisture content as established by the 95 percent intercept on the moisture density curves or the moisture content at the shrinkage limit, whichever is less.

2. If fill material is too wet, provide and operate approved means to assist the drying of the fill until suitable for compaction

3. If fill material is too dry, provide and operate approved means to add moisture to the fill layers.

I. Proofrolling:

1. All areas where pavement or structures are to be built on compacted fill and other areas where indicated on the Drawings, shall be proofrolled to detect soft spots prior to the placement of fill material or construction of foundations.

2. Proofrolling shall consist of the moving a 20-30 ton loaded dump truck or pneumatic tire roller over the subgrade after the subgrade is shaped. Proofrolling shall be witnessed by the Engineer.

3. Pneumatic-tired rollers shall have not fewer than four pneumatic tired wheels which shall be of such size and ply that tire pressure can be maintained between 80 and 100 pounds per square inch for 25,000 pound wheel load during rolling operations. Unless otherwise required, rolling shall be done with tires inflated to 90 psi. The roller wheels shall be located abreast in a rigid steel frame. Each wheel shall be loaded with an individual weight box so that each wheel will bear an equal load when traversing uneven ground. The weigh boxes shall be suitable for ballast loading such that the load per wheel shall be 25,000 pounds. The spacing of the wheels shall insure that the distance between the nearest edges of adjacent tires shall be not greater than one-half of the tire width of a single tire at the operating pressure for a 25,000 pound wheel load. The roller shall be operated not faster than 5 feet/second.

4. Subgrade shall be proofrolled with 6 passes of the roller. Depressions that develop during the proofrolling operations shall be filled with suitable material and those filled areas shall be proofrolled with 6 passes of the roller. If, after having been filled and proofrolled, the subgrade still contains depressions, the soil shall be undercut to the full depth of the soft material or 5 feet whichever is less, backfilled, and rolled to achieve a subgrade acceptable to the Engineer.

5. After the proofrolled subgrade has been accepted by the Engineer, the surface of the subgrade shall be finished with a smooth steel wheel roller weighing not less than 10 tons. Finished surface of the subgrade shall be within a tolerance of 0.04 feet at every point.

6. Conduits, pipes, culverts and underdrains shall be neither disturbed nor damaged by proofrolling operations. Rollers shall neither pass over, nor approach closer than 5 feet of conduits, pipes, culverts and underdrains unless the tops of those facilities are deeper than 3 feet.

3.12 PIPE BEDDING

A. The contractor shall excavate to a minimum of 8-inch below the bells or couplings for the full width of the trench and shall place a minimum of 8-inches of No. 57 crushed stone bedding upon which the pipe is to be laid. In cases as determined by the Engineer, where trench material is suitable for use as bedding, the trench may be excavated to a point above the invert grade, and the trench bottom handshaped so that the bottom segment of the pipe is firmly supported on undisturbed material.

B. Gravity Sewers and Accessories: Lay all pipes with minimum Type 5 – Class B or C bedding unless shown or specified otherwise. Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Place and compact bedding material to the proper grade before installing the pipe. After pipe has been brought to the proper grade, haunching material shall be carefully placed by hand and compacted to the top of the pipe.

C. Manholes: Excavate to a minimum of 12-inch below the planned elevation of the base of the manhole. Place and compact crushed stone bedding material to the required grade before constructing the manhole.

D. At pipe subgrade, if foundation soil in trench is soft, wet, spongy, and unstable or does not afford solid foundation for pipe, the Contractor shall excavate as instructed by Engineer and provide stable base for placement of pipe bedding. Quantities of in-place crushed rock bedding which are in excess to those required on Drawings will be paid on basis of Unit Prices listed in Bid Form.

E. Where rock has been excavated in the trench, the Contractor shall construct a base by placing crushed rock upon which a subgrade can be prepared. Crushed rock bedding in excess to that shown on Drawings will be paid for on basis of Unit Prices listed in Bid Form.

F. Before any pipe is lowered in place, the trench bottom or bedding shall be prepared so that each pipe will have a firm and uniform bearing over the entire length of the barrel and a width equal to one-half the outside diameter of the pipe. All adjustments in line and grade shall be made by scraping away or filling and tamping in under the barrel of the pipe. Wedging and/or blocking are not permitted.

3.13 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone Backfill:

1. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane at a point above the top surface of the pipe. The bedding is defined as that portion of pipe zone, backfill material between the

trench subgrade and the bottom of the pipe. The embedment is defined as that portion of the pipe zone backfill material between the bottom of the bedding and a level line of initial backfill (12" above the top of pipe).

2. After compacting the bedding, the Contractor shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.

3. The pipe zone shall be backfilled with the indicated backfill material. The Contractor shall exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.

4. If a moveable trench shield is used during backfill operations, the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. The Contractor shall not displace the pipe or backfill while the shield is being moved.

5. Selected backfill material for the pipe zone shall consist of specified material herein or native or imported granular material as approved by Engineer in advance of placement. Place material in the trench simultaneously on each side of the pipe for the full width of the trench and the depth of the pipe zone in layers 6-inches in depth. Each layer shall be thoroughly compacted by mechanically tamping or vibrating. In all cases, backfilling of the pipe zone must be done by hand. Particular attention shall be given to underside of the pipe and fittings to provide a firm support along the full length of the pipe. The pipe zone shall be considered to extend 12-inches above the top of the pipe, and shall be compacted to a compaction of not less than 95 percent of maximum dry density at optimum moisture content as herein after specified. Care shall be taken not to damage pipe or special coatings on the pipe.

B. Trench Zone Backfill:
After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying as indicated between a plane above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade. If flooding, ponding, or jetting is used, the pipe shall be filled with water to prevent flotation.

C. Backfilling Pipe Trench: After the pipe had been laid in the trench and has been inspected and approved, and backfilling in the pipe zone is complete and compacted, the remainder of the trench may be backfilled. The backfill

material shall be suitable material as hereinbefore specified. Care shall be taken to insure that no voids remain under, around or near the pipes.

D. Compaction: The maximum dry density and optimum moisture content of each soil type used in the controlled compacted fill shall be determined by ASTM D698 compaction method. Field density tests shall be determined in accordance with ASTM D1556. Testing shall be paid for separately by the City directly to the testing laboratory.

E. Placement and Compaction of Trench Backfill: The placement and compaction of all trench backfill shall conform to one of the following methods, subject to the qualification specified therein:

1. Mechanically Compacted Backfill (Unpaved Areas):. With approval of Engineer, backfill shall be mechanically compacted by means of tamping rollers, sheepsfoot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical tampers to a minimum of 95 percent at optimum moisture. Trench backfill compaction above the pipe zone shall be to a minimum 95 percent in areas under buildings and pavements. Where the backfill soil has had a clay-like behavior and has a plasticity index of at least 12, only the upper 3-feet of material placed will require minimum compaction of 95 percent. All such equipment shall be of size and type approved by the Engineer. Impact-type pavement breakers (stompers) will not be permitted over any pipe. Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or improvements installed under the Contract. The Contractor shall make its own determination in this regard. Mechanically compacted backfill shall be placed in horizontal layers not exceeding the maximum thickness of 8 inches. Each layer shall be evenly spread, the moisture content brought to near optimum condition and then tamped or rolled until the specified compaction and moisture content had been attained.

2. Graded Aggregate Base (Paved Areas) – See Appendix F - Department of Public Works Public Right of Way Manual.

F. Additional Material: Where final grades above the pre-construction grades are required to maintain minimum cover, additional fill material will be shown on the Drawings. Utilize excess material excavated from the trench, if the material is suitable. No additional payment will be made for additional material when excavated materials are used. If excess excavated materials are not suitable, or if the quantity available is not sufficient, provide additional suitable fill material.

G. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

3.14 BACKFILLING AROUND STRUCTURES

A. General:

1. Remove debris from excavations before backfilling.

2. Do not backfill against foundation walls until so instructed by the Engineer.

3. Wherever possible, backfilling shall be simultaneous on both sides of walls to equalize lateral pressures.

4. Do not backfill on only one (1) side of vertically spanning walls unless walls are adequately shored or permanent construction is in place to furnish lateral support on both top and bottom of wall.

3.15 FIELD TESTING

A. General: All field soils testing will be done by a testing laboratory of the City's direction except as indicated below. Testing shall be paid for separately by the City.

B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 698. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method, ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth), or by such other means acceptable to the Engineer.

C. In case the test of the fill or backfill show non-compliance with the required density, the Contractor shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the City and paid by the Contractor.

D. The Contractor shall provide test trenches and excavations including excavation, trench support, and groundwater removal for the City's field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the City.

3.16 GRADING

A. General:

1. Perform all rough and finish grading required to attain the elevations indicated on the Drawings.

2. Perform rough grading to an accuracy of plus or minus 0.15 feet.

B. Grading Around Buildings: Control the grading around buildings so the ground is pitched to prevent water from running into the excavated areas of a building or damaged other site features.

C. Treatment After Completion of Grading:

1. After grading is completed, permit no further excavation, filling or grading, except with the approval of the Engineer.

2. Use all means necessary to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

3.17 EXCESS WATER CONTROL

A. Regulations and Permits: Obtain all necessary soil erosion control permits in accordance with the Georgia Soil Erosion and Sedimentation Control Act, and all pertinent rules, laws, and regulations.

B. Unfavorable Weather:

1. Do not place, spread, or roll any fill material during unfavorable weather conditions.

2. Do not resume operations until moisture content and fill density are satisfactory to the Engineer.

3. Any inundated area that freezes shall be removed and refilled at no additional cost to the City.

C. Provide berms or channels to prevent flooding of subgrade. Promptly remove all water collected in depression.

D. Pumping, Drainage and Dewatering:

1. Provide, maintain and use at all times during construction adequate means and devices to promptly remove and dispose of all water from every source entering the excavations or other parts of the Work

2. Dewater by means that will insure dry excavations, preserve final lines and grades, and do not disturb or displace adjacent soil.

3. All pumping and drainage shall be done with no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic or the work of other contractors, and in accordance with all pertinent laws, ordinances, and regulations.

4. Do not overload or obstruct existing drainage facilities.

3.18 SETTLEMENT

A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments, which may occur within one (1) year after final acceptance of the Work by the City.

B. The Contractor shall make, or cause to be made, all repairs, or replacements made necessary by settlement within thirty (30) days after receipt of written notice from the Engineer.

3.19 CLEANING

A. Upon completion of the Work of this Section, remove all rubbish, trash, and debris resulting from construction operations. Remove surplus equipment and tools. Leave the site in a neat and orderly condition acceptable to the engineer, and in conformance with the General Conditions of the Contract Documents.

END OF SECTION

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SECTION 02270

Vegetative Erosion Control and Bank Stabilization

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide erosion control and streambank stabilization including but not limited to fertilizing, seeding, planting, mulching, installation of erosion control fabric, guarantee and maintenance for all disturbed areas shown on the Contract Drawings and in accordance with this specification.

1.02 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

A. This section is related to the following specification sections.

1. SECTION 02125: Erosion and Sediment Control
2. SECTION 02271: Gabions
3. SECTION 02273: Riprap

B. This section references the following commercial standards:

1. "Manual for Erosion Control in Georgia", published by the Georgia Soil and Water Conservation Commission (4310 Lexington Road, Athens, Georgia 30603), which is available on the Internet as a free download at http://www.gaswcc.org.

2. "Guidelines for Streambank Restoration", published by the Georgia Soil and Water Conservation Commission (4310 Lexington Road, Athens, Georgia 30603) in cooperation with Metro Atlanta Association of Conservation Districts, USDA Soil Conservation Service (now Natural Resources Conservation Service or NRCS), and the Georgia Environmental Protection Division.

1.03 CONTRACTOR SUBMITTALS

A. General: Submittals shall be furnished in accordance with Section GC-28 – Working Drawings, Shop Drawings, Data on Material and Equipment, Samples and Licenses.

B. Product Information:

1. Manufacturer's product information for erosion control fabrics, geo-textile fabrics (natural and synthetic fiber) and cellular confinement

systems must be provided to the Engineer for written approval, prior to installation on any project site.

2. Information regarding the composition, infiltration rate, and chemical analysis of soil amendments including, but not limited to, fertilizer (natural and synthetic), agricultural lime, plant material compost, leaf or straw mulch, and peat moss must be provided to the Engineer for written approval prior to installation on any project site.

3. Information regarding the species mix and germination rates of erosion control grass seed mixes must be provided to the Engineer for written approval prior to installation on any project site.

C. Certificates:

1. Supplier or manufacturer's certificates, stating the source, quantity, and type of material, shall accompany each delivery. All certificates shall be submitted to the Engineer at the time of delivery. No materials or products shall be left at the project site without first notifying the Engineer.

2. Certificates of inspection of commercial plant material, as may be required by Federal, state, local, or other authorities having jurisdiction, must accompany the plant material shipment and must be submitted to the Engineer at the time of delivery.

D. Samples:

1. Grass seed: two-pound samples of each type of grass seed must be submitted to the Engineer for approval before the bulk grass seed is delivered to the project site. The samples shall be accompanied by a supplier's or dealer's germination rate and percentage of weed seed certifications. The Contractor shall plant the grass seed in test plots designated by the Engineer and analyze the plots for germination rates and weed content. Grass seed shall not be delivered to the project site without written approval from the Engineer. Approval of the seed samples by the Engineer shall not affect the right of the Engineer or Owner to reject the seed upon or after delivery.

E. Reports:

1. Soil Fertility Test: Independent laboratory test results for pH, organic material, texture, soluble salts, nitrogen, phosphorus, potassium, iron and micro-nutrients.

2. Soil Percolation Test: Independent laboratory test results for on-site soil percolation rates defining the infiltration rate through the top 8-inches of soil. Information to be used to assist in determining irrigation requirements.

1.04 SITE DISTURBANCE MINIMIZATION AND EROSION HAZARD REDUCTION

A. The Contractor shall be responsible for minimizing the amount of disturbed area on the site during construction. To accomplish this task the Contractor shall:

1. Install required temporary erosion control measures, as specified on the Contract Drawings prior to initiating any ground disturbing activities within the project site. The Contractor shall notify the Engineer when all temporary erosion control measures have been installed. The Engineer shall, within 24 hours following such notification, inspect all temporary erosion control measures installed by the Contractor. Following inspection the Engineer will notify the Contractor, in writing, that the installation of the temporary erosion control measures meets the Contract requirements and authorize the Contractor to proceed with ground-disturbing activities.

2. Limit site access to the approved site access locations shown on the Contract Drawings unless otherwise authorized in writing by the Engineer.

3. Limit the amount of exposed soils, in areas where vegetation removal is required, to the smallest practical area and for the shortest practical time period. See 1.04.B below.

4. Extract, salvage and store all woody vegetation that has to be removed during construction but which can be replanted following the completion of construction. Salvaged plant material shall be stored in a temporary nursery. The property Owner, in conjunction with the Engineer, shall designate the approved location of the temporary nursery area prior to the initiation of plant salvage activities. The Engineer will review and approve the Contractor's plant salvage methods prior to the initiation of plant salvage activities. The Contractor shall provide temporary irrigation as necessary to maintain healthy plants based on site and climate conditions at the temporary nursery location.

5. Salvage and stockpile onsite soils removed during clearing and grading activities and designated as suitable for reuse within the project site. All salvaged soil shall be covered with erosion control fabric or plastic to prevent wind or rainfall induced erosion.

Protective covering shall be anchored around the edges of the stockpile area using sandbags or other anchoring systems as approved by the Engineer.

6. Protect all vegetation within the project site that has not been specifically identified for removal or that is outside of any areas designated for clearing, grading, or construction activities. Vegetation to be preserved shall be identified and clearly marked using florescent pink or florescent orange flagging (attached to each plant) prior to initiation of clearing, grading, or construction activities.

    a. Vegetation to be preserved shall include all existing vegetation vital to streambank stabilization that is not within a designated clearing, grading, or construction area.

    b. Any vegetation providing food and/or critical habitat for any species listed as rare, threatened, or endangered by any Federal or state agencies shall be preserved. Such vegetation shall not be located within any areas of the project site designated for clearing, grading, or construction activities.

    c. All vegetation within the delineated boundaries of jurisdictional or regulated wetland areas shall be preserved unless otherwise directed by the Engineer or as identified on the Contract Drawings. Any impacts to vegetation within delineated wetland area caused by or related to clearing, grading, or construction related activities within the project site shall be mitigated in accordance with applicable Federal, state, and/or local regulations. The Contractor shall be responsible for insuring that any Federal, state, or local permits required to alter delineated jurisdictional or regulated wetlands have been acquired and are included as part of the Contract Documents.

7. The Contractor shall establish all clearing limits within the project site in accordance with Contract Documents. Clearing limits shall be delineated in the field using “Hi-Vis Barrier Fencing” (available through Forestry Suppliers, Inc., 205 West Rankin Street, Jackson, MS 39201) or authorized substitute.

    a. The barrier fence shall be installed by attaching the fence material to 6-foot metal fence posts driven into the ground a minimum of 2 feet at 6-foot intervals along the edge of those areas within the site that are not designated for clearing, grading, or construction related activities. The barrier fence

shall be attached to the fence posts using loops of No. 9 wire; three loops spaced equidistant along each fence post.

b. The Contractor shall install barrier fence around all areas where existing vegetation is to be preserved or protected. Barrier fence is reusable and shall be removed after all construction-related activities within the project site have ceased or as directed by the Engineer.

B. The Contractor shall notify the Engineer when ground-disturbing activities have ceased within an area of the site where all construction activities (excluding those activities inside of structures) has been completed. This notification shall occur within 24-hours following the completion of ground-disturbing activities. The Engineer shall inspect those areas and notify the Contractor, in writing, that the Contractor shall apply erosion control seed/mulch mixtures to reduce or eliminate erosion hazards within those disturbed areas. The Contractor shall, within 24-hours after receiving notification from the Engineer, apply erosion control seed/mulch mixes in accordance with the Contract Documents.

1.05 ACQUISITION OF PLANT MATERIALS

A. The Contractor shall obtain all live plant materials (cuttings and whole plants) from local plant suppliers (nurseries, landscaping companies, plant collectors, etc.). All live plant material shall be from plant stocks grown within a 50-mile radius of the project site. Locally grown or harvested plant materials are generally better adapted to local growing conditions and tend to be more resistant to plant diseases and climatic variations than plants grown or plant materials harvested form outside the local area of the project.

1. If the Contractor is unable to obtain the specified plant materials from the local area the Contractor shall notify the Engineer in writing regarding the inability to obtain specified plant material. The Engineer shall notify the Contractor in writing regarding authorized plant material substitutions or alternative sources.

B. The Contractor shall abide by all Federal, state, and local regulations regarding the collection of plant materials. The Contractor shall be responsible for obtaining all required collection permits (or shall insure that the Contractor's plant material supplier has obtained all required collection permits) from any and all Federal, state, or local jurisdictions with permitting or regulatory authority regarding plant material collection.

1. In addition to any and all Federal, state, and local permits or authorizations the Contractor shall insure that any plant materials collected on private property were obtained with written permission or authorization from the property owner.

C. All plant materials (cuttings or whole plants) collected from natural (non-nursery) locations shall be collected during the time period when those plants are dormant. All whole plants collected from natural (non-nursery) setting shall be collected in such a manner as to protect the plant's root system from a distance 3 inches to 6 inches outside the drip line of the plant to the stem and to a depth equal to or slightly greater than the radius of the drip line. All whole plants collected form natural (non-nursery) settings shall have the excavated root ball wrapped in burlap (tied with twine) to protect the root system.

PART 2 – PRODUCTS

2.01 FERTILIZER

A. The Contractor shall have the native soil, within the project site and in those areas where plant materials (cuttings or whole plants) will be installed, tested to determine if fertilizers need to be added to the soil to assure viable plant growth and survival. The addition of fertilizer to the soil will not be required except in those soils with test results indicating low soil fertility or low organic content.

B. The Contractor shall ameliorate natural soils with low soil fertility values with commercial, chemical type fertilizer, which has a certified composition of 10 percent nitrogen, 10 percent available phosphoric acid, and 10 percent soluble potash (10-10-10). Any chemical fertilizers added to the native soils shall be of a type that conforms to all applicable Federal, state, and local laws and regulations. Fertilizer shall be applied at a rate of 500 to 700 pounds per acre. The Contractor shall supply the fertilizer in one of the following forms:

1. A dry free-flowing granular fertilizer, suitable for application by an agricultural or commercial grade fertilizer spreader.

2. A soluble form that will permit complete suspension of insoluble particles in water, suitable for application by a power sprayer (or commercial hydro-seeder).

3. A homogenous pellet, suitable for application through a "Ferti-Blast™" gun or other similar device.

4. A tablet or other form of controlled release with a minimum one-year release period.

C. The Contractor shall be responsible for assuring the application of fertilizers is consistent with Federal, state, and local laws and regulations

particularly in those areas within 25 feet of open water or wetland ecosystems.

D. The Contractor shall provide the fertilizer in the form specified by the Contract Documents or as directed in writing by the Engineer.

E. The Contractor may, with written authorization from the Engineer, use natural, composted materials to elevate low soil fertility. The Contractor shall provide the Engineer with the results of soil fertility tests conducted to evaluate the fertility of the native soil/organic compost mixture.

2.02 LIME

A. The Contractor shall apply agricultural lime to the native soils unless soil test results indicate that the addition of agricultural lime is unnecessary. The Contractor shall provide the Engineer with test results indicating the application of agricultural lime is unnecessary. Agricultural lime shall be of a standard manufacture, flour grade, meeting the requirements of ASTM C-602.

2.03 WHOLE LIVE PLANTS

A. The following describes the types of whole live plants that may be required as a part of this contract.

1. Seedlings: Plants grown from cuttings, seeds, or other approved propagation methods (i.e., air rooting). These plants do not normally show form characteristics of the species and are generally less than three years of age and less than 24 inches in height. Measurement for purposes of payment or design is in 3-inch height increments.

2. Whips: Bareroot, broadleaf trees, generally unbranched and between 2 feet and 6 feet in height. Measurement for purposes of payment or design is in 1-foot height increments.

3. Broadleaf Trees: Branched deciduous trees over 6-feet in height. Measurement for purposes of payment or design is by mainstem diameter or in 1-foot height increments.

4. Coniferous Trees: Coniferous trees over 2 feet in height. Measurement for purposes of payment or design is in 1-foot height increments.

5. Shrubs: Typically multi-stem or single-stemmed plants species that are less than 30 feet in height at maturity. Shrubs used in restoration projects are typically between 2-foot and 4-foot in height

when delivered to a project site. Shrubs can be either delivered with a burlap wrapped root ball or in containers ranging from a 1-gallon to 5-gallon size. Measurement for purposes of payment or design is typically by container size or in 1-foot height increments.

6. Groundcover Species: Typically low growing or prostrate plants delivered to a project site in 4-inch, 6-inch, 10-inch, or 1-gallon size nursery pots. The species can vary form woody to herbaceous plants. Measurement for purposes of payment or design is typically based on container size.

2.04 MULCH AND OTHER AMENDMENTS

A. Bark or Wood Chip Mulch: Bark or Wood Chip Mulch shall be derived from pine or hemlock species. Local hardwood species can be used with authorization from the Engineer. The mulch shall be ground so that a minimum of 95 percent of the material by loose volume will pass through a 1.5-inch mesh screen (sieve) and no more than 55 percent of the material by loose volume will pass through a ¼-inch mesh screen (sieve). The mulch shall not contain any resin, tannin, or other compounds in quantities that would be detrimental to plant life, water quality or aquatic organisms.

B. Wood Cellulose Fiber Mulch: Wood Cellulose Fiber Mulch shall be used, as part of the hydro-seeding application shall be a fibrous wood cellulose product produced and marketed specifically for use in hydro-seeding applications. Mulch shall be produced from natural or recycled wood fiber such as woodchips, mill wastes, logging slash, or recycled construction wastes.

1. Mulch shall be free of any rock, plastic, metal, or other non-woody material.

2. Mulch shall be treated with a non-toxic green dye that facilitates inspection and application. The dye must be certified to contain less than 250 ppm of boron and certified as non-toxic to both plants and animals.

3. Mulch shall be manufactured in such a manner that after addition to water and agitation in slurry tanks the fibers stay uniformly suspended to form homogenous slurry.

4. When hydraulically applied to the ground the mulch shall allow the absorption and percolation of water.

5. Each package of mulch shall be tagged or marked to show dry weight and a certification of at least 93 percent organic content on an oven-dry basis as determined by ASTM 586.

6. The moisture content of the mulch shall be no greater than 15 percent as determined by oven-dried weight.

2.05 SEED

A. The Contractor shall supply specified seed mixes, which are certified a minimum of 95% pure with a germination rate of 80% or greater, to the project site in the supplier's original, unopened bags. The Contractor shall insure that a certification tag is attached to each bag that displays or clearly identifies:

1. the scientific and common names of the seed,

2. the species names of all grass, legume, or cover crop seed included in the mix,

3. the lot number of the mix,

4. the percentage of weed seed and inert material,

5. the germination rate, and

6. the purity percentage.

2.06 SOD

A. Sod shall contain a minimum of 85% perennial grass species adapted to average climatic conditions at the project site. Any proposed substitute grass seed mixes, available in the local market at the time sod is to be installed at the site, shall be submitted to the Engineer for review and approval.

1. Sod shall be field grown for one calendar year or longer and have a well-developed root structure.

2. Sod shall be free of thatch, weeds, undesirable plant species, nematodes, diseases, and insect damage.

3. Sod shall be free of stones larger than 1-inch diameter, large chunks (>1 cubic inch in size) of woody material, and all human-made products such as plastic, glass, metal objects, and concrete.

4. Prior to harvest the sod shall be green, in an active and vigorous state of growth, and mowed to a height not less than ¼-inch and no greater than 1-inch.

5. Sod shall be cut in rectangular pieces with straight edges. Any sod with torn ends or irregular edges shall be rejected by the Engineer.

2.07 TALL WOODEN STAKES

A. These shall be untreated wooded stake or poles, preferably cedar, 5 feet to 8 feet in length, and either nominally 2-inch by 4-inch dimension lumber or 3-inch diameter poles.

2.08 TACKIFIER

A. Tackifier used in hydro-seeding or mulching applications to hold the seed or mulch product to the soil or slope shall conform the following:

1. Tackifier shall be derived from organic plant sources containing no growth or germination inhibiting materials.

2. When combined with water the tackifier shall have the property of even dispersion and suspension and shall blend evenly in slurry (i.e. a water and wood cellulose fiber mix).

3. Tackifier shall be mixed with a dyed wood cellulose fiber at a rate of 150 pounds of fiber per acre to monitor application rates and coverage.

2.09 EROSION CONTROL FABRICS/GEOSYNTHETICS

A. Acceptable erosion control products include:

1. Jute Matting Or Coconut Fiber (Coir) Matting - Natural fiber products that are woven into a fabric that is typically produced in widths ranging from 4 feet to 16 feet (or more) and delivered to the end user in rolls. These materials are generally rolled out over an area of disturbed soil to stabilize the soil, reduce splash erosion, and provide a seedbed for the erosion control seed mix. This product shall be anchored using nine-inch 2-legged wooden or metal staples or as otherwise specified by the product manufacturer.

a. Jute matting or coconut fiber matting shall be provided in rolls that are 4 feet (48 inches) wide and 50 yards (150 feet) with finished edges on the long sides.

b. The matting shall be a woven material made of twisted, unbleached “yarn” with a weave opening of ¼-inch to ¾-inch square.

c. Selected materials used shall be consistent with the site conditions, anticipated runoff velocities, soil characteristics, and rainfall intensities. The Engineer prior to procurement and delivery to the site shall approve selected materials.

d. All manufacturers' specifications shall be provided to the Engineer for approval.

2. Erosion Control Blanket

Manufactured product combining two layers of woven synthetic material with a layer of straw, coconut fiber, shredded bark, or wood fiber (excelsior) sandwiched between the synthetic fabric layers. This product is manufactured in rolls of varying widths and lengths and is available from a variety of manufacturers and suppliers. Acceptable manufacturers include Belton Industries, North American Green, and CSI Geosynthetics. Products vary in specification and shall be selected based on their applicability to the project site conditions. Product is anchored using nine-inch, 2-legged wooden or metal staples or as specified by the product manufacturer.

a. Selected material used shall be consistent with the site conditions, anticipated runoff velocities, soil characteristics, and rainfall intensities.

b. All manufacturers' product specifications shall be provided to the Engineer for approval.

3. Plastic (Polyethylene) Sheeting

This product is used to temporarily cover exposed soils to prevent erosion or to cover areas where seed has been applied but temperatures are below germination levels and surface erosion risk is moderate to high. This product is generally anchored with sandbags.

a. Plastic sheeting shall be clear and a minimum thickness of 6 mils.

b. Refer to Specification Section 02125 for additional specifications.

4. Cellular Confinement System

The cellular confinement system shall meet or exceed the following specifications:

a. Expanded Dimension 8 feet x 20 feet

b. Collapsed Dimension 11 feet 5 inches by 5 inches

c. Panel Thickness (Nominal) 0.047 inches

d. Panel Weight 57 pounds (deeper cells weigh more)

e. Individual Cell Depth 4 inches (other depths available)

f. Cell Area 38 square inches

g. Cell Seam Node Pitch 13 inches

h. Welds per Seam 3

i. Seam Tensile Peel Strength 225 PSI

j. Installation Temp. Range -16 degrees to 110 degrees F.

k. Polymer Material HDPE (High Density Polyethylene)

l. Color Black

m. Carbon Black Content 2%

n. Chemical Resistance Superior

2.10 WARRANTY

A. The manufacturer shall warranty that the products under this specification are free from defects in materials and workmanship. The manufacturer and/or supplier shall agree to replace all defective materials without charge. The manufacturer shall have the right to inspect all materials identified by the purchaser as defective to determine probable cause or defect prior to replacement. The supplier shall provide the Engineer with specification tags for a cellular confinement system products delivered to the project site.

PART 3 – EXECUTION

3.01 GENERAL

A. Weather Conditions:

1. The Contractor is responsible to monitor weather conditions and weather forecasts to ensure that no areas of exposed soil shall be

developed unless the appropriate erosion control measures can be implemented within 12 hours prior to a predicted rain event.

2. No seeding, fertilizing, or mulching shall be done:

   a. when wind velocity exceeds 4 mph

   b. within 12 hours after rain

   c. when ground is frozen

   d. if compacted soils have not been scarified prior to application

B. Soil Preparation:

1. The ground to be seeded or planted shall be graded in conformance with the Contract Drawings unless otherwise directed by the Engineer.

2. The ground shall be scarified (loosened) to alleviate compaction and manipulated to remove large rocks (>3-inch diameter), roots or pieces of wood (>24 cubic inches) and all human-made materials exposed within the seeding, planting, sod installation, and/or erosion control fabric or cellular confinement system placement areas.

3. The Contractor may leave larger rocks and roots or pieces of woody debris if authorized by the Engineer or as shown on the Contract Drawings.

C. Grading and Shaping:

1. All slopes steeper than 4:1 shall be graded and shaped to promote plant establishment.

2. All areas where over-excavation is specified to allow incorporation of soil amendments, the Contractor shall notify the Engineer within 24 hours prior to final over-excavation grading and prior to the incorporation of any soil amendment products.

3. No soil amendment products shall be added to the native soil material until the Engineer approves the amendment.

4. Final grades shall be the elevation of the ground as shown on the Contract Documents after all soil amendments have been added.

5. The Contractor shall notify the Engineer within 48 hours prior to completion of final grading.

6. Final grading shall be inspected and approved by the Engineer. Unless otherwise authorized the Contractor shall not commence seeding, sod installation, erosion control fabric placement, installation of cellular confinement systems, or construction of bank stabilization measures until the final grading has been approved.

D. Soil Amendments:

1. Prior to seeding any areas the soil will be tested to determine the need for the addition of agricultural lime, organic compost, and/or fertilizers. The Engineer will collect the appropriate samples and submit those samples for testing. Results of the testing will be transmitted to the Contractor to allow determination of soil amendment needs.

2. Soil amendments such as fertilizer, lime, and mulch may be added separately as in the Dry Method described below (see Section 3.02) or incorporated into a water-based homogenous slurry that is applied by hydroseeding methods (see Section 3.03).

3. Soil amendments shall not be applied by water-based slurry on slopes steeper than 3:1.

3.02 DRY METHOD SEEDING

A. Seeding: The Contractor shall notify the Engineer not less than 24 hours in advance of any seeding operation and shall not begin work until area prepared or designated for seeding have been approved. Following approval by the Engineer, seeding shall commence immediately. Seed shall be applied at the specified rate and with the seed mix specified in the Contract Documents. Dry seeding shall be conducted with one of the following procedures:

1. Use an approved blower system with an adjustable disseminating device capable of maintaining a constant measured rate of material discharge that will provide an even distribution of seed at the rate specified and in the area specified;

2. An approved power-drawn drill or seeder capable of maintaining a constant measured rate of material discharge that will apply an even distribution of seed at the rate specified and in the area specified;

3. A hand-operated seeder capable of maintaining a constant measured rate of material discharge that will an even distribution of seed at the rate specified and in the area specified; or

4. By hand broadcasting with frequent assessment of application rates. If hand applications are used the seed shall be incorporated into the upper ¼-inch of topsoil using rake or other method approved by the Engineer.

Any reseeding ordered by the Engineer and not considered to be the Contractor's responsibility shall be performed by the Contractor and Payment made at unit contract prices for the areas reseeded.

B. Fertilizer: Fertilizer shall be applied in accordance with the procedures and requirements specified for seeding in Section 3.02.A. Fertilizer shall be placed at the rate and composition specified.

1. If specifications are not provided on the Contract Documents, fertilizer application rates and composition shall be determined by the results of a certified soil nutrient analysis**.**

   a. The Contractor shall collect soil samples from within the project area and from stockpiles of soils imported to the site prior to initiating construction.

   b. The Contractor shall submit the samples to a certified testing facility for soil nutrient analysis.

   c. The Contractor shall forward the results of the soil nutrient tests along with recommended fertilization rates to the Engineer for review and approval.

2. Aerial or broadcast application of fertilizer application within 25 feet of the edge of an open, flowing or still, body of water or wetlands shall be prohibited.

3. Spot applications of fertilizer may be made, as necessary, within 25 feet of open water or using equipment other than aerial application equipment or blowers. Caution shall be exercised when applying fertilizer adjacent to a water body or wetland because of the risks of adversely impacting water quality (and aquatic organisms).

C. Mulch Application: Specified mulch shall be spread evenly at the specified rates or 1,500 pounds over seeded areas within 24 hours after seeding unless otherwise directed by the Engineer.

1. Distribution of straw mulch shall be by means of an approved type mulch spreader, which utilizes forced air to blow mulch on seeded areas. In spreading straw mulch, the Contractor shall not use equipment that chops the straw into short (less than 6 inch) stalks.

2. In areas that are not accessible by mechanized mulching equipment, the Contractor shall mulch the area using hand methods approved by the Engineer.

3.03 HYDROSEEDING

A. Equipment: Hydroseeding is a method of applying a slurry-mixture that may contain grass seed (and/or the seeds of other native plants), fertilizer, wood cellulose fiber (dyed), tackifier, and water. The components of a hydroseed mix shall be mixed in tank (part of an approved hydroseeder) that uses water as a carrying agent and maintains continuous agitation and circulation through the use of internal mixing paddles (inside the mixing tank). The mixture shall be homogenous and dischargeable through a nozzle.

1. The approved hydroseeder shall have sufficient tank capacity to be able to cover ½-acre of seeding area per tank load.

2. The tank shall have a discharge system capable of discharging slurry at a continuous, uniform, specified application rate at a distance of 500 feet horizontally from and at an elevation difference of 150 feet vertically above the hydroseeder.

3. Discharge lines shall be large enough to prevent blockage as slurry passes through the lines.

4. The hydroseeder shall be equipped with discharge spray nozzles that will provide a uniform distribution of the specified slurry.

5. The Engineer shall inspect and authorize use of any hydroseeder delivered to the project site prior to the Contractor initiating any hydroseeding activity.

B. Mixture: The following mixture shall be used unless an alternate is approved by the Engineer:

1. Proportions per acre are:

a. 2,500 pound of wood cellulose fiber mulch,

b. 120 pounds of tackifier or soil stabilizer,

c. 60 pounds of fertilizer (or more if soil nutrient tests indicate a high nutrient need),

d. 3,000 gallons of water, and

e. Grass seed, using the specified seed mix and application rates.

2. Preparation: As the mixture components are being placed in the tank the agitator should be running at a slow to medium speed to assure good blending of the materials and a complete homogenous mixture of the ingredients.

a. fill the tank 1/3 full of water,

b. add ½ of the total amount of tackifier or stabilizer needed,

c. add three 50 pound bales of wood cellulose fiber,

d. add ½ the total fertilizer required.

e. add enough water to bring the tank to half and increase the speed of the agitator to a fast speed.

f. add remaining 200 pounds of wood cellulose fiber when the tank is ¾-full.

g. add remaining tackifier and fertilizer.

h. add remaining water and begin immediately to apply slurry to areas designated for seeding.

C. The grass seed to be used for this project shall be specified Contract Documents, in pertinent Special Provisions, or by the Engineer following consultation with a local agronomist or landscape architect.

1. Application:

a. All of the slurry prepared must be applied within two hours following the start of mixture preparation.

b. Slurry shall not be applied if there is a forecast for rain within 3 days following application.

3.04 SOD PLACEMENT

A. Sod Placement Period: Sod placement will be authorized by the Engineer after consultation with a local landscape architect or landscaping company to determine the earliest and latest start dates that will allow for a reasonable chance of success when sod is installed. The installation may start as early as May 15th and should be completed prior to November 1st each year.

B. Designated Sod Placement Areas: Sod shall be placed in areas as designated on the Contract Drawings or as directed by the Engineer.

C. Sod Placement Procedures: The Contractor shall notify the Engineer a minimum of 48 hours prior to sod installation to allow an inspection of the prepared areas. The Contractor is responsible for insuring the sod placement area has smooth scarified soils, is properly graded, has an appropriate soil moisture prior to sod placement, and is free of larger rock (>2-inches diameter), woody debris, and human-made products.

1. On long steep slopes sod shall be laid perpendicular to the fall line of the slope.

2. In ditches sod shall be laid at right angles to the flow line.

3. When required, or as directed by the Engineer, sod sections placed on steep slopes shall be pinned using 2 anchoring pins on each side of the sod section.

4. All air pockets shall be removed from under the sod by trampling or rolling with a compacting roller.

5. Frayed ends of sod sections will be removed. Holes in sod area shall be patched with new, undamaged sod.

D. Finishing: The Contractor shall insure the sod installation results in smooth parallel rows tightly packed together and in a relatively straight line. Sod sections shall be placed immediately adjacent to one another, as tightly packed together as possible. All joints shall be butted tightly together and staggered laterally. Sod sections shall not be stretched or reduced in size so they will fit.

E. Watering: Irrigation may be required in sodded areas installed during the warmer, drier periods of the year. The Contractor shall have appropriate temporary irrigation equipment on site prior to starting the installation of sod. Irrigation of the sod shall commence at the end of the first day sod placement in initiated. Watering shall be provided at a rate of 1.5-inches per week (7 days). Watering shall, be the responsibility of the Contractor.

3.05 EROSION CONTROL PLAN IMPLEMENTATION

A. Silt Fence Installation: Silt fence shall be installed as shown on the Contract Drawings, as described in the Temporary Erosion and Sediment Control Plan (TESCP) or as directed by the Engineer. Silt fence shall be installed a minimum of 48 hours prior to the time the Contractor initiates construction activities (i.e. clearing, grubbing, and grading).

B. Erosion Proofing Ingress/Egress Points: The Contractor shall place quarry spalls at all ingress/egress points on the site that are transitions for pavement to grassed or bare native soil. These transition areas will be 24 feet long and 12 feet wide. The Contractor shall place a geo-textile on the native soil prior to placing quarry spalls to prevent spalls from being pushed into the ground during wet site conditions.

C. Application of Straw Mulch: See Section 3.02.C.

D. Erosion Control Blankets:

1. Placement:

a. Biodegradable erosion control blanket shall be used on all slopes 4H:1V and steeper.

b. The erosion control blanket shall be spread only on prepared, fertilized and seeded surfaces.

c. On all slopes, the erosion control blanket shall be laid up-and-down the slope in the direction of water flow.

d. Waste of erosion control material shall be minimized by limiting overlaps as specified and by utilizing the full length of the netting at roll ends.

e. The erosion control blanket shall also be used on flatter areas where surface soil protection is considered critical to the establishment of vegetation and stabilization of erosive forces (i.e. water, wind, raveling, drying, etc.).

f. Proper selection of materials is critical for specific slopes and slope distances. No one product is applicable for all situations. The erosion control products should be selected on a case-by-case basis in consultation with the manufacturer.

2. Anchoring Process:

a. Ends and sides of adjoining pieces of material shall be overlapped 6-inches and 4-inches respectively and stapled. Six anchors shall be installed across ends. A common row of staples shall be used at side joints. Staple through both blankets, placing staples approximately 6-inches apart.

b. The top edge of the erosion control blanket shall be anchored in a 6-inch deep by 6-inch wide trench. Backfill and compact trench after stapling.

c. Anchorage shall be by means of 9-inch long, two-legged staples driven vertically and full-length into the ground. The legs shall be spread 3 inches to 4 inches apart at the ground to improve resistance to pullout. In loose soils the use of 18-inch metal/washer pins may be required to properly anchor the blankets.

d. All 3:1 or greater slopes shall be stapled with 2 staples per square yard in a triangular pattern. Staples shall be installed per the manufacturer's recommended staple pattern guide.

e. The erosion control blanket shall not be stretched, but should be laid loosely over the ground to avoid the blanket being pulled downslope.

f. The erosion control blanket shall not be rolled out onto ground containing frost within the 9-inch penetration zone of the anchorage staples. Further, no stapling shall be undertaken while any frost exists within the staple penetration zone.

g. Refer to Specification Section 02125 – Erosion and Sedimentation Control for additional product requirements.

3.06 BANK STABILIZATION

A. Brush Mattress:

1. General Description: Brush mattress stabilization system is a combination of living material that forms a protective cover of vegetation over a relatively shallow slope (flatter than 2H to 1V gradient). The eroding surface shall be protected by placing layers of live branch cuttings directly on the slope with the basal ends of the cuttings located at or very near the toe of the slope and the growing tip oriented up the slope parallel to the fall line. Live stakes interspersed in the brush mattress shall be used as anchor points

for tying a network of heavy duty landscaping twine to bind the brush mattress to the slope. In addition the toe of the treated slope shall be protected with either live or dead fascines anchored into the slope using stout stakes.

2. Construction Requirements:

a. Preparation Time: Live branch cuttings shall be collected locally and within 5 days prior to planned installation. Live cuttings shall be stored in a cool, shaded area to avoid desiccation. Live stakes and live fascines (bundles of live branch cuttings) shall be prepared immediately (within 1 day – 24 hours) prior to installation.

b. Planting Period: Plants shall be planted when willows or other suitable species used are dormant. This period extends from the time the leaves start to turn yellow in the autumn to the time new growth starts in the spring.

c. Construction Sequence:

1) Anchor the lower edge of the brush mattress in a trench, using a fascine to anchor and protect the lower bank edge from undermining.

2) Place live branches on slope with butt ends pushed into soil below the mean high water level with growing tips placed at a slight angle in the direction of stream flow.

3) Branches shall be placed to give coverage of approximately 4 branches every 6 linear inches.

4) Pound wooden stakes to ½ their length into soil between branches 3-feet on center.

5) Wrap wire or jute (heavy duty landscaping twine) around stakes and over branches as tightly as possible.

6) Once the twine or wire has been placed and made as tight as possible by hand, pound wooden stakes further into the ground to tighten the wire or jute and compress branches to slope.

7) Tamp live stakes between wooden stakes.

8) After fascines and branches are installed, place soil on top slightly exposed material. Fill voids between the branches of the brush mattress with loose soil to promote rooting.]

B. Branch Packing:

3. General Description: Branch packing is a process of placing alternating layers of live cuttings and soil in a hole, gully, or slump area in a slope or streambank. Live cuttings shall be oriented so the growth end points out of the hole, gully, or slump area and the basal end is embedded into the native soil. The layers of live cuttings shall be placed at approximately a 20-degree to 30-degree angle above horizontal with the growth end higher in elevation than the basal end. In large hole, gully, or slump areas dormant posts or tall wooden stakes shall be installed vertically, within the area being stabilized, in a pattern designed to allow a network of heavy landscaping twine to be tied to the vertical posts and over the top of the last live branch layer to hold that layer in place. The last layer of live branch cuttings shall be covered with soil. In addition, the vertical posts or stakes add horizontal stability to the layers of live cuttings.

4. Construction Sequence:

a. Begin at the lowest point, drive stakes 3 to 4 feet vertically into the ground. Set the stakes 1 to 1.5 feet apart.

b. Place an initial layer of branches 4 to 6 inches thick at the bottom between the vertical stakes. Place additional branches in a crisscross pattern covering the entire surface of the layer. Add a layer of soil no thicker than 120 inches and compact it.

c. The thickness of the layer shall be determined by the steepness of the slope (thinner when steeper) and/or problems with bank seepage.

d. Growing tips of branches shall protrude slightly from the filled surface to retard velocity and filter sediment.

e. Growing tips of branches shall protrude slightly from the filled surface to retard flow velocity and filter sediment.

f. Install a relief drain at the rear of the trench and above the base flow level. Place outlet at or above flow level to protect against further slumping.

g. The final installation shall conform to the existing slope.

B. Brush Layering:

1. General Description:

a. A layer of soil shall be wrapped in a coir fabric to form an approximately 12-inch thick “soft gabion” which shall be placed over the layer of live cuttings. More live cuttings shall be placed on top of the soft gabion and another soft gabion shall be placed on top of those cuttings and so on.

b. Alternating layers of live cuttings and soft gabions shall be installed so the face of the gabions forms a slope ranging from 1H:1V to 3H:1V. The live cuttings shall protrude out of the soft gabion reinforced slope face approximately 2 to 3 feet.

c. Brush layering/soft gabion systems over 7 feet in height and 20 feet in length shall have an Engineering analysis for completed determine slope stability prior to construction. The Contractor shall be consult with the Engineer prior to initiating construction of a vegetated soft gabion wall. The Contractor shall be responsible for collecting slope and soil stability information at slope or bank restoration sites where brush layering/soft gabion systems are proposed for installation.

2. Construction Sequence:

a. The slope shall be prepared by excavating a native soil bench at the lowest elevation of the affected area. In the case of a streambank that is typically at the ordinary high water mark.

b. The bench shall be constructed the full length of the effected area and shall be reinforced at the toe of the effected area using rock or dead plant cutting fascines to protect the toe from additional erosive forces. The bench shall be cut into the slope approximately 4 to 6 feet at a downward angle of approximately 5-degrees. The back slope of the treatment area is shall be cut at 0.5 to 1 or steeper.

c. Soil excavated from the treatment area during the construction of the bench shall be stockpiled in an area

designated by the Engineer. This soil shall be mixed with fertilizer and mulch.

d. Live branch cuttings; shall be collected locally, brought to the project site, inspected and approved by the Engineer. Following acceptance by the Engineer, the Contractor shall place the bundles of live cuttings in close proximity to the work area. The Contractor shall protect the cuttings from animal damage and desiccation.

e. After excavation has been completed, the soil has been removed and the treatment area has been prepared and a layer of live cuttings shall be placed in the bottom of the cut bench and covered with native soil. The basal end of the cuttings shall be pushed into the soil at the vertical slope to provide contact with groundwater. The basal end of the cuttings shall be placed into the treatment area so they are oriented perpendicular to the slope face. The growth end of the cuttings shall protrude from the bank approximately 2 to 3 feet. There shall be 8 to 12 live cuttings per linear foot of bench in each brush layer.

f. After the brush layer has been placed, roll out the coir fabric over the top of the live cuttings, insuring the selvage edge on one side of the roll is against the back slope of the cut-bench. Lay the remaining width of the material out so ½ the fabric width is laying flat and the other ½ is bunched up and laying on the live cuttings outside of the area where soil is to be placed.

g. With the soft gabion fabric in place, add a layer of soil 14 inches to 16 inches thick (loose) and compact to a layer 10 inches to 12 inches thick. Containment boards shall be used to contain the outer edge or nose of the soft gabion and prevent soil from being cast down the slope or into the water.

h. After the soil has been compacted roll the ½ of the fabric that was not covered by the soil over the top of the soil to form a coir pillow or soft gabion filled with soil.

i. Using dead stout stakes anchor the selvage edges of the fabric into the back wall of the cut-bench area. The Contractor shall exercise care when anchoring the ends of the soft gabion to avoid having soil emigrate out of the soft gabions and to reduce the risk of failure at the ends of the gabions.

j. During dry weather conditions the Contractor shall irrigate each brush layer/soft gabion combination.

k. The Contractor shall continue steps (e) through (i) until the desired elevation has been reached and the bank or slope stabilization area is fully treated.

C. Cellular Confinement Systems:

1. General Description: The cellular confinement system is a three dimensional system used for soil stabilization. It is defined as a series of symmetrical shaped cells joined together sharing common walls such that the final system confines infill material within the cells and reduces both vertical and lateral movement.

2. Construction Sequence:

a. The Contractor shall verify site conditions are as shown on the Contract Drawings. Notify the Engineer if site conditions are not acceptable. The Contractor shall not begin preparation or installation until unacceptable conditions have been corrected or the Engineer has authorized initiation of work.

b. The Contractor shall install the cellular containment system according to standard practices recommended by the manufacturer in accordance with the purpose of the application.

c. The Contractor shall prepare the subgrade in accordance with manufacturer's specifications. Excavate or fill foundation soils so the top of installed cellular confinement system is flush with or slightly lower than adjacent terrain or final grade.

d. Anchor cellular confinement sections at crest of slope. Use type of anchor and frequency of anchoring indicated on the Contract Drawings or as directed by the Engineer or per the Manufacturer's specifications.

e. Expand cellular confinement sections down slope. Ensure each Geoweb section is expanded uniformly to required dimensions and outer cells of each layer are correctly aligned. Interleaf or overlap edges of adjacent sections in each layer, according to which sidewall profiles abut. Ensure upper surfaces of adjoining Geoweb sections are flush at joint and adjoining cells are fully anchored. Anchor with specified anchors per manufacturer's recommendations.

f. Place infill in expanded cells with suitable material handling equipment, such as a backhoe, front-end loader, conveyor, or crane-mounted skip. Limit drop height to a maximum of 1 m (3 feet). Avoid displacement of cellular confinement sections by infilling from the crest to toe of slope. Overfill and compact infill in accordance with consistency of material and cell depth as follows: overfill screened topsoil between 25 50m (1 to 2-inches) and lightly tamp or roll to leave soil flush with top edge of cell walls. Apply specified surface treatment.

E. Live Staking:

1. Construction Sequence:

a. Plants shall be planted when willow, or other species suitable for use in vegetated riprap projects, is dormant. This period extends from the time the leaves start to turn yellow in the autumn to the time new growth starts in the spring. The Contractor shall schedule plant material installation for early spring just before the plants come out of the dormancy period.

b. Prior to installation the Contractor shall dip the butt end of all plant specimens (i.e. live stacks) into a liquid mycorrhizae root dip gel (rooting hormone with soil bacteria) to stimulate root growth.

c. Live stakes shall be planted right side up with the butt ends planted into the ground. In order to identify the top of the stakes, the butt ends should be pointed or otherwise marked at the time of cutting. Alternatively the tops of the stakes may be painted with a water-soluble latex paint.

d. The Contractor shall ensure that live stakes are to be planted as deep as possible. About 80 percent of the stake shall be inserted into the ground. The Contractor shall avoid stripping the bark or bruising the stake. The Contractor shall not pound the stakes with an ax or sledge. In hard ground the Contractor shall use an iron bar to prepare holes for the cuttings.

e. The Contractor shall tamp soil around the live stakes after they have been placed into the ground. The live stakes shall be firm in the ground so that they cannot be easily moved or pulled out.]

3.07 IRRIGATION (WATERING)

A. Short-term Irrigation: Trees and shrubs shall be thoroughly soaked after planting and provided with additional water at intervals necessary to provide for good health and growth of the planting. The Contractor shall be responsible for ensuring that adequate short-term irrigation is provided for the project.

1. The Contractor is responsible for providing water for irrigation and must adhere to all related legal and permit requirements.

2. Upon completion of planting, all planted and seeded areas within the project site shall be soaked to saturation by a fine spray. The new plantings and seedings shall be watered by an on-site sprinkling system during dry weather or whenever necessary for proper establishment of the planting and/or seeding until final project acceptance.

3. At no time shall the planting be allowed to dry out.

4. The Contractor shall implement appropriate measures to avoid excessive watering, soil washing (sheet erosion), excessive soil saturation, and/or areas of excess standing surface water.

5. Any damage to soils or plants that result from the Contractor's excessive or irregular irrigation (watering) practices shall be repaired within 24-hours by the Contractor at no additional cost to the OWNER.

6. Long-term Irrigation: The Contractor shall be responsible for providing an appropriate irrigation system to allow for watering of planted and seeded areas, that were constructed during as part of the project.

7. The Contractor shall provide irrigation after the initial construction period and throughout the maintenance and guarantee period. This Contractor responsibility extends to any performance monitoring periods that may be associated with agency permits issued to authorize the project work.

8. The Contractor shall review all short-term and long-term irrigation system proposals with the Engineer to ensure that said systems are adequate. No irrigation systems shall be installed or implemented without review and approval by the Engineer. Approvals from the Engineer shall be obtained 2-weeks prior to the time to begin required irrigation.

3.08 MAINTENANCE PRIOR TO ACCEPTANCE

A. The Contractor shall maintain the planted areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include the filling, leveling, and repairing of any washed or eroded areas, as may be necessary, and sufficient watering to maintain the plant materials in a healthy condition. The Engineer may require replanting of any areas in which the establishment of the vegetative ground cover does not appear to be developing satisfactorily.

1. Plants shall be maintained in a vigorous, thriving condition by watering, cultivating, weeding, pruning, spraying, and other operations necessary. No trees or shrubs will be accepted unless they are healthy and show satisfactory foliage conditions.

B. At time of acceptance of the completed project, all seeded areas shall be totally established with no bare spots. In addition, all seeded areas shall have no more than 5 percent aerial coverage by non-native invasive plant species and 0 percent aerial coverage by noxious weeds.

C. At the time of acceptance of the complete project all planted areas shall have a minimum of 85 percent survival of vegetative species (trees, shrubs, perennials).

D. Vegetation/Pest Management:

1. Maintenance of grass species within the erosion control areas outside a critical wildlife or fish habitat areas shall be undertaken using conventional mowing, trimming, weeding, and other vegetative management techniques.

2. The Contractor shall remove all noxious weeds and non-native, invasive plant species from within the project areas as regularly as necessary to prevent establishment of any noxious or non-native, invasive plant species.

3. The Contractor shall be responsible for the removal of animal pest species from the project area if said pest species are adversely impacting the health of the erosion plantings or seedings.

a. The Contractor shall submit a plan for pest control to the Engineer detailing the pest problems and the recommended approach for controlling and/or eliminating said pest problems within the project area.

b. The Contractor shall, through consultation with appropriate Federal, state, and local agencies, determine the regulatory requirements related to pest control.

4. Pesticide and herbicide use shall be implemented in accordance with all applicable Federal, state, and local regulations and policies.

a. The Contractor shall be responsible for acquisition of all permits and licenses require for use and application of pesticides and herbicides.

b. The Contractor shall be responsible for appropriate storage and disposal of all chemical agents used within the project site for the purposes of controlling or eradicating pests or undesirable vegetation.

c. The Contractor shall be responsible for all “chain of custody” requirements associated with all chemical constituents used for the control and/or eradication of pest and/or undesirable vegetation.

d. The Contractor shall not use pesticides and/or herbicides in critical wildlife and fish habitats (i.e. riparian zones, nesting cover, etc.)

e. The Contractor shall employ a licensed pesticide applicator as required by any Federal, State or local laws.

E. The Contractor shall provide adequate protection to all newly seeded areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until the end of the one-year correction period.

F. The Contractor shall replace any materials or equipment damaged by its employees or subcontractors.

G. The Contractor shall periodically inspect all erosion control blankets and matting following installation, particularly after rainstorms, to check for erosion and undermining. Any dislocation or failure shall be repaired within 24 hours. If washouts or breakage occurs, the Contractor shall reinstall the material after repairing the damage. The Contractor shall continue to monitor the project until it becomes permanently stabilized.

3.09 FINAL INSPECTION, ACCEPTANCE, AND GUARANTEE

A. Inspection of seeding and planting work shall be completed at conclusion of the maintenance period.

B. Written notice requesting inspection shall be submitted to the Engineer and Owner at least 10 days prior to the anticipated inspection date.

C. The Contractor shall submit inspection reports and/or maintenance records to the permitting agencies that have the ultimate approval authority with regard to when an erosion control project is successful.

D. Final acceptance of the work prior to beginning the guarantee period of the contract will be accepted upon written approval by the Engineer and/or Owner, which is based on the satisfactory completion of all work, including maintenance, but exclusive of the replacement of plant material or any required seeding.

E. The Contractor shall replace, as soon as weather conditions permit, all dead plants and all plants not in a vigorous, thriving condition, which are observed at the end of the one-year correction period.

F. Plants used for replacement shall be of the same size and variety specified in the Contract Documents unless otherwise directed by the Engineer. Plants shall be furnished, planted, staked, and mulched as specified in the Contract Documents.

G. At time of final acceptance of the completed project, all seeded areas shall be totally established with no bare spots. In addition, all seeded areas shall have no more than 5 percent aerial coverage by non-native invasive plant species and 0 percent aerial coverage by noxious weeds.

H. At the time of acceptance of the completed project all areas where bank stabilization techniques were implemented shall have a minimum of 85 percent survival of vegetative species (trees, shrubs, perennials) installed. In addition, the vegetative species (trees, shrubs, perennials) shall provide 85 percent aerial cover.

I. Prior to final acceptance the Contractor shall provide the Engineer with a written report (with photographs) documenting the condition of onsite plants and seedings. This report shall be used as part of the final project inspection and acceptance.

3.10 MAINTENANCE/GUARANTEE AFTER ACCEPTANCE

A. The Contractor shall be responsible for a period of one year after date of acceptance of all work under the Contract, for all plant replacements

including trees, shrub seedlings, perennials and any other portion of the bank stabilization treatment requiring maintenance or replacement.

B. The work covered by the maintenance and guarantee portions of these specifications consists of providing all replacements of plants, labor, materials, equipment, and supplies and performing all operations in connection with maintenance and guarantees.

C. The Contractor shall provide the Engineer and OWNER with a monthly record describing all maintenance activities performed including dates, materials, irrigation schedule and other pertinent activities. The person who actually supervised and/or performed the work shall sign the report.

D. The inspection of seeded areas is independent of the final inspection and maintenance period.

END OF SECTION

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SECTION 02271

Gabions

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide wire mesh gabion baskets and all appurtenant work, including the furnishing and placement of all fill rock, compacted embankment or other fill material, and geotextile filter material, as well as excavation, and disposal of excess or waste material, when directed by the Engineer.

1.02 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

A. This Section references the following related Specification Sections:

02200 – Earthwork

B. This Section references the following Commercial Standards:

ASTM A 641	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
ASTM A 764	Standard Specification for Steel Wire, Carbon, Drawn Galvanized and Galvanized at Size for Mechanical Springs.
ASTM A 975	Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses.

1.03 CONTRACTOR SUBMITTALS

A. The Contractor shall submit samples of all materials proposed to be used in the work in accordance with the requirements in Section GC-28 – Working Drawings, Shop Drawings, Data on Material and Equipment, Samples and Licenses. Sample size shall be as determined by the testing laboratory.

B. Contractor shall submit a letter certifying that rock from its selected rock source meets the requirements of this specification and, if requested, shall coordinate inspection of the rock source by the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials used in the manufacture and assembly of gabions shall comply with all requirements of ASTM A 975 for Style 1 standard galvanized gabions, except as modified herein.

B. Gabions shall be fabricated in such a manner that the sides, ends, lid and diaphragms can be assembled at the construction site into rectangular baskets of the sizes specified and shown.

C. Gabions shall be of single unit construction, manufactured with all components mechanically connected at the production facility; the base, lid, ends, and sides shall be woven into a single unit in such a manner that the strength of the unit shall meet the requirements of paragraph 2.02 D below.

D. Where the length of the gabion exceeds one and one-half its horizontal width, the gabion shall be divided by diaphragms, of the same mesh and gage as the body of the gabions, into cells whose length does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that no additional tying is required at this juncture.

E. Wire mesh used for gabion manufacture shall be fabricated in such a manner as to be non-raveling. This is defined as the ability to resist pulling apart at any of the twists or connections forming the mesh when a single wire strand in a section of mesh is cut.

2.02 GALVANIZED STEEL WIRE MESH GABIONS

A. Gabion basket units shall be of non-raveling construction and fabricated from a double twisted hexagonal mesh of hot dipped galvanized steel wire. The mesh opening shall be hexagonal in shape and uniform in size measuring not more than 3-1/4 inches by 4-1/2 inches.

B. Mesh wire, lacing wire, and stiffener wire used in the construction of gabions shall meet the minimum requirements shown below:

Property	Governing Standard	Minimum Requirement
Tensile Strength	ASTM A 641, Soft Temper	54,000 to 70,000 psi – Mesh and Selvedge Wire 54,000 to 75,000 psi – Lacing and Stiffener Wire
Zinc Coating	ASTM A 641, Class 3	0.90 oz/sq.ft. – Selvedge Wire 0.85 oz/sq.ft. – Mesh Wire 0.70 oz/sq.ft. – Lacing and Stiffener Wire
Diameter – Mesh Wire	ASTM A 975, Syle 1	0.120 in.
Diameter – Lacing and Stiffener Wire	ASTM A 975, Syle 1	0.087 in.
Diameter – Selvedge Wire	ASTM A 975, Syle 1	0.150 in.

C. Fasteners used in the construction of gabions shall meet the minimum requirements shown below:

Property	Governing Standard	Minimum Requirement
Tensile Strength	ASTM A 764, Coating Class 3, Coating Finish 1, Coating Type B, Tensile Class II	230,000 to 273,000 psi
Zinc Coating	ASTM A 764, Coating Class 3, Coating Finish 1, Coating Type B, Tensile Class II	0.80 oz/sq.ft.
Diameter	ASTM A 975, Style 1	0.118 in.

D. The minimum strength requirements of the wire mesh and connections shall comply with ASTM A 975 as listed below:

Test Description	Minimum Requirement
Parallel to twist	3500 lbf/ft
Perpendicular to twist	1800 lbf/ft
Connection to selvedges	1400 lbf/ft
Panel to panel connection	1400 lbf/ft
Punch test	6000 lbf

E. Gabions shall be manufactured by Maccaferri, TerraAqua, or approved equal.

2.03 ROCK FILL MATERIALS

A. Rock fill shall consist of durable, angular field or quarry stone of approved quality which is sound, hard, and free from seams, cracks, or other structural defects, weighing at least 156-pounds per cubic foot or more. Flat, slabby, or shaley pieces will not be acceptable. Stones shall be resistant to weathering and to water action and free from overburden,

spoil, and organic material. The minimum dimension of any rock or stone shall be 4 inches and the maximum dimension shall not be greater than 8 inches. The rocks or stones shall be graded in size so as to produce a reasonably dense mass.

B. Rock fill shall be hauled from a pit or site approved by the Engineer. On site quality control shall be through visual inspection. Rock that does not meet the requirements of this specification may be rejected by the Engineer or its designated representative.

2.04 GEOTEXTILE FABRIC

A. Geotextile fabric shall meet the requirements of GA DOT Section 881.06 for nonwoven fabrics, having physical properties as follows:

Puncture Resistance (ASTM D 4833)	30 lbs.
Grab Tensile Strength (ASTM D 4632)	65 lbs.
Grab Elongation (ASTM D 4632)	40%
Flow Rate (GDT: 87)	50 – 350 gal/min/ft^2

B. Fabric shall be Mirafi 140N or approved equal.

PART 3 - EXECUTION

3.01 FOUNDATION PREPARATION

A. The foundation areas for the gabions shall be excavated to the slopes, lines and grades shown and shall be smooth and firm, free of brush, trees, stumps, and other objectionable material.

B. The Contractor shall remove and exclude all stormwater, groundwater and creek or stream water from the excavation. Sump pumps and sand bags, or other means, shall be used to remove and exclude water and continuously maintain water level below the bottom of the excavation. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed. Any water removed from the excavation shall not be discharged into any surface stream or other water body unless such discharge meets water quality standards. Removed water may be disposed on-site by land application using sprinklers in an area designated by the Engineer or by discharge into an approved treatment system.

C. Foundation fill materials, procedures, and testing shall be as indicated on the Drawings and in accordance with the applicable requirements of the Section 02200, "Earthwork". Foundation fill materials shall be compacted to 95-percent of maximum density unless otherwise indicated

D. Geotextile fabric shall be placed where indicated and oriented and secured as recommended by the manufacturer. Use a minimum of 1-foot overlap for each joint. Use a wider overlap if recommended by the geotextile manufacturer.

3.02 ASSEMBLY AND INSTALLATION OF GABIONS

A. Gabions shall be assembled and installed in accordance with the manufacturer's recommendations. Empty gabion units shall be assembled individually and placed on the prepared surface to the lines and grades shown. The sides, ends, and diaphragms shall be erected in such a manner as to insure the correct position of all creases and that the tops of all sides are uniform.

B. All adjoining gabion units shall be connected by tie wire lacing along the perimeter of their contact surfaces in order to obtain a monolothic structure. Lacing of adjoining basket units shall be accomplished by continuous stitching with alternating single and double loops, with a half-hitch on each double loop, spaced at intervals of not more than 6 inches. All lacing wire terminals shall be securely fastened.

C. Fasteners may be used in lieu of tie wire lacing and shall be installed such that the strength requirements of paragraph 2.02 D are met, and with a spacing interval of not more than 6 inches for all connections, including internal diaphragm to basket connections. Fasteners used for assembly of gabion units shall only be attached when the basket units are empty.

D. After adjoining empty basket units are set to the desired lines and grades and common sides with adjacent units thoroughly laced, they shall be placed in tension and stretched to remove any kinks from the mesh and to form a uniform alignment. The stretching of empty basket units shall be accomplished in such a manner as to prevent any possible unraveling.

3.03 PLACING ROCK FILL

A. Rock filling operations shall carefully proceed with placement by hand or machine so as not to damage the wire coating, to assure a minimum of voids between the stones, and the maintenance of alignment throughout the filling process. Undue bulging of the mesh shall be avoided. To avoid localized deformation, the basket units in any row are to be filled in stages consisting of maximum 12-inch courses, and at no time shall any cell be filled to a depth exceeding one foot more than the adjoining cell. The last layer of stone shall over-fill each basket by 1-in. to 2-in. to compensate for future rock settlement. The maximum height from which the stone may be dropped into the basket units shall be 3-feet.

B. Along all exposed faces, the outer layer of stone shall be carefully placed and arranged by hand to insure a neat and compact appearance. All stones used on exposed faces shall have no dimension smaller than the mesh opening size.

C. Each partitioned section of the gabion shall be filled and leveled at the 1/3 point for 3-ft high gabions or the 1/2 point for 1.5-ft high gabions and shall be cross tied through the middle with connecting wire from end to end and side to side. Connecting wires shall be looped around one mesh opening at each basket face and the wire terminals shall be securely twisted to prevent their loosening.

D. Lids shall be stretched tight over the stone fill using crowbars or lid closing tools, until the lid meets the perimeter edges of the front and end panels. The lid shall then be tightly laced with tie wire along all edges, ends, and internal cell diaphragms by continuous stitching with alternating single and double loops, with a half-hitch on each double loop, spaced at intervals of not more than 6 inches. Special attention shall be given to assure that all projections or wire ends are turned into the baskets. The Contractor shall have the option of securing the lids by using fasteners spaced at intervals of not more than 6 inches along all edge, end, and internal cell diaphragm connections provided that the strength requirements of paragraph 2.02 D are met.

E. After filling and securing the gabion lids, any space remaining between the stream bank and the gabion baskets shall be filled with a graded gravel clean and free from organic matter and meeting the following criteria:

1. It shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall conform to the following gradation (GA DOT Section 800.01, No. 467 modified):

Size	*Percentage Passing*
2-inch	100
1 1/2 inch	95-100
3/4 inch	35-70
3/8 inch	10-30
No. 4 Sieve	0-10

2. The backfilled gravel material shall be compacted with hand or mechanical tampers to a minimum of 80-percent of maximum density. The compaction must be performed so as to not displace the gabion baskets.

3.04 PROTECTION OF THE WORK

A. The construction sequence shall be planned and carried out in such a manner that no tracked or wheeled vehicles nor any heavy equipment will travel over or on a completed gabion.

END OF SECTION

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SECTION 02273

Riprap

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide stone riprap, including associated earthwork and geotextile filter material, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

A. This Section references the following Commercial Standards:

Georgia Department of Transportation (GA DOT), Standard Specifications Construction of Roads and Bridges, 1993 Edition

ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 535	Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
AASHTO T 85	Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
AASHTO T 210	Method of Test for Aggregate Durability Index.
AASHTO T 134	Optimum Moisture Content

1.03 CONTRACTOR SUBMITTALS

A. The Contractor shall submit samples of all materials proposed to be used in the work in accordance with the requirements in Section GC-28 – Working Drawings, Shop Drawings, Data on Material and Equipment, Samples and Licenses. Sample size shall be as determined by the testing laboratory.

B. Testing certificates from a qualified testing agency shall be submitted prior to acceptance of the rock source to verify the conformity to the requirements of the Contract Documents. Contractor shall, if requested, coordinate inspection of the rock source by the Engineer.

PART 2 – PRODUCT

2.01 STONES FOR RIPRAP

A. All Stone for riprap shall be sound, durable pieces of quarried stone weighing 156-pounds per cubic foot or more. The stone shall be angular and random in shape; rounded boulders or cobbles shall not be used. Flat, slabby, or shaley pieces will not be acceptable. Stones shall be resistant to weathering and to water action and free from overburden, spoil, and organic material and shall meet the gradation requirements below.

B. Riprap shall be of the type indicated on the Drawings and shall conform to the size types as follows:

Type 2 – equivalent to GA DOT specification for "Plain Riprap":

Percent by Weight	Volume (cu.ft.)	Weight (lb.)	Diameter (in.)
65 – 100 %	0.75 – 2.0	125 - 320	15 – 24
10 – 65 %	0.04 – 0.75	7 - 125	5 – 15
0 – 10 %	0.0 – 0.04	0 - 7	0 – 15

Type 3 – equivalent to GA DOT specification for "Dumped Riprap – Type 3":

Percent by Weight	Volume (cu.ft.)	Weight (lb.)	Diameter (in.)
65 – 100 %	0.10 – 1.0	17 – 65	6 – 18
10 – 65 %	0.01 – 0.1	2 – 17	2 – 6
0 – 10 %	0.0 – 0.01	0 - 2	0 – 2

C. Stones shall consist of durable, sound, hard, angular rock meeting the following requirements for durability absorption ratio, soundness test, and abrasion test:

Durability Absorption Ratio	Acceptability
Greater than 23	Passes
10 to 23	Passes only if Durability Index is 52 or greater
Less than 10	Fails

$$\text{Durability Absorption Ratio} = \frac{\text{Durability Index (Coarse)}}{\text{\% absorption} + 1}$$

D. The durability index and percent absorption shall be determined by AASHTO T 210 and AASHTO T 85, respectively. The minimum apparent specific gravity of the stones shall be 2.5 as determined by AASHTO T 85.

E. Stones shall have less than 10 percent loss of weight after five cycles, when tested per ASTM C 88.

F. Stones shall have a wear not greater than 40 percent, when tested per ASTM C 535.

G. Control of gradation shall be by visual inspection. The Contractor shall furnish a sample of the proposed gradation of at least 5 tons or 10 percent of the total riprap weight, whichever is less. If approved, the sample may be incorporated into the finished riprap at a location where it can be used as a frequent reference for judging the gradation of the remainder of riprap. Any difference of opinion between the Engineer and the Contractor shall be resolved by checking the gradation of two random truckloads of stones. Arranging for and the costs of mechanical equipment, a sorting site, and labor needed in checking gradation shall be the Contractor's responsibility.

H. The acceptability of the stones will be determined by the Engineer prior to final placement.

2.02 GEOTEXTILE FABRIC FILTER

A. Geotextile fabric shall meet the requirements of GA DOT Section 881.06 for woven fabrics, having physical properties as follows:

Tensile Strength - any direction (ASTM D 4634)	200 lbs
Bursting Strength (ASTM D 3786)	500 psi
Elongation Before Breaking (ASTM D 4634)	10 – 35%
Percent Open Area (GDT: 88)	4.0 – 6.0%

B. Fabric shall be Mirafi Filterweave 403 or approved equal.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

A. Surfaces to receive filter materials and riprap, including the toe trench and slope, shall be brought to the line and grade indicated and shall be smooth and firm, free of brush, trees, stumps, and other objectionable material. Where filling of depressions is required or a filled bank is constructed, the new material shall be compacted with hand or mechanical tampers to a minimum of 85-percent of maximum density.

B. The Contractor shall remove and exclude all stormwater, groundwater and creek or stream water from the excavation. Sump pumps and sand bags or portable dams, diversions, or other approved means, shall be used to remove and exclude water and continuously maintain water level below

the bottom of the excavation. Water shall be removed and excluded until both geotextile filter material and riprap have been placed. Any water removed from the excavation shall not be discharged into any surface stream or other water body unless such discharge meets water quality standards. Removed water may be disposed on-site by land application using sprinklers in an area designated by the Engineer or by discharge into an approved treatment system.

C. Cleared and excavated materials shall be hauled off site to an appropriate disposal location arranged by the Contractor and at its sole expense unless otherwise indicated or specified.

D. Riprap installed at the toe of a stream bank below the elevation of the water in a stream to prevent scour from undermining the riprap shall be backfilled and covered with native soil to the original grade. The backfilled native soil shall be compacted with hand or mechanical tampers to a minimum of 80-percent of maximum density.

3.02 PLACEMENT OF GEOTEXTILE FABRIC

A. The fabric shall be placed with the long dimension running up the slope, with the upstream strip overlapping the downstream strip. Use a minimum of 2-foot overlap for each overlap. Use a wider overlap if recommended by the geotextile manufacturer.

B. The fabric shall be placed loosely with sufficient folded or gathered material to prevent stretching and tearing during riprap placement.

C. The fabric shall be anchored into place using securing pins with type and spacing as recommended by the manufacturer. In addition, the fabric shall be secured at the toe and crest of the slope using anchor trenches at least 2-feet deep. If a stream bank extends sufficiently above a stream such that riprap would not be installed to the top of the bank, then the fabric shall be anchored in a 2-foot deep trench up-slope from the top of the minimum free-board of 0.5 feet above the flow resulting from a 50-year, 24-hour storm runoff event.

3.03 STONE RIPRAP

A. Placement of riprap shall begin at the toe and proceed up the slope. The stones shall be placed, or dumped from a height of not more than three feet and placed with equipment or by hand. Sufficient hand work shall be performed to produce a neat and uniform surface, true to the lines and grades indicated on the Drawings.

B. Dumped riprap shall be used only where there is an existing road access to the top and/or bottom of the stream bank. Riprap shall be dumped into

place, beginning at the toe and proceeding up the slope, and may be spread using suitable equipment. Care must be taken to prevent damage to the underlying filter material. Sufficient hand work shall be performed to produce a neat and uniform surface, true to the lines and grades indicated on the Drawings.

END OF SECTION

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SECTION 02491

Rehabilitation of Sanitary Sewer Manholes

PART 1 – GENERAL

1.01 SCOPE

A. This specification covers the work necessary to expose and raise existing sanitary sewer manholes to grade and to rehabilitate or replace existing sanitary sewer manholes. All work shall be performed only as directed by the Engineer or shown on the task order Drawings. The Work includes:

1. Sealing to exclude infiltration; and/or

2. Lining of manhole interiors; and/or

3. Removal and replacement of manholes; and/or

4. Replacement and/or removal of broken manhole covers and frames, corroded step irons or corroded ladders.

B. The Contractor is responsible for field verification of location and condition of all manholes.

C. The Contractor shall provide all labor, materials and equipment required to clean, raise, or rehabilitate the manholes.

D. The Contractor shall comply with the City's and OSHA requirements for confined space entry.

E. No manhole cover slabs shall be removed to undertake the work until prior notice has been given to the Engineer.

F. Before commencing work at existing manholes, a perforated catch bucket (to retain particulate larger than U.S. No. 8 sieve, for subsequent removal), or similar, shall be fitted to the outgoing pipe from the manhole structure. Contractors shall strictly adhere to the requirement that construction debris and waste material be prevented from entering downstream sewers.

G. The Contractor shall keep accurate records of the location of and nature of the rehabilitation work performed at each manhole as directed by the Engineer. The Contractor shall provide copies to the Engineer as required.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The following references are part of this Specification. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Specification shall prevail. The latest edition of the following references shall be used:

1. ASTM C794 Test Method for Adhesion-in-Peel Elastomeric Joint Sealant

2. ASTM D412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension

3. ASTM D882 Test Methods for Tensile Properties of Thin Plastic Sheeting

B. Other ASTM standards as referenced in the Specifications below.

1.03 SUBMITTALS

A. The Contractor shall submit the following information:

1. Written certification by the manhole rehabilitation system manufacturer stating that the applicator is approved to install the rehabilitation system specified. **(At Pre-construction Meeting)**

2. Manhole rehabilitation system manufacturer's literature describing the rehabilitation system components, rehabilitation material utilized, including the materials' physical and chemical characteristics. **(At Pre-construction Meeting)**

3. Experience record of a minimum of sixty (60) manholes rehabilitated within the last three (3) years. **(At Pre-construction Meeting)**

4. Description of installation method including **(At Pre-construction Meeting)**:

   a. Product Material Safety Data Sheets.

   b. Maximum pot life, storage life and essential storage requirements of all rehabilitation materials

   c. Mixing and proportioning requirements (as applicable).

d. Environmental requirements for application and worker safety including ventilation, humidity, and temperature ranges.

e. Application film thickness per coat of activator and mastic (as applicable).

f. Curing time, including specific formulation requirements to provide specified setting time for foamed mastic (as applicable)

g. Wastewater flow control plan in accordance with Section 02750.

B. Methodology, including detail drawing and necessary product data for finishing all anticipated pipe connections to rehabilitated manholes to prevent infiltration and exfiltration (e.g. anticipated pipe connections, including through pipe, side connections and drop connections). In the case of lining, such details shall be provided by the liner manufacturer or approved in writing by the liner manufacturer.

1.04 QUALITY ASSURANCE

A. Materials and supplies provided shall be the standard products of manufacturers. The standard products of manufacturers other than those specified may be accepted if it is demonstrated that they are equal in composition, durability, and usefulness for the purpose intended. All material components of an installed lining system shall be supplied by a single manufacturer.

B. The Engineer will inspect the rehabilitated manholes to evaluate the Contractor's work.

1.05 RELATED SECTIONS

A. The Work of the following Sections apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.

1. Section 02511: Preconditioning and Cleaning Manholes and Sewers

2. Section 02750: Wastewater Flow Control

3. Section 02200: Earthwork

4. Section 02140: Dewatering

1.06 TRIAL TEST AND METHODOLOGY REVIEW

A. The Contractor shall comply with the following conditions before a manhole rehabilitation technique becomes accepted as a viable option on a repeat basis:

1. A successful demonstration of manhole rehabilitation, for a manhole chosen by the Engineer, shall be carried out including type and quality control tests as recommended by the manufacturer and in compliance with industry standards.

2. The trial shall be performed prior to approval for adoption by the Engineer of the manhole rehabilitation technique to prove that the equipment, materials and installation methodology are fully acceptable to meet local conditions. Payment will be made through the applicable unit price for the work.

3. The Contractor shall allow for any further requirement of the Engineer, subsequent to the trial, to modify the equipment, material and/or installation methodology in order to complete the work satisfactorily and meet all testing standards, including vacuum testing of Rehabilitated Manholes, at no cost to the City.

B. A representative from the manufacturer of the manhole rehabilitation system shall be present on-site for the entire duration of the trial test and methodology review. The manufacturer's representative shall certify in writing that the system applicator and/or installer has performed the application and/or installation in accordance with the manufacturer's requirements and recommendations.

PART 2 – PRODUCTS

2.01 GENERAL

A. The installer shall warrant and hold harmless the City and the Engineer against all claims for patent infringement and any loss thereof.

B. The materials used shall be designed, manufactured and specifically intended for sewer manhole rehabilitation and the specific application in which they are used. The materials shall have a proven history of performance in sewer manhole rehabilitation for a minimum of three (3) years in sewer systems elsewhere nationally, of similar age, groundwater levels and circumstance.

C. The materials shall be delivered to the job site in original unopened packages and clearly labeled with the manufacturer's identification (brand name), date of manufacture, storage life and printed instructions.

D. Stored materials shall be protected from weather and excessive heat or cold, and stored in accordance with the manufacturer's instructions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life recommended by the manufacturer shall be removed from the site.

E. The Contractor shall dispose of all wastes in accordance with applicable regulations.

F. At the request of the Engineer, the Contractor shall provide a representative employed by the manufacturer having technical training in any of the specific manhole rehabilitation materials and/or system or technique being applied. The appropriate specialist shall be available for consultation on site within 48 hours notice, at no cost to the City.

G. All completed rehabilitation work shall be resistant to:

1. Continuous immersion in septic sewage at temperatures up to 85˚F

2. Continuous exposure to hydrogen sulfide gas from septic sewage at temperatures up to 85˚F

3. Deposits of free sulfur on exposed surfaces

4. Continuous exposure to 10% sulfuric acid at temperatures up to 85˚F

Seals shall be tested to withstand all subsequent infiltration, inflow, and exfiltration as specified herein.

PART 2A – MANHOLE INTERIOR RENEWAL

2A.01 MANHOLE SEALING TO EXCLUDE INFILTRATION

A. General:

1. Manholes will be sealed when active leaks are present, and/or will be patched when there is exposed aggregate (concrete manholes) or brick mortar missing (brick manholes) in small isolated areas.

2. The generic chemical sealing materials to be used are listed with the basic properties, performance standards, and mix ratios that are

known to give acceptable performance.

3. In every case, mixing and handling of chemical sealing material shall be in accordance with the manufacturer's recommendations.

B. Characteristics of Sealing Chemicals:

1. All chemical sealing materials used in the performance of the work specified must have the following characteristics:

a. The chemical sealant must be able to react/perform in the presence of water (groundwater) while being injected, i.e., the sealant must be hydrophilic.

b. The cured material must withstand submergence in water without degradation.

c. The resultant sealant (grout) formation must prevent, on a continuing basis, the passage of water (infiltration) through manhole and sewer pipe joints.

d. The sealant material, after curing, must be flexible as opposed to brittle.

e. The sealant formation should be able to withstand freeze/thaw and wet/dry cycles without adversely affecting sealant properties. Note: This primarily applies to storm sewers, which are shallow and sometimes dry.

f. The sealant formation must not be biodegradable.

g. The cured sealant should be chemically stable and resistant to the mild concentrations of acids, alkalis, and organics found in normal sewage.

h. Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling.

i. Mixing of the component materials must be compatible with field operations and not require precise measurements of the ingredients by field personnel.

j. Clean up must be done without inordinate use of flammable or hazardous chemicals.

k. Residual sealing materials must be easily removable from the sewer line to prevent reduction or blockage of the sewage flow.

C. Acceptable Chemical Sealing Materials:

1. The following is a generic listing of permissible chemical sealing materials currently in use and the basic requirements, properties and characteristics of each.

a. Acrylamide base gel sealing material:

1) A minimum of 10% acrylamide base material by weight in the total sealant mix. A higher concentration (%) of acrylamide base material may be used to increase strength or offset dilution during injection.

2) The ability to tolerate some dilution and react in moving water during injection

3) A viscosity of approximately 2 centipoise which can be increased with additives

4) A constant viscosity during the reaction period

5) A controllable reaction time from 10 seconds to 1 hour

6) A reaction (curing) which produces a homogeneous, chemically stable, non-biodegradable, firm, flexible gel

7) The ability to increase mix viscosity, density and gel strength by the use of additives

b. Acrylic base gel chemical sealing material:

1) minimum of 10% acrylic base material by volume in the total sealant mix. A higher concentration (%) of acrylic base material may be used to increase strength or offset dilution during injection.

2) The ability to tolerate some dilution and react in moving water during injection

3) A viscosity of approximately 2 centipoise, which can be increased with additives

4) A constant viscosity during the reaction period

5) A controllable reaction time from 5 seconds to 6 hours

6) A reaction (curing) which produces a homogeneous, chemically stable, non-biodegradable, flexible gel

7) The ability to increase mix viscosity, density and gel strength by the use of additives

c. Urethane base gel chemical sealing material:

1) One (1) part urethane prepolymer thoroughly mixed with between 5 and 11 parts of water by weight. The recommended mix ratio is 1 part urethane prepolymer to8 parts of water (11% prepolymer).

2) A liquid prepolymer having a solids content of 77% to 83%, specific gravity of 1.04 (8.65 pounds per gallon), and a flash point of 20°F

3) A liquid prepolymer having a viscosity of 300 to 1000 centipoise at 70°F that can be pumped through 500 feet of 1/2-inch hose with a 1000 psi head at a flow rate of 1 ounce per second

4) The water used to react the prepolymer should have a pH of 5 to 9.

5) Gel times shall be as short as practical and as short as two (2) minutes for polyurethane grouts, in accordance with the manufacturer's recommendations. Control of gel times is a critical aspect of successful chemical grouting. Higher water ratios give longer cure times.

6) A relatively rapid viscosity increase of the prepolymer/water mix in the first minute. (Viscosity increases from about 10 to 60 centipoise in the first minute for 1 to 8 prepolymer/water ratio at 50°F).

7) A reaction (curing) which produces a chemically stable and non-biodegradable, tough, flexible gel.

8) The ability to increase mix viscosity, density, gel strength and resistance to shrinkage by the use of additives to the water

d. Urethane base foam chemical sealing material:

1) Approximately one part of urethane prepolymer with one part of water by weight (50% prepolymer)

2) A liquid prepolymer having a solids content of 82 specific gravity of 1.1 (9.15 pounds per gallon) flash point of 200°F

3) A liquid prepolymer having a viscosity of 30 centipoise at 72°F that can be pumped through 50 feet of 1/2-inch hose with a 500 psi head at a flow rate of one ounce per second

4) A cure time of 15 minutes at 40°F, 8.2 minutes at 60°F 4.6 minutes at 100°F when the prepolymer is reacting with water only

5) A cure time of 5.5 minutes at 40°F, 8.2 minutes at 60°F, 2.6 minutes at 100°F when the prepolymer is reacting with water containing 0.4% accelerator

6) During injection; foaming, expansion, and viscosity increase occur.

7) Physical properties of the cured foam of approximately 14 pounds per cubic foot density, 80 to 90 psi strength, and 700% to 800% elongation when a mixture of prepolymer and 50% water undergoes a confined test and expands five times its initial liquid volume.

8) Acrylamide and acrylic gel grouts maintain a viscosity close to that of water (2 centipoise) during the time between mixing material solution with the activator solution and the formation of a gel. This time period is referred to as the cure time, induction period, or gel time. The low viscosity is advantageous for penetration but makes the grouts susceptible to dilution during the reaction period.

9) Urethane gel grout undergoes a viscosity increase during the time between mixing the base material with water and the formation of a gel. This time period is cure time or gel time. The increasing viscosity limits penetration by dilution, particularly by groundwater.

2A.02 PATCHING

A. Manhole patching work includes re-pointing, filling, and repairing non-leaking holes, cracks, and spalls in concrete and masonry manhole walls, benches and slabs as well as through-flow channel dressing and repair.

B. The patching material shall consist of a premixed non-shrink cement-based patching material consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents, which has been formulated for vertical or overhead use. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder, or gas forming agents or promote the corrosion of steel it may come into contact with. Set time (ASTM C-191) shall be less than 30 minutes. One hour compressive strength (ASTM C-109) shall be a minimum of 200 psi and the ultimate compressive strengths (ASTM C-882 Modified) shall be a minimum of 1700 psi.

PART 2B – MANHOLE LINING SYSTEMS

2B.01 EPOXY BASED LINING SYSTEM

A. Manholes will be lined with epoxy or epoxy mortar when the manholes are subject to high groundwater levels (manholes near lakes/creeks, etc.) resulting in significantly active infiltration (runners and gushers) and/or subject to corrosive environments.

B. Epoxy lining systems shall be completely watertight and free of any joints or openings other than pipe inlets and the rim opening. The junction of the lining material with the pipe material at the inlets and outlets shall be completely watertight.

C. Each lining application shall be designed for application over damp (but not wet or active running water) surfaces without degradation of the final product and the bond between the product and the manhole surfaces.

D. Generally, the entire interior walls of manholes as designated to be rehabilitated shall be lined with epoxy or epoxy mortar liner, as follows:

1. The epoxy or epoxy mortar liner shall be used to form a monolithic liner covering all interior surfaces of the manhole, including benches and inverts.

2. The finished epoxy based monolithic liner shall conform to the following minimum requirements at 28 days:

PROPERTY	TEST METHOD	RESULTS
Compressive Strength	ASTM C-579	≥ 6,500 psi
Tensile Strength	ASTM C-307	≥ 2,500 psi

Flexural Strength	ASTM C-580	≥ 4,500 psi
Shrinkage	ASTM C-531	< 0.15%
Bond Strength	ASTM D-4541	Concrete failure

3. The finished manhole shall be resistant to corrosive conditions common to municipal wastewater and shall prohibit water infiltration.

4. The epoxy based liner shall be suitable for application over damp or dry concrete surfaces.

E. At a minimum, the manhole rehabilitation epoxy or epoxy mortar liner system (product coating designation) must have received a passing score without receiving an N/E result in any category as documented in the following study:

> "EVALUATION OF PROTECTIVE COATINGS FOR CONCRETE"
> August, 2002 Update
>
> John A. Redner, Sewerage Departmental Engineer, Randolph P. Hsi, Associate Engineer, Edward J. Esfandi, Senior Engineer, Roger Sydney, Civil Engineer, Robin M. Jones, Associate Engineer, and Donna Won, Senior Engineer
>
> County Sanitation Districts of Los Angeles County, Whittier, California.

F. Acceptable systems include, but are not limited to, the following:

1. Raven 405 (Raven Lining Systems)
2. Mainstay DS-4 (Madewell Products)
3. Magma Quartz or Belzona 4111 (Belzona Inc.)
4. Sauereisen-210 (Sauereisen)
5. Warren Epoxy Spray or Laminate (Warren Environmental)

2B.02 FIBERGLASS LINING SYSTEM

A. Manholes will be lined with a cured-in-place fiberglass insert when the manhole interior is structurally deteriorated (concrete or brick manholes), and/or subject to a corrosive environment.

B. The fiberglass lining system shall consist of a three layer composite, laminate system comprised of one non-permeable synthetic, environmental membrane embedded and bonded between two layers of structural fiberglass woven fabric impregnated with a modified epoxy resin system. The average wall thickness of the fiberglass liner system shall be no less than 0.5-inch unless otherwise allowed, but shall be structurally designed to withstand all structural loads.

C. The finished fiberglass liner shall conform to the following minimum physical properties:

PROPERTY	TEST METHOD	RESULTS
Max. Flexural Fiber Stress	ASTM D-790	≥ 44,000 psi
Flexural Modulus of Elasticity	ASTM D-790	≥ 1,000,000 psi
Compressive Strength	ASTM D-695	≥ 11,000 psi
Compressive Modulus	ASTM D-695	≥ 900,000 psi
Strength at Break	ASTM D-638	≥ 28,000 psi
% Elongation at Break	ASTM D-638	< 9%
% Elongation at Max. Load	ASTM D-638	< 2%

D. Acceptable products are equal to Poly-Triplex PTLS-6800 series manufactured by Poly Triplex Technologies, Inc.

2B.03 CEMENTITIOUS LINING SYSTEM

A. Manholes will be lined with cementitious lining for preventive maintenance when the manhole interior is mildly weathered or aged, and/or subject to minor infiltration (seepers or drippers).

B. Cementitious lining systems shall be completely watertight and free of any joints or openings other than pipe inlets and the rim opening. The junction of the lining material with the pipe material at the inlets and outlets shall be completely watertight.

C. Each lining application shall be designed for application over damp (but not wet or active running water) surfaces without degradation of the final product and the bond between the product and the manhole surfaces.

D. Generally, the entire interior walls of manholes as designated shall be lined with calcium aluminate cementitious liner, as follows:

1. The calcium aluminate cementitious liner shall be used to form a monolithic liner covering all interior surfaces of the manhole, including benches and inverts.

2. The finished cementitious liner shall conform to the following minimum requirements at 28 days:

PROPERTY	TEST METHOD	RESULTS
Compressive Strength	ASTM C-109	≥ 8,000 psi
Tensile Strength	ASTM C-496	≥ 800 psi
Flexural Strength	ASTM C-293	≥ 1,500 psi
Shrinkage (@ 90% R.H.)	ASTM C-490	0%
Bond Strength	ASTM C-882	≥ 2000 psi

3. The finished manhole shall be resistant to corrosive conditions common to municipal wastewater and shall prohibit water infiltration.

E. The cementitious liner mix shall be factory blended requiring only the addition of water at the jobsite. The liner mix shall be suitable for "wet" application by progressive cavity pump type equipment only. Gunite mixes will not be allowed.

F. The liner applicator must use approved equipment designed and/or approved by the material manufacturer specifically for the application of cementitious liners in manholes. Only low-pressure, progressive cavity pump type equipment for "wet" application will be allowed.

G. Acceptable systems are those equal to:

1. Strong-Seal® by The Strong Company, Inc.;
2. Sewpercoat® by Lafarge Calcium Aluminates, Inc.;

PART 2C - MANHOLE RAISING/ADJUSTMENT TO GRADE

2C.01 GENERAL

A. Brick

1. Brick shall conform to ASTM C-32 for grade SM. Bricks shall conform to the following dimensions, unless otherwise approved by the Engineer:

	Depth (inches)	Width (inches)	Length (inches)
Standard Size	2 ¼	3 ¾	8
Allowable Variation	± ¼	± ¼	± ½

2. All brick shall be new and whole, or uniform standard size and with substantially straight and parallel edges and square corners. Bricks shall be of compact textures, burned hard entirely through, tough and strong, free from injurious cracks and flaws, and shall have a clear ring when struck together. No soft or salmon brick shall be used except at such places, to such extent, and under such conditions as may be approved by the Engineer.

B. Mortar

1. The Contractor shall use mortar meeting the requirements of ASTM C-270 Type S unless directed otherwise by the Engineer.

2. The Contractor shall prepare mortar only in quantities needed for immediate use. Mortar which has been mixed for more than 30 minutes, which has set, or which has been retempered shall not be used.

3. No mortars utilizing latex emulsifiers or plasticizers as a filler are acceptable. No bonding agents are allowed.

C. Cast Iron Adjustment Rings

1. For adjusting lid elevation: Adjusting rings shall be cast iron equal to Series R-1979-H (heavy duty) manufactured by Neenah Foundry.

2. All adjusting rings shall be securely sealed to the casting frame using resilient, flexible, non-hardening, preformed butyl mastic equal to Rub R Nek or EZ Stick. This mastic shall be applied in such a manner that no surface water or ground water inflow can enter the manhole through gaps between the first adjusting ring, between adjusting rings, or between the last adjusting ring and the manhole frame. Up to two (2) inches of adjusting rings may be installed on a given manhole. No more than two (2) adjusting rings in total shall be used for the final adjustment to grade.

D. Concrete Grade Rings

1. For manhole adjustment to grade: Pre-cast concrete grade rings may be used instead of brick and mortar for adjusting pre-cast concrete manholes to grade. The pre-cast concrete rings shall be installed between the top of the cone and the casting frame. Grade rings shall be pre-cast concrete, as manufactured by Standard Concrete Products (lightweight) or approved equal.

2. All grade rings shall be securely sealed to the bottom of the casting frame and the top of the cone using a resilient, flexible, non-

hardening, preformed butyl mastic equal to Rub R Nek or EZ Stick. No less than two beads shall be applied 1/2 inch wide and 3/4 inch high between grade rings when grade rings are stacked. No less than one inch of non-shrink cement based patching material shall be applied to the inside and outside faces of the grade rings when grade rings are stacked.

2C.02 MANHOLE CASTING EMBEDMENT SEALANT TO EXCLUDE RDI/I

A Provide a premium, extruded bituminous tacky rubber sealant in rope form for use on manholes as an embedment material for the frame to adjusting brick/mortar corbel.

B. Sealant shall conform to AASHTO M-198 Type B and SS-S-210 and SS-S-210A.

C. Properties:

1. Chemical Composition:

	SPEC REQUIRED	
Hydrocarbon Plastic Content % by wt	ASTM D4 (mod.)	50-70
Inert Mineral Filler % by wt	SS-S-210A	30-50
Volatile Matter % by wt	ASTM D6	3.0 max

2. Physical Properties:

Specific Gravity, 77°F	ASTM D71	1.20-1.35
Ductility, 77°F	ASTM D 113	5.0 min
Softening Point	ASTM D36	320 min
Flash Point, C. 0. C. min	ASTM D92	600 min
Fire Point, C. 0. C. min.	ASTM D92	625 min
Penetration, 77°F (150 gm) 5 sec.	ASTM D217	50 to 120

3. Chemical Resistance:

30-Day Immersion: No visible deterioration when tested for 30 days in 5% caustic potash, 5% hydrochloric acid, 5% sulfuric acid, or 5% saturated hydrogen sulfide

Elongation Initial, 77°F	300% min
Two Weeks, Total Water Immersion	300% min
Flow Resistance (one inch wide overhead joint exposed to 135°F for 7 days)	No Flow
Storage Life	Indefinite
Application Temperature Range	10 to 125°F
Service Temperature Range	-20 to 200°F

PART 2D – REPLACEMENT MANHOLE FRAMES AND COVERS

2D.01 GENERAL

A. New manhole covers and frames shall conform to the requirements of the City's standard and standard details.

B. Frames and covers shall be Neenah Foundry, Series R-1700 (heavy duty) or equivalent. Light duty covers shall not be used.

C. Where manholes are located in flood plains, frames and covers shall be Neenah Foundry, Series R-1700 (heavy duty) or equivalent. Light duty covers shall not be used. The top surface of the frame and covers shall have bolt down lids with a watertight gasket.

2D.02 ELASTOMERIC CORBEL SEAL TO EXCLUDE RDI/I

A. Provide a frame-to-manhole elastomeric seal consisting of a two component, aliphatic chemical curing, urethane sealant formulated as a high build coating to seal the casting to the manhole corbel. The purpose is to stop infiltration by the application of a corrosion resistant flexible coating to be applied to the inside wall. The corrosion resistant flexible urethane shall be Flex-Seal Utility Sealant as manufactured by Sealing Systems, Inc., Loretto, or approved equal.

B. Minimum Requirements for Flexible Aromatic Urethane Resin Liner Primer:

Hardness	ASTM-D2240	85 Brinell
Elongation	ASTM-D412	400%
Tensile Strength	ASTM-D412	3000 p.s.i.
Adhesive Strength	ASTM-D0903	3 50 lb./in.
Tear Resistance	ASTM-D1004	200 lb./in.

C. Minimum Requirements for Flexible Aromatic Urethane Resin Liner Final Coat:

Hardness	ASTM-D2240	50 Brinell
Elongation	ASTM-D412	750 %
Tensile Strength	ASTM-D412	1100 p.s.i.
Adhesive Strength	ASTM-D0903	175 lb./in.
Tear Resistance	ASTM-DIO04	155 lb./in.

D. Minimum Final Thickness: 80 mils.

PART 2E – REPLACEMENT MANHOLES

2E.01 GENERAL

A. New manholes shall conform to the requirements of Section 02730 and the City's standard details.

PART 3 – EXECUTION

3.01 PERFORMANCE REQUIREMENTS

A. Perform work needed to make manholes structurally sound, improve flow, prevent entrance of inflow or groundwater infiltration, and prevent entrance of soil or debris.

B. Existing manhole shall be Preconditioned and Cleaned in accordance with Specification Section 02511 prior to any and all rehabilitation work.

3.02 PROJECT CONDITIONS

A Manholes Containing Flow Monitoring Equipment:

1. Drawings may not show locations of flow monitoring equipment. If a manhole contains any mechanical hardware or electrical flow monitoring equipment, immediately notify the Engineer.

2. Reschedule work in such manholes until equipment has been removed by the City and further instructions are given, at no additional cost.

3. Do not subject manholes with mechanical hardware or electrical equipment to bypass or diversion pumping.

4. Damage to installed equipment, due to Contractor's failure to adhere to the above, will be repaired by the City and cost of repairs charged to Contractor.

B. Field Location of Manholes:

1. Manholes may be located within project limits, which are not part of the system being rehabilitated. Properly identify manholes before starting work. No payment will be made for work in manholes not indicated on the Drawings or not directed in writing by the Engineer

3.03 SALVAGE

A. Manhole covers and frames, as well as adjusting rings from abandoned, broken or adjusted manhole castings remain the property of the City. Deliver salvaged items to City's storage facility or as otherwise directed by the City at the conclusion of the project.

3.04 PROTECTION

A. Provide barricades and warning lights and signs for excavations created by manhole casting work in accordance with the drawings.

B. Do not allow sand, debris or runoff to enter sewer system.

3.05 EXCAVATION

A. Excavate in accordance with City's Standard Specifications and Section 02200.

B. Perform work in accordance with OSHA standards. Employ a trench safety system, as required for excavations.

C. Install and operate necessary dewatering and surface water control measures as required.

3.06 FLOW BYPASS AND DIVERSION PUMPING

A. Install and operate bypass and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow in accordance with Specification Section 02750 – Wastewater Flow Controls.

3.07 LINERS

A. General. The entire interior walls of manholes as designated on the drawings or instructed by the Engineer to be rehabilitated shall be lined with epoxy/epoxy mortar lining, cementitious lining or fiberglass lining system.

B. All liners shall be installed in accordance with the manufacturer's written instructions.

3.08 EPOXY LINER

A. Storage, mixing, application and curing procedures shall conform to the recommendations of the monolithic epoxy or epoxy mortar liner manufacturer. The epoxy or epoxy mortar may be spray, trowel or brush

applied onto the interior surfaces of the manhole as recommended by the manufacturer.

B. Surfaces shall be made free of oil, grease, water and other contaminants prior to application of the epoxy or epoxy mortar liner. An abrasive blast, high-pressure water blast, or acid etching shall be used to obtain a uniform sound substrate with a neutral pH prior to the application of the epoxy liner.

C. After cleaning and prior to liner installation, all large voids and spalled areas shall be filled and patched with a suitable patching. The patching compound shall conform to the recommendations of the epoxy or epoxy mortar liner manufacturer.

D. The epoxy or epoxy mortar lining system shall be installed to the manufacturer's recommended thickness and number of coat applications. No sagging of the liner on vertical surfaces shall be acceptable to the Engineer.

E. The epoxy or epoxy mortar liner shall not be installed on surfaces in direct sunlight or when surfaces are subject to rising temperatures to prevent blistering of materials due to thermal expansion of trapped air or moisture in the substrate.

3.09 FIBERGLASS LINING SYSTEM

A. After cleaning and prior to liner installation, all large voids and spalled areas shall be filled and patched with a suitable patching compound. The patching compound shall be as recommended by the lining system manufacturer.

B. The installation of the lining system shall be in strict accordance with the manufacturer's written installation procedures.

C. After the liner system is installed it shall be cut and trimmed. The completed product shall be a permanent, monolithic, lined and impervious structure shaped to the interior of the existing manhole. The manhole shaft lining systems shall be completely water tight and free of any joints or openings other than pipe inlets, pipe outlets and the rim opening.

D. All defective areas and imperfections including, but not limited to, poor adhesion, excessive void, and air bubbles shall be repaired in strict conformance with the recommendation of the lining system manufacturer and subject to the approval of the Engineer.

3.10 CEMENTITIOUS LINER

A. Storage, mixing, application and curing procedures shall conform to the recommendations of the cementitious liner manufacturer. The cementitious liner shall be spray applied using a low-pressure, progressive cavity type pump onto the interior surfaces of the manhole as recommended by the manufacturer. Gunite or "dry" applications will not be allowed.

B. Surfaces shall be made free of oil, grease, water and other contaminants prior to application of the cementitious liner. An abrasive blast, high-pressure water blast, or acid etching shall be used to obtain a uniform sound substrate with a neutral pH prior to the application of the cementitious liner.

C. After cleaning and prior to liner application, loose and protruding brick, mortar, or concrete shall be removed and all large voids and spalled areas shall be filled and patched with a suitable patching compound. The patching compound shall conform to the recommendations of the cementitious liner manufacturer.

D. The cementitious lining system shall be installed to the manufacturer's recommended thickness and number of coat applications up to one-inch (1") thickness, but not less than one-half-inch (1/2") thickness. The finished surface shall then be trowel-finished and/or brush-finished to a relatively smooth finish.

E. The freshly applied liner shall be protected from high-velocity surface drying or air movement.

3.11 MANHOLE BENCHES/THROUGH-FLOW CHANNELS

A. Formation of Through-Flow Channel:

1. Remove obstructions and loose materials from benches prior to shaping the through flow channel. Form a smooth, U-shaped channel having a minimum depth of one pipe diameter and channel it across the floor of the manhole using an approved manhole rehabilitation material as specified in Part 2. Control flow to allow sufficient setting time for material used.

2. Form a smooth transition with a reshaped channel and a raised manhole bench to eliminate sharp edges of pipe and concrete bench. Build up and smooth through flow channel of manhole to match flow line of pipe.

3. Make finished benches and through flow channels smooth and without defects which would allow for accumulation of debris.

B. Remedial Work to Existing Manhole:

1. Exposed reinforcement shall be sand blasted, epoxy primed and protected by a premixed non-shrink cement-based patching material consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents, which has been formulated for vertical or overhead use. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder, or gas forming agents or promote the corrosion of steel it may come into contact with.

C. Connection of Pipelines to Replacement Manholes:

1. In connecting pipelines to replacement manholes, the Contractor shall ensure that the connections are watertight and that the existing sewers and replacement manholes are not damaged.

2. The Contractor shall ensure that there is no interruption to existing flows during the connection works.

3. The Contractor shall adjust replacement manhole benchings and bases to accommodate existing pipelines to ensure a continuous invert without steps.

4. All connections into manholes shall be designed and installed so as to ensure that groundwater is not permitted to enter the confines of the sewer or manhole. The Contractor shall submit proposals together with any material specification for making fully sealed connections into replacement manholes to the Engineer for approval.

3.12 REPLACEMENT MANHOLE FRAMES AND COVERS

A. Adjust all manhole frames and covers above or at grade, reset loose frames, and install elastomeric corbel seal.

B. Where manholes are constructed in paved areas, the frame and cover shall be combined with brick work or cast iron adjustment rings so that the elevation of the top surface of the installed casting cover is flush with the surrounding pavement constructed to the exact slope, crown and grade of the existing adjacent pavement. Manholes in locally low-lying areas, where surface water may collect, may incorporate self-sealing covers or manhole inserts as directed by the Engineer. Inside surface of all manhole cover frames shall incorporate the unique 3-digit manhole number corresponding to the City's GIS identification number. The number shall be stenciled with

1.5-inch high epoxy painted figures on surface prepared to manufacturer's requirements. For example, if the 11-digit manhole number is 23250111401, the number 114 will be stenciled on the inside surface of the frame.

C. Where manholes are constructed in paved areas in flood plains, the frame and covers shall have bolt down lids with a watertight gasket. The frame and cover shall be combined with brick work or cast iron adjustment rings so that the top surface of the installed casting cover is flush with the surrounding pavement constructed to the exact slope, crown and grade of the existing adjacent pavement. Inside surface of all manhole cover frames shall incorporate the unique 3-digit manhole number corresponding to the City's GIS identification number. The number shall be stenciled with 1.5-inch high epoxy painted figures on surface prepared to manufacturers requirements or as directed by the Engineer.

D. Where manholes are constructed in non-pavement areas in flood plains or otherwise, the top surface of the frame and covers shall have bolt down lids with a watertight gasket, as directed by the Engineer. Manhole frame and covers in the wooded or un-maintained areas shall be 30-inches above grade when combined with brick work or cast iron adjustment rings. Manholes in grassed areas maintained as lawns etc., shall be adjusted to be flush with the ground unless otherwise directed. The inside surface of all manhole cover frames shall incorporate the unique 3-digit manhole number corresponding to the City's GIS identification number. The number be shall stenciled with 1.5-inch high epoxy painted figures on surface prepared to manufacturers requirements or as directed by the Engineer.

3.13 MANHOLE RAISING/ADJUSTMENT TO GRADE

A. The Contractor shall utilize maps, surveys, sounding instruments, or information from local residents to determine approximate location of buried manholes. Manholes shall be exposed utilizing hand techniques or by carefully probing with mechanical equipment. Manhole exposure in paved areas shall be accomplished by making a square cut in the surface with sufficient width to allow for the excavation of the material around the manhole to expose it to a depth necessary to facilitate adjustments.

B. Manhole adjustment to grade is defined as raising the manhole cover (lid) elevation to grade by removing the casting frame, building up the manhole chimney to a maximum of 12 inches, then re-installing the frame and cover. The chimney may be built-up using brick and mortar or pre-cast concrete grade rings conforming to the requirements of this Section. Brick and mortar shall be used for manholes constructed of brick. Concrete grade rings shall be used for manholes constructed of concrete. A maximum adjustment of 12 inches will be allowed using brick and mortar or concrete grade rings between the bottom of the casting frame and the

top of the cone section. [Note: The 12-inches maximum is a cumulative limit – any existing brick or concrete in place between the frame and cone shall be included in the measurement of the allowable 12-inches.] Non-shrink mortar shall be applied to create a smooth finish on the interior and exterior prior to backfill. Cast iron adjusting rings may be used for either brick or concrete manholes to raise the cover (lid) at the top of the frame, if necessary for final adjustment. Up to two (2) inches of cast iron adjusting rings may be installed on a given manhole. No more than two (2) adjusting rings in total shall be used.

C. Manhole raising to grade is defined as raising the manhole cover (lid) to grade by removing the casting frame, chimney and cone section, then rebuilding the manhole (with new components) up to grade in accordance with the Contract Drawings. Should any part(s) of the manhole below the cone be deemed incompatible with the new manhole components, then the entire manhole shall be removed and replaced to grade.

3.14 ELASTOMERIC CORBEL SEAL TO EXCLUDE RDI/I

A. The surfaces on which the elastomeric seal is to be installed shall be circular, clean, reasonably smooth and free of any loose material and excessive voids. If the surface is rough or irregular and would not provide an effective seal, it shall be smoothed with an approved microsilica enhanced grout. Any flaw or flaws in the manhole frame such as cracks, pits or protrusions, shall be repaired by filling with concrete or grinding smooth. This type of surface work will need to be done on manholes that have not been lined. Manholes that have been lined should not need any surface work in order to install the seal.

B. Installation of seal shall be as directed by the manufacturer's installation instructions. A manufacturer's representative will train the Contractor in the proper method of installing the seal and will assist the Contractor with any problems they might encounter installing the seals.

C. Frame to manhole seals shall be installed in such a manner that will prevent water migration between the manhole frame and manhole structure.

D. The lower 3 inches on the casting frame and top 3 inches of the corbel must be prepared according to the manufacturer's instructions. The corbel/casting interface area shall receive a thickened flexible urethane to achieve a thickness of 80 mils to 120 mils. The seal shall be applied by spray, brush, or trowel 3 inches above the bottom of the frame, and shall cover the entire area to 3 inches below the lowest of bottom of the frame or lowest adjusting ring.

3.15 INSPECTION AND TESTING OF COMPLETED MANHOLE

A. After manhole sealing or manhole lining has been completed, the surface of the installed liner shall be cleaned and prepared to permit visual inspection. Visually inspect the manhole in the presence of the Engineer. Check for cleanliness and for elimination of active leaks.

B. Assist Engineer in verifying installation of lining thickness and sounding. Test points on the manhole wall where directed by the Engineer. Repair verification points prior to final acceptance of payment. The finished surface shall be free of blisters, "runs" or "sags" or other indications of uneven lining thickness. No evidence of visible leaks shall be acceptable. All costs for verification and testing shall be included in the unit price for manhole rehabilitation.

C. In addition, at the City's request, the Contractor may be required within one year to visually inspect the manholes that were sealed or lined. Any work that has become defective within the one-year period shall be redone by the Contractor at no additional expense to the City.

D. Vacuum testing is required for all manholes lined. This test must meet all requirements of Section 02730. The Engineer must be present during the test. All costs for vacuum testing shall be included in the unit price for manhole rehabilitation.

3.16 REPLACEMENT OF EXISTING MANHOLE

A. The Contractor shall replace manholes where shown on the Drawings, or as directed by the Engineer. The Contractor shall dispose of all materials from the removed manholes to a licensed landfill.

3.17 VACUUM TESTING

A. Rehabilitated and/or replaced pipelines and manholes shall be vacuum tested and/or low air pressure tested to detect possible points of infiltration in accordance with Section 02730. All inlets to the system shall be effectively closed and any residual flow shall be deemed to be infiltration. The attached form shall be used to document the test results.

B. The Contractor shall include the cost of the vacuum test in the unit prices for rehabilitation or replacement for the purposes of carrying out the vacuum/low-pressure air test and all the foregoing requirements of this paragraph.

PART 4 – WARRANTY

4.01 MATERIAL WARRANTY

A. A written guarantee of 5 years submitted to the City for the specific project shall be provided by the Manufacturers of the manhole rehabilitation materials.

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4.02 WORKMANSHIP WARRANTY

A. A written guarantee of 2 years minimum shall be provided by the Contractor against any shortcoming in Workmanship.

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ATTACHMENT A

MANHOLE LEAKAGE TEST RESULTS

VACUUM-AIR METHOD

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MANHOLE LEAKAGE TEST RESULTS

VACUUM-AIR METHOD

Work Order Number: _____ Date:_____

Project Description: _____

Contractor:_____*Manhole Diameter:_____

Specific Location of Test:_____

Manhole Depth 'A' From Flowline to Top of Cone(feet):_____

Initial Vacuum Gauge Reading:_____ **Must Be 10-inch Hg**

Time Test Must Be Conducted:_____ **In Seconds**

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS AND DEPTHS			
Depth 'A' (feet)	**Minimum Test Times with a 4 ft. Diameter**	**Minimum Test Times with a 5 ft. Diameter**	**Minimum Test Times with a 6 ft. Diameter**
8	20	28	33
10	25	33	41
12	30	39	49
14	35	48	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

Final Vacuum Gauge Reading: _____ **Inches of Hg**

Is Final Vacuum Gauge Reading greater than or equal to 9" of Hg? **YES** or **NO**

Mark One:

If YES is marked above, the test has PASSED

If NO is marked above, the test has FAILED

Inspector's Signature: _____

A. Per Manufacturer of Vacuum Test Unit. For a 60-inch Manhole Over 30 ft. deep, add 6.5 seconds for each 2-feet over 24-feet. depth to a base time of 78 seconds. Therefore, [((Depth – 24)/2) x 6.5] + 78 = Test Time In Seconds.

END OF SECTION

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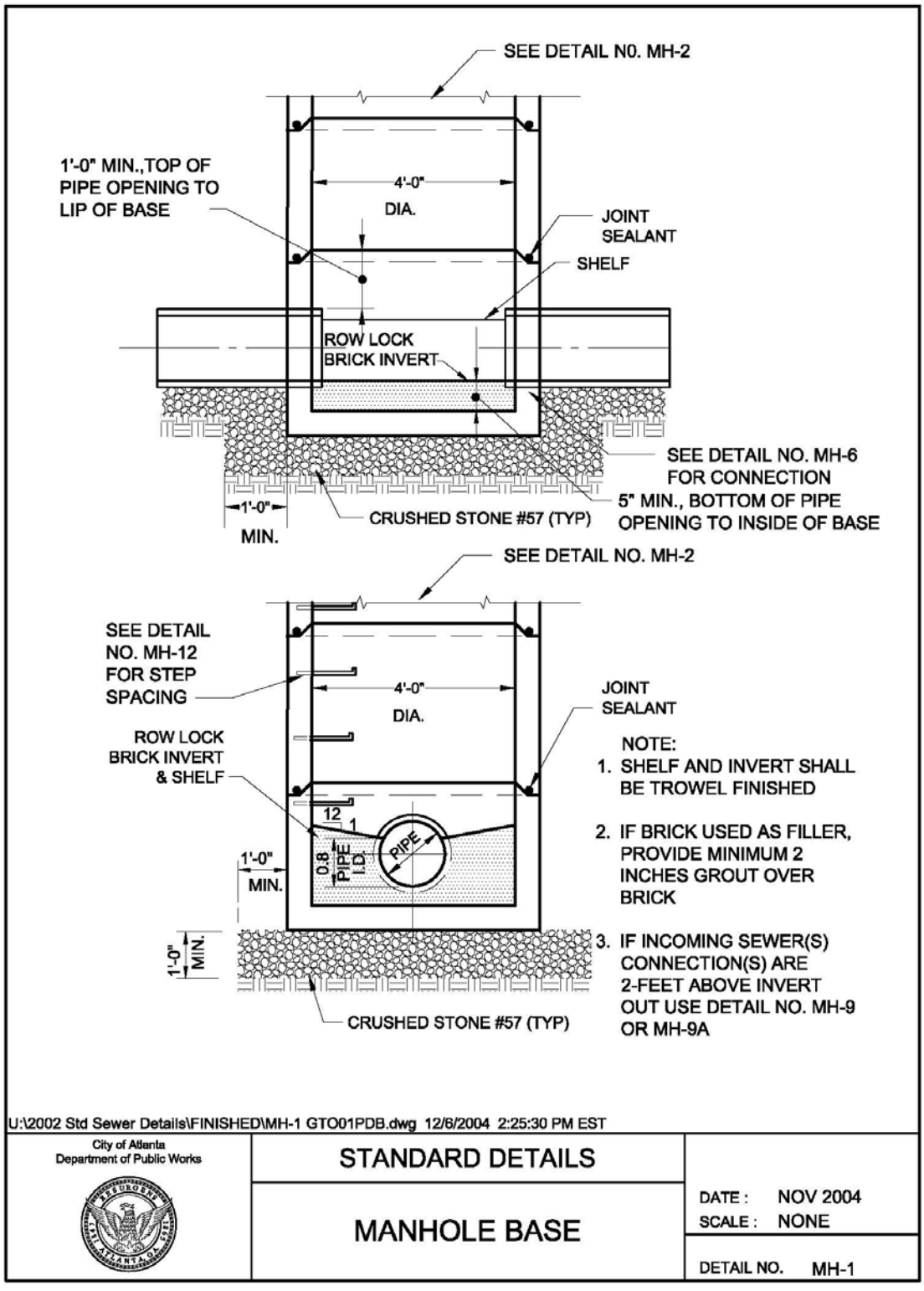
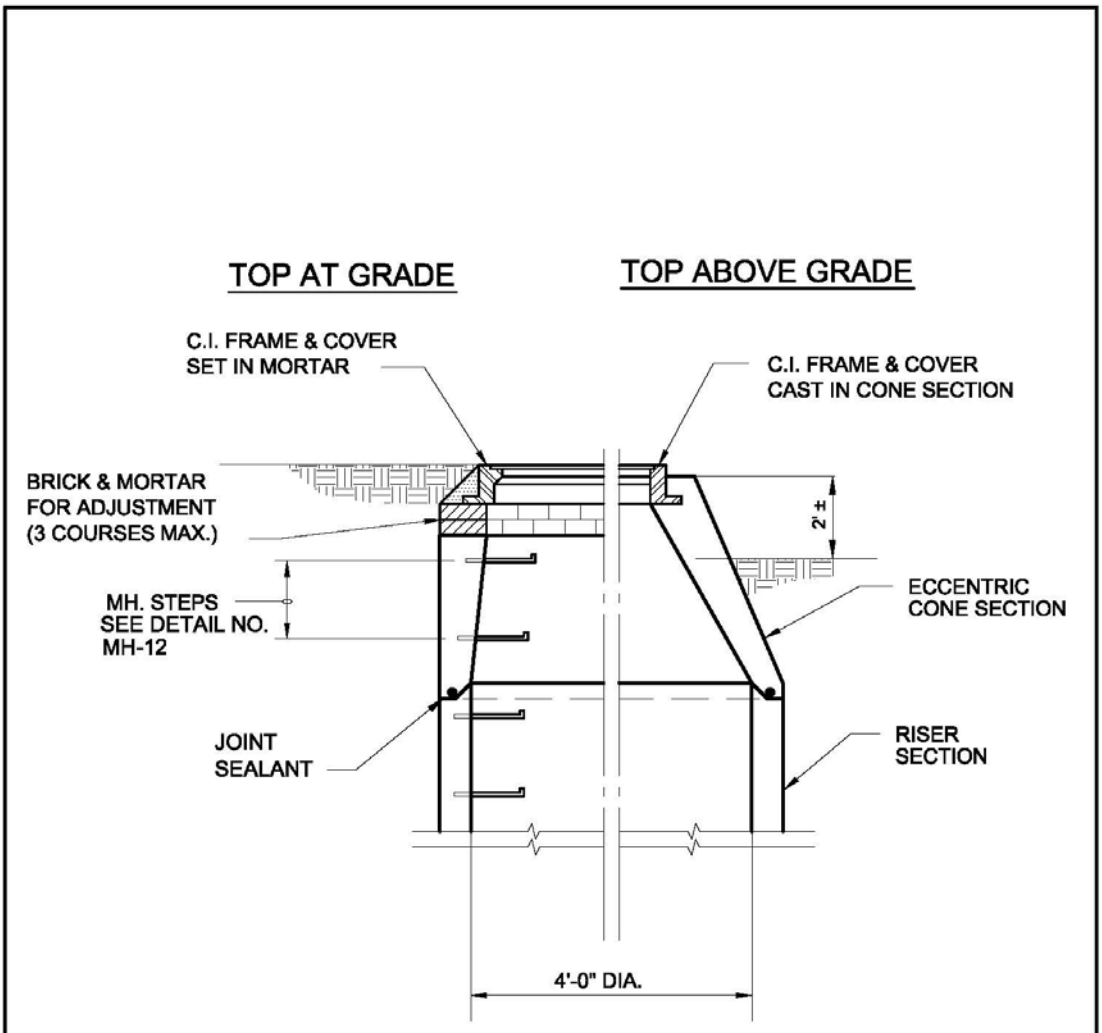
ATTACHMENT B

STANDARD DETAILS





NOTE: FRAME & COVER SHALL BE CAST IN ALL CONE SECTIONS
UNLESS FRAME & COVER IS TO BE FLUSH WITH FINAL GRADE.

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City of Atlanta Department of Public Works	STANDARD DETAILS	
	MANHOLE RISER AND CONE	DATE : JAN 1997 SCALE : NONE DETAIL NO. MH-2

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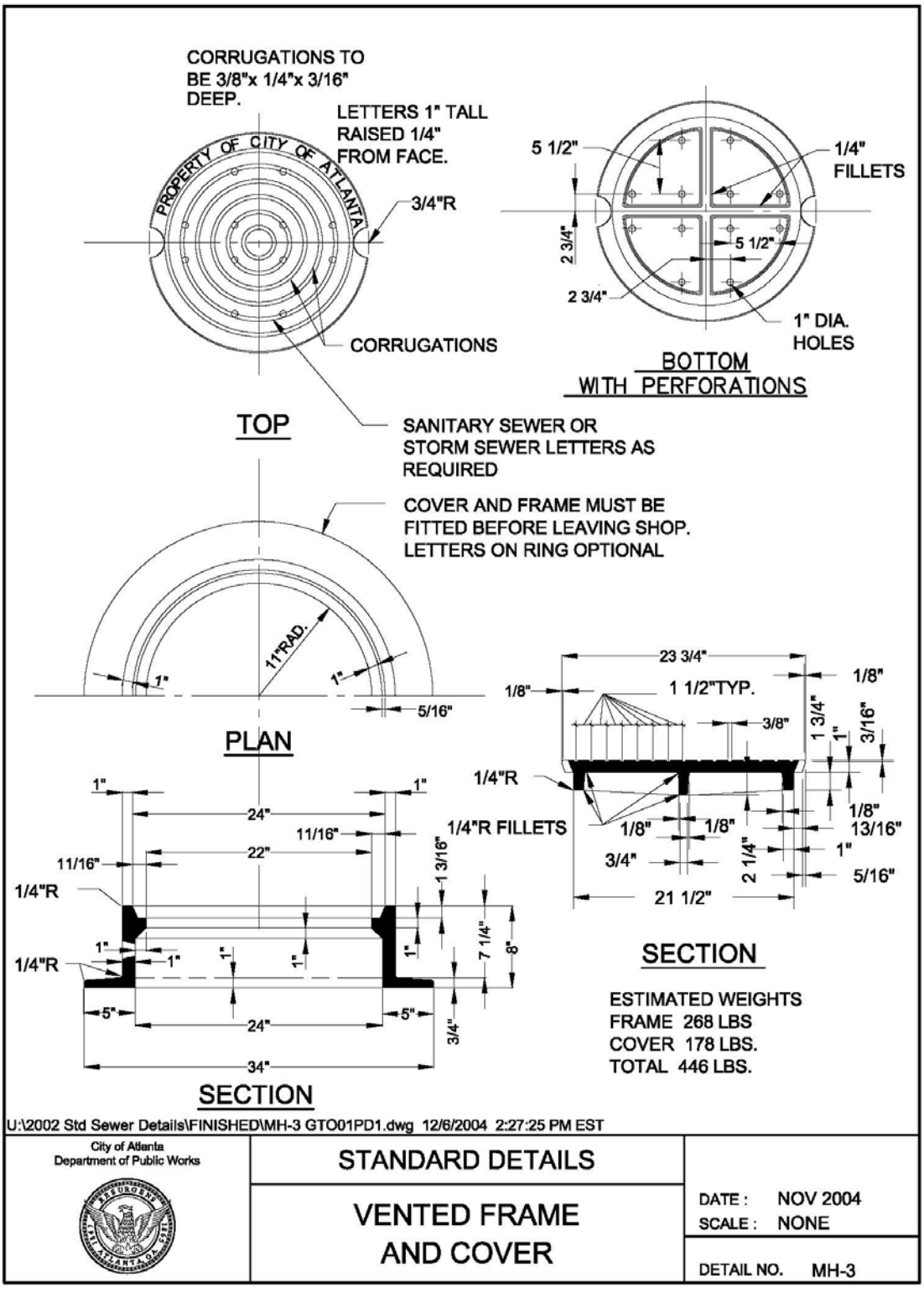

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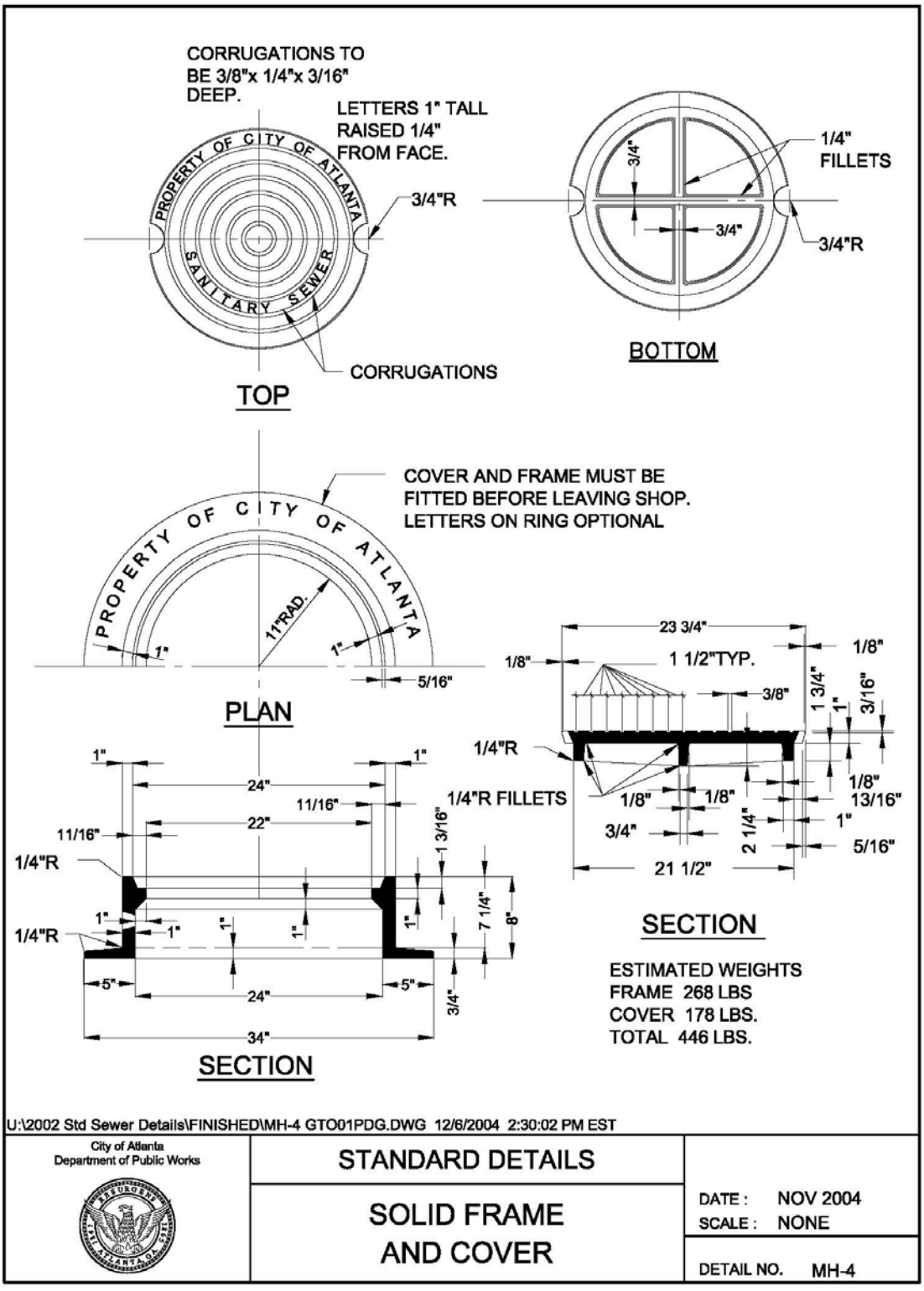

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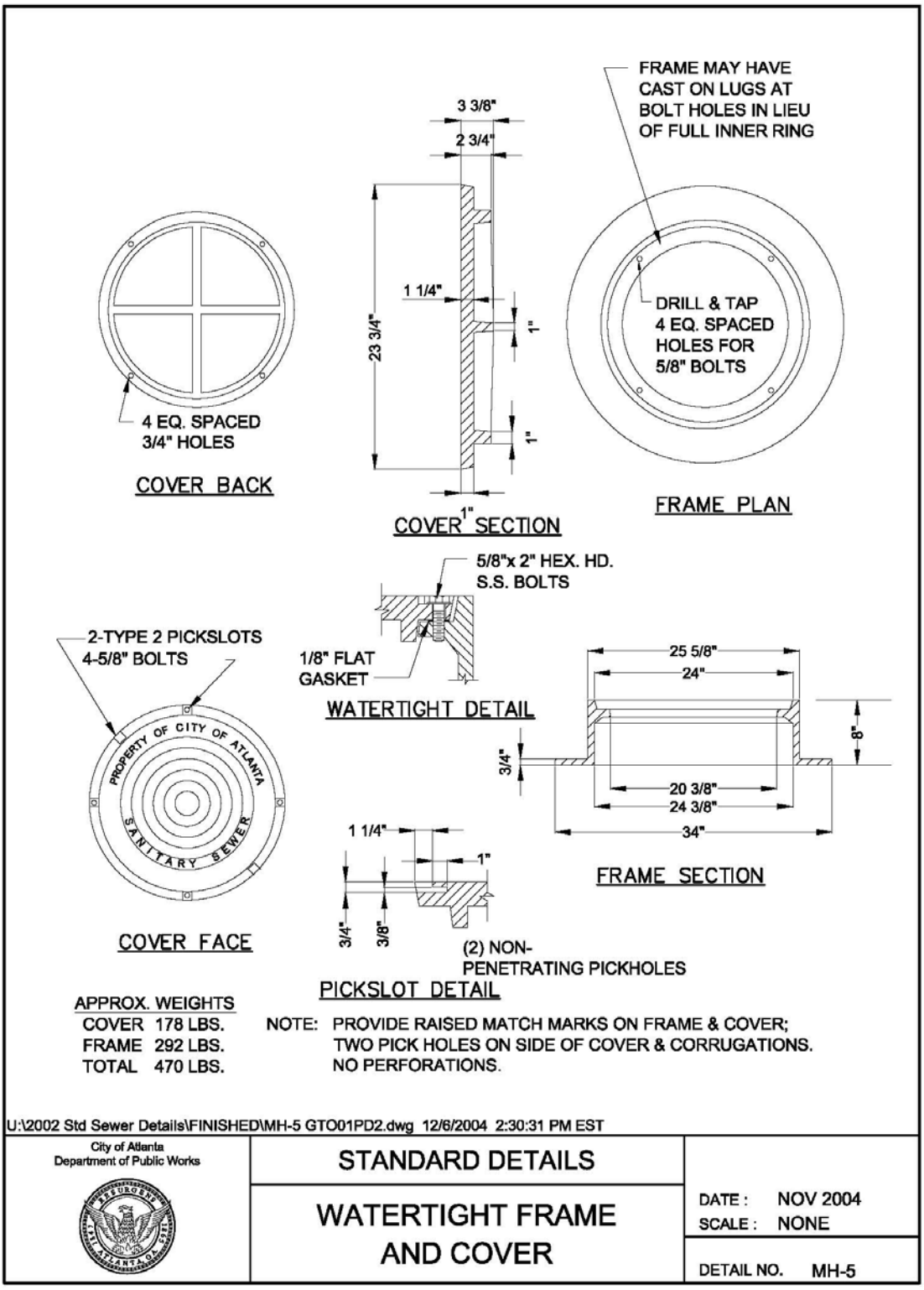

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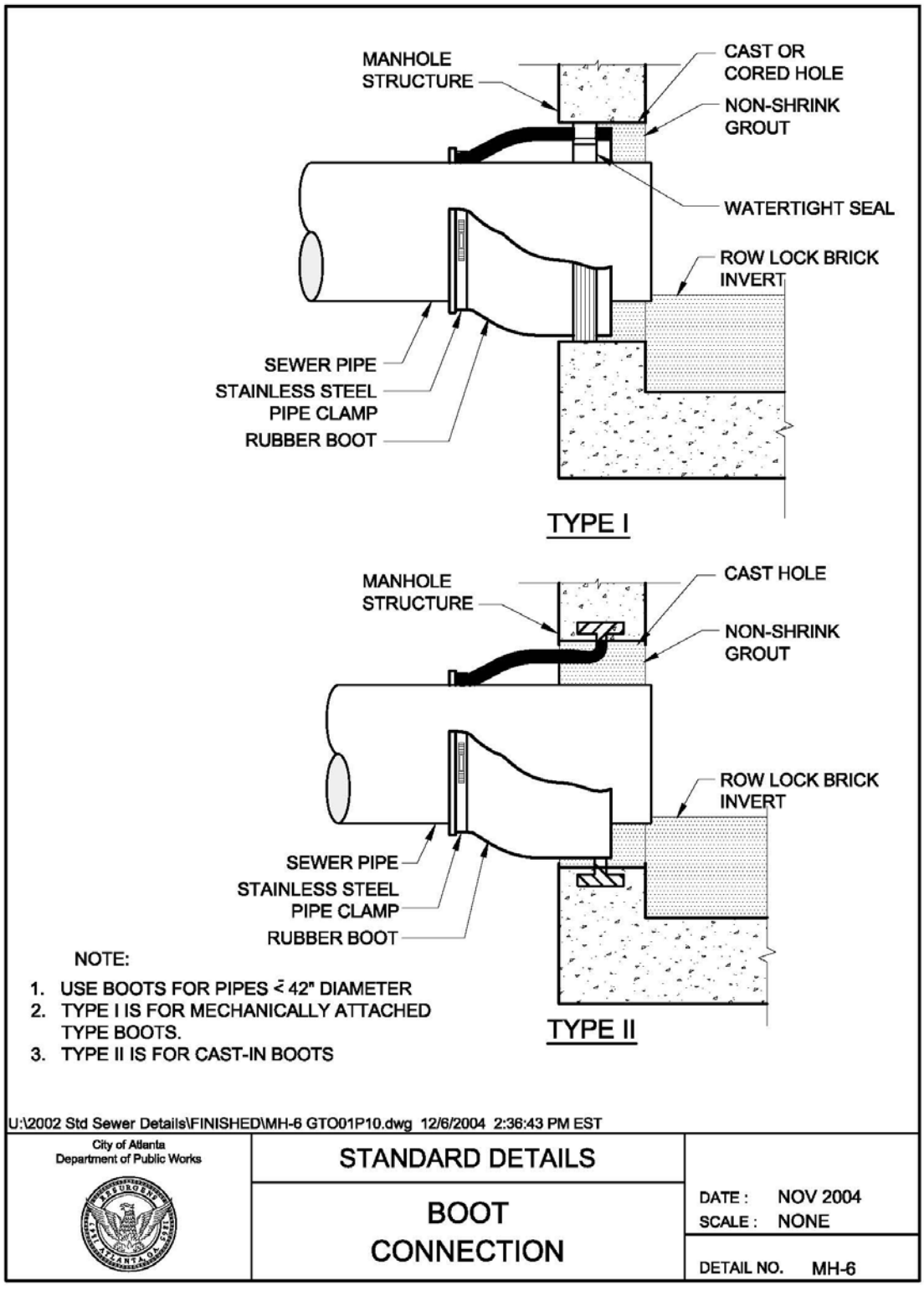

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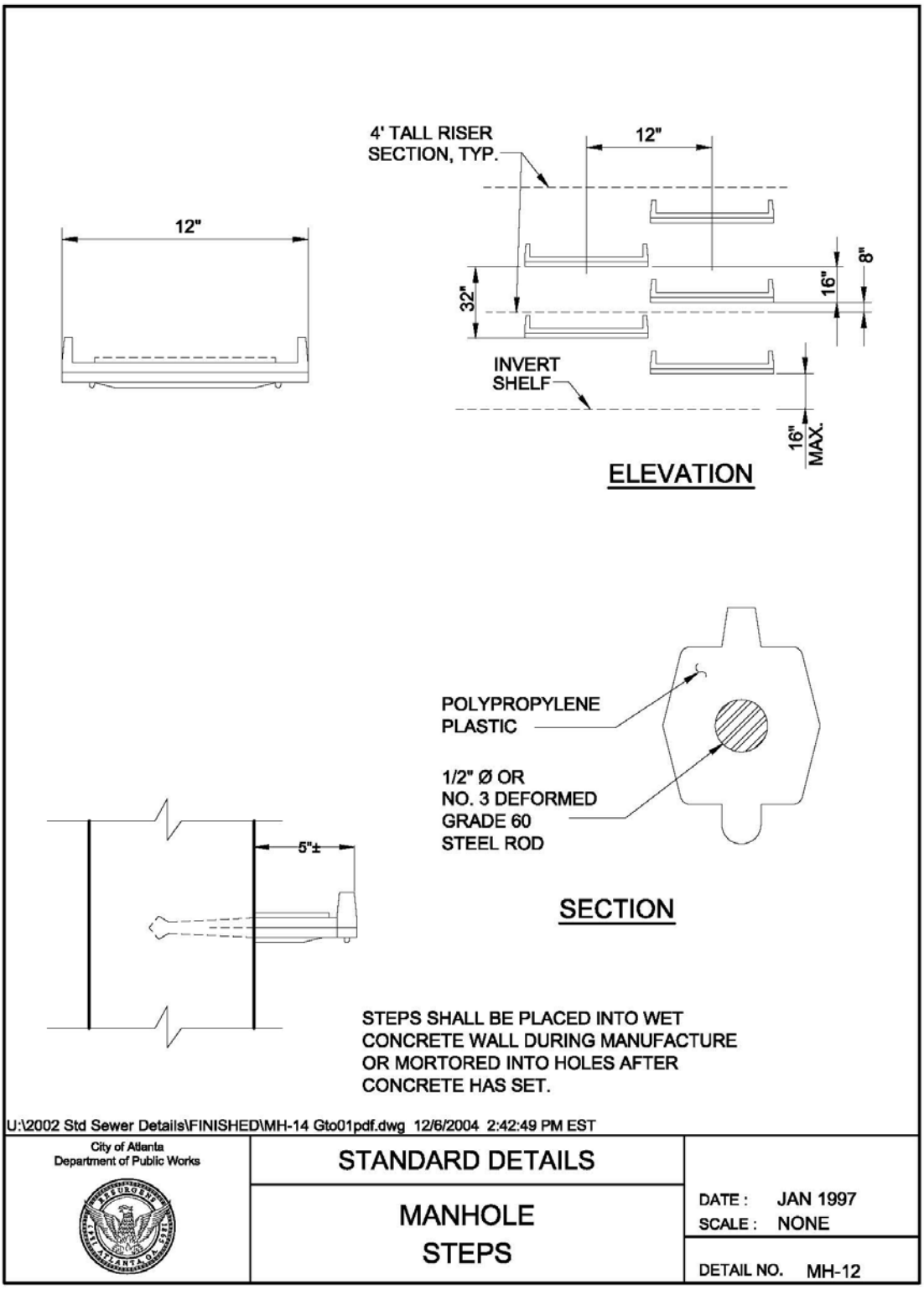

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END OF SECTION

SECTION 02511

Preconditioning and Cleaning Manholes and Sewers

PART 1 – GENERAL

1.01 SCOPE

A. The objective of preconditioning and cleaning is to maximize sewer and manhole service efficiency and effectiveness. Preconditioning and cleaning involves removal of silt, which is defined as any and all solid or semi-solid materials, including fine and granular material, such as sand, grit, gravel, and rock as well as debris, grease, oil, sludge, slime, or any other loose material or encrustation lodged in the manhole or sewer. Preconditioning and cleaning also involves removal of invading roots, corroded concrete, corroded manhole rungs, corroded ladders, intruding laterals and any other extraneous debris. Two levels of performance concerning preconditioning and cleaning of manholes and sewers shall be adhered to in this contract, as directed:

1. Preconditioning and cleaning as a general level of service; this requires that manholes and sewers shall be considered preconditioned and cleaned if:

   a. Silt is removed and disposed of to a nominal depth of not more than 10% of the through flow channel in manholes, or sewer between manholes, where the through flow channel or sewer has an equivalent diameter up to and including 24-inches.

   b. Silt is removed and disposed of to a nominal depth of not more than 5% of the through flow channel in manholes or sewer between manholes, where the through flow channel or sewer has an equivalent diameter greater than 24-inches.

   c. No surface or appurtenance in manholes including walls, cones, slabs (both intermediate and roof slabs), rungs and benches and drop shafts shall have any remnant of silt, coating, loose bricks, unsound concrete or mortar or loose material.

   d. All roots, corroded concrete, corroded rungs, corroded ladders and intruding laterals are treated or reduced and cut flush with the interior surface of manholes and sewers, removed and disposed of.

Fulfillment of these requirements (e.g., depth of silt or cleanliness of surface) is to be determined by internal manhole and sewer condition survey or inspection of each manhole and sewer length preconditioned or cleaned as directed.

2. Preconditioning and cleaning prior to rehabilitation and repair; which requires that manholes and sewers shall be considered preconditioned and cleaned if, in addition to the requirements of Section 1.01.A.1 above, all silt has been removed from a minimum of 95% of the through flow channel and sewer cross section. In the case of manholes, all surfaces shall be free of cleaning agents and their reactant products. Fulfillment of these requirements is to be established by internal manhole and sewer condition survey or inspection of each manhole and sewer length preconditioned or cleansed as directed.

B. The Contractor shall precondition and clean the manholes and sewers selected by the Engineer or specified herein so as to remove all silt, debris, roots, corroded concrete, corroded rungs and ladders, intruding laterals, etc., and dispose of the material at an approved site.

C. During preconditioning and cleaning work and all other associated Contractor operations, sewer services shall be maintained at all times. This requirement may be relaxed only with the written approval of the Engineer.

D. The manholes and sewers to be preconditioned and cleaned convey sanitary sewage or combined sewage. In many instances such sewers are subject to high flows, either continuously or in a periodically varying cycle, due to rainfall, infiltration, and/or pumping operations. The Contractor shall include in his bid provisions for dealing with such variations, and where necessary, schedule his Work to accommodate such variation in flows.

1.02 RELATED SECTIONS

A. The Work of the following Sections apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of Work.

1. Section 02752: Internal Sewer Condition Assessment.

1.03 REGULATORY REQUIREMENTS

A. The Work of this Section shall comply with the current versions, with revisions, of the following: OSHA 29 CFR 1910.146 (permit-required confined-space regulations)

B. All work and testing shall comply with the applicable Federal codes, including Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended, and applicable state and local codes and standards; and to the extent applicable with the requirements of the Underwriter's Laboratories, Inc. and the National Electric Code.

1.04 EXPERIENCED WORKERS

A. All crew chief(s) responsible for preconditioning and cleaning work shall have a minimum of 3 years previous experience in preconditioning, cleaning and related activities including:

1. Use of gas safety monitors/detectors/testers

2. Safe working in confined spaces

3. Utilization of hydraulic pressure jetting/water blasting in sewers and confined spaces

4. Utilization of root cutters and/or root treatment using chemicals

5. Utilization of a wide range of cleaning nozzles in widely differing conditions

B. The Contractor shall provide the Engineer with written documentation that all workers on site meet these experience requirements. This documentation shall include a list of projects on which each individual worked and client name and telephone number for each reference.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION OF THE WORK

3.01 GENERAL

A. Preconditioning and cleaning works shall be carried out from the downstream access manhole or chamber to the upstream access manhole or chamber and shall entirely comply with the performance requirements defined in the relevant sub-clause of clause 1.01 above.

3.02 WORKING AREA

A. The working area in which machinery and equipment operates is to be kept to a minimum. Equipment not in use shall be removed from the work site so as to minimize disruption to traffic and the general public.

B. The working area is to be free from silt and debris when the Contractor leaves the site at the end of each visit.

C. Open manholes, machinery and standing equipment shall be protected at all times.

3.03 LOCATION

A. The locations of sewers included in the Work are indicated in the Drawings.

3.04 TRAFFIC CONTROL

A. Refer to Specification Section 01500: Temporary Control of Construction Operations for requirements.

3.05 NOISE CONTROL

A. All work activities for preconditioning and cleaning sewers and manholes shall comply with the requirements of SC-11.6. The Contractor shall employ the "best practicable means" to minimize and mitigate noise as well as vibration resulting from operations. Mitigation measures shall include the utilization of sound suppression devices on all equipment and machinery particularly in residential areas and in the near vicinity of hospitals and schools, especially at night.

3.06 FENCING

A. All unattended open manholes and working areas shall be provided with temporary fencing and/or barriers meeting applicable Federal, State, and City of Atlanta standards and subject to the approval of the Engineer.

3.07 WORKING HOURS

A. Work hours are per the General Conditions of the Contract Agreement. No work shall be carried out at any other time including Saturday, Sunday and holidays without permission in writing from the Engineer except when the work is unavoidable or necessary for the saving of life or protection of property. In such case the Contractor shall immediately notify the Engineer.

B. Work on principal highways and major roads shall be restricted to certain hours as directed by the Engineer and/or specified herein. The Contractor will be compensated through the appropriate Task Allowance for additional costs incurred when work hours are restricted.

3.08 SCHEDULING OF WORK

A. After discussion with the Engineer, the Contractor shall prepare and submit a schedule of work that will meet the requirements of the City and the limitations imposed under the Contract Documents. The Contractor shall follow the approved schedule as specified in the General Conditions of the Contract.

3.09 PROLONGED ABSENCE FROM SITE

A. If the Contractor will be absent from the work site, or part of the work site, for a prolonged period, he shall inform the Engineer, replace manhole covers, and clear any roadways of his equipment and materials, including temporary traffic control measures he may be using.

3.10 OPERATIONAL REQUIREMENTS

A. Each preconditioning and cleaning unit and each CCTV/sonar unit shall carry sufficient numbers of guides and rollers such that, when cleaning and inspecting or surveying, all bonds (e.g. metal winch cable) are supported away from sewer and manhole structures.

B. Each preconditioning and cleaning unit shall carry a range of flow control equipment, as opposed to bypass pumping equipment, for use in controlling the flow during the work. A minimum of one item of each size of equipment ranging from 4-inch to 24-inch diameter inclusive shall be carried.

C. The system of silt and debris removal shall be capable of operating in such a way as to minimize the obstruction to sewer flows and preconditioning and cleaning operations.

D. Basements, homes and all other vulnerable property shall be prevented from being flooded where hydraulic preconditioning and cleaning methods are used to precondition and clean manholes and sewers.

E. The Contractor shall make his own arrangements for the secure “off road” overnight parking of his vehicles and cleaning equipment and shall comply with all relevant statutory traffic regulations and local laws.

3.11 HANDLING AND DISPOSAL OF REMOVED MATERIAL

A. The Contractor shall remove all silt, debris, detritus, etc. resulting from all manhole and sewer preconditioning and cleaning activities at least once each working day. Such material shall be caught and collected in a suitable trap, weir, or dam within the manhole or chamber being preconditioned and cleaned and/or at the downstream manhole of the sewer segment being preconditioned and cleaned. The Contractor shall ensure that the capture

method or methods used effectively prevent silt migration downstream. Descriptions of such methods, including details of the equipment used, shall be provided to the Engineer on request.

B. All material removed from sewers and manholes shall be deposited in suitable closed watertight containers such that the total amount removed can be easily measured if required. The Contractor is to give the Engineer such assistance as may be necessary in carrying out this measurement work.

C. The type and capacity of containers to be employed for the holding and transport of the removed materials shall be determined by the Contractor. The Contractor shall not accumulate or store debris, silt, and/or liquid waste or sludge on site. Under no circumstances shall sewage, silt or solids be dumped onto the ground surface, ditches, catch basins or storm drains.

D. The Contractor's work procedures shall be such that sewer preconditioning and cleaning work is not delayed by a lack of an empty container in which to deposit the materials removed from the sewer.

E. The Contractor is advised that it may not always be possible for the container to be positioned immediately adjacent to the manhole from which materials are being removed and that "double handling" of the materials may be necessary. The Contractor shall provide for such "double handling" to be carried out safely and efficiently at no additional cost to the City.

F. The Contractor must make his own arrangements for the proper disposal of materials removed from the sewer. The disposal site must be licensed to accept such materials and must be approved by the Engineer prior to commencement of the work. The Contractor shall be responsible for obtaining all necessary disposal permits and for complying with all state and City regulations for handling silt laden sewage.

G. All costs associated with disposal permitting and silt handling must be included in the Contractor's rates for work.

H. The containers for the disposal of materials removed from sewers and manholes shall be routed through an approved weigh station and a copy of each weight ticket submitted to the Engineer. Such tickets shall be used to determine the quantities of materials removed.

3.12 WATER SUPPLY

A. Prior to the commencement of work, the Contractor shall locate all hydrants from which water may be obtained.

B. The Contractor is responsible for making his own arrangements for obtaining water for the work, and he shall comply with all local conditions regarding the use of construction and flushing water. Such arrangements shall be approved by the Engineer prior to commencement of work.

C. All details of the point of water connection, backflow protection, conveyance methods, draw-off rates, times and all local conditions regarding the use of water shall be approved by the Engineer prior to commencement of work. All equipment, labor, and material required for obtaining water for the work shall be provided by the Contractor.

D. The Contractor shall provide constant attendance when water is being drawn off any hydrant.

E. The Contractor must ensure that a 12-inch minimum air gap is maintained at the supply point on desilting/cleaning/jetting equipment or any other receiving apparatus.

F. The use of any standpipe or hydrant, which has not been approved by the Engineer, is expressly forbidden.

3.13 TRAVEL

A. The cost of all travel required in the completion of the specified work shall be included in the Contractor's rates for work.

B. The cost of travel required for the completion of extra work for which unit costs are not included in the Contract shall be at rates documented in writing by the Contractor.

3.14 SUPERVISION

A. A responsible representative of the Contractor shall be present on the site of the work, or other location approved by the Engineer, to provide supervision of the work. At all times, and especially when a change of work location is underway, the Contractor's representative shall keep the Engineer continuously aware of the location, progress, planned execution of the work, and problems encountered.

3.15 COMMUNICATION

A. The Contractor's on-site representative directly responsible for the work shall be immediately reachable at any time during the normal working day and shall immediately respond to all questions and directions by the Engineer.

B. Adequate means of communication by telephone, portable radio, or other electronic means of communication must be maintained at all times as part of the routine work methodology and in case of an emergency, between all points of activity along the length of the sewer being preconditioned and cleaned.

3.16 DAMAGE TO MANHOLES OR SEWERS CAUSED BY CONTRACTOR

A. The Contractor shall use special care in his work methods and take all necessary precautions against improper use of the preconditioning and cleaning equipment to avoid damaging the sewer and/or manholes being preconditioned and cleaned. If in the Engineer's opinion, the Contractor's work has caused damage to the manhole or sewer, the Contractor shall repair the damage to the complete satisfaction of the Engineer at no additional cost to the City.

3.17 RESPONSIBILITY FOR OVERFLOWS OR SPILLS

A. It shall be the responsibility of the Contractor to schedule and perform his Work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from the sewer system.

B. In the event that the Contractor Work activities contribute to overflows or spills, the Contractor shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the designated Engineer in a timely manner, all in accordance with the City's Emergency Response Plan.

C. Contractor will indemnify and hold harmless the City for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the Contractor, including the legal, engineering and administrative expenses of the City in defending such fines and claims

PART 4A – GENERAL TECHNICAL EQUIPMENT SPECIFICATION - SEWERS

4A.01 GENERAL

A. The Contractor shall certify that sufficient cleaning units can be provided, including standby units in the event of breakdown, in order to complete the work within the contract period. Further, the Contractor shall certify that standby or back-up equipment can be delivered to the site within 48 hours in the event of equipment breakdown.

B. The cleaning unit(s) shall be capable of operating routinely, up to a minimum of 500-feet from the point of access to the sewer.

C. Each cleaning unit shall carry a mobile telephone to facilitate communication with the Engineer and to comply with relevant safety requirements defined in the safe working procedures approved by the Engineer for the execution of the work.

4A.02 CCTV AND SONAR INSPECTION/SURVEY UNITS

A. All CCTV and sonar survey units shall comply with Specification Section 02752 unless otherwise determined.

4A.03 WINCHING EQUIPMENT

A. Winching equipment shall be sufficient for the purposes of attaining the degree of cleanliness specified in Section 1.01A

B. The Contractor shall provide conventional power winching equipment and all associated equipment, including winching buckets, balls, breakers, kites, scooters, scrapers, tires, tools and safety apparatus. Complete details of equipment proposed for use in preconditioning and cleaning shall be provided to the Engineer before work commences.

C. Dredging of sewers shall be undertaken by passing various sized buckets, balls, breakers, kites, scooters, scrapers, tires etc, through the sewers to physically remove accumulated silt, sludge and other debris. Where conditions dictate, power boring equipment and/or winching equipment shall be used to loosen the silt prior to its removal. All necessary equipment including cables, lines, and tools must be available at all times as required.

D. The equipment shall be capable of operating efficiently and effectively in the sizes of sewers and depth included in the project at distances of up to 500-feet between adjacent manholes.

E. The project sewers convey sanitary sewage, storm water, or combined sewage flows. Certain Sections of sewer may be flowing entirely full or in a

surcharged condition and the Contractor must be prepared at all times to use manual pushing rods, mechanical boring equipment or other methods to pass a leading line through the sewer prior to commencing dredging operations with winching.

F. Any item of CONTRACTOR plant or equipment associated with the Work, which may cause obstruction to the flow in the sewer, shall be removed from the sewer at the close of work each day. It shall be permitted to leave a line or winching cable through the sewer during breaks in the work.

G. Dredging operations in a particular Section of sewer will generally proceed in a downstream direction, working between consecutive manholes using winch buckets of sizes stated below.

H. The size of winch bucket used in sewers up to 48” shall be 90% of the sewer bore up to a maximum of 24”. It is anticipated that buckets of smaller sizes than those stated will need to be winched through Sections of sewer prior to the use of the maximum sizes. The maximum size bucket as stated may be varied at the discretion of the Engineer. However, no buckets larger than these maximum sizes specified shall be used without the approval of the Engineer.

I. The Contractor is advised that use of the maximum size buckets listed above may not be practical due to restricted access through manhole covers and other access points. The Contractor shall ensure that his working procedures will not be unduly affected by such restrictions and shall allow for inefficiencies due to all such restrictions in his unit rates.

J. The winches used to draw buckets, balls, breakers, scooters, scrapers, or tires shall be power driven. They shall incorporate a torque-limiting device to prevent the breaking of winching lines in case the line becomes jammed by obstructions.

K. Where the operational cleaning equipment is towed by winch and bond through the sewer, all winches shall be stable with either lockable or ratcheted drums. All bonds shall be steel or of an equally non-elastic material to ensure the smooth and steady progress of the equipment. All winches shall be inherently stable under loaded conditions.

4A.04 PRESSURE JETTING EQUIPMENT

A. Pressure jetting equipment used shall be sufficient for the purposes of attaining the degree of cleanliness in sewers and manholes as specified in Section 1.01.

B. Jetting units in sewers must be capable of jetting a minimum distance of 500-feet either upstream or downstream from a manhole. Minimum nominal hose size shall be one-inch diameter.

C. The Contractor's unit prices specified in the bid form shall include jetting in sewers both upstream and downstream.

D. Successive passes using constantly moving pressure jetting techniques shall be applied to sewers until they are cleaned to the level specified. Nozzle hold-time (stationary time), for any particular location, shall not be more than 60 seconds in order to forestall damage to the pipe being cleaned. Nozzles shall have jet angles of between 30º to 45º. "High efficiency nozzles" (discharging "pencil jets") with jet angles higher than this figure shall not be allowed to be stationary at any time.

E. Silt shall be collected at manholes as specified herein. No silt shall be allowed to pass beyond the Section of sewer being cleaned.

F. Pass rates (rewind speed) for the jetting head shall be at a consistent speed without jerking and excessive variations. Typical pass rates shall be 4 inches to 8 inches per second. The hose reel shall be power driven in the rewind direction.

G. Manual pressure jetting within manholes shall not be allowed. Progress towards the desired level of service specified in manholes may be monitored by a stem linked TV camera. Manhole pressure jetting for the purpose of cleaning or preconditioning shall be executed either:

1. Manually from the ground surface, or

2. Robotically within the manhole

H. The Engineer shall be notified of the jetting equipment proposed by the Contractor in the bid documents. The jetting equipment will be operated utilizing the pressures specified unless otherwise noted elsewhere in the document. The proposed equipment shall be categorized from the following table:

TABLE 4.4.1

CATEGORY	MACHINE TYPE	CAPACITY (GALL/MINUTE) min max	PRESSURE (p.s.i.) min max
Manholes			
1	High pressure/low volume – trailers	1 – 35	3,000 – 10,000
2	**High pressure/low volume – mini**	9 – 35	3,000– 10,000
3	High pressure/low volume – non HGV/HGV jetter/combination	9 – 35	3,000 – 5,000
Sewers			
4	Low pressure/high volume – HGV	30 – 50	1,500 – 2,000
5	Low pressure/high volume – combination	30 – 75	1,500 – 3,000
6	Low pressure/high volume – super combination	75 – 175	2,000 – 2,500
7	Low pressure/high volume – separate jumbo jetter/suction units	75 – 200	2,000 – 2,500
Other			

Notes for Table 4.4.1

1. The categories listed are typical only of the equipment for use in the present contract. Exceptions to the duty and equipment shown above will be allowed subject to appropriate notification and approval. The Contractor is required to complete the table with details of any other equipment proposed.

2. Discretion shall be used concerning the maximum pressure used for cleaning sewers. In general for asbestos cement, clay and concrete pipes cleaning pressures shall be limited to 5000 psi (340 bar). For brick sewers cleaning pressures shall be limited to 3500 psi (240 bar) For pitch fiber and plastic pipes cleaning pressures will be limited to 1500 psi (102 bar) and 2500 psi (170 bar) respectively.

3. Cleaning pressures in concrete manholes shall be limited to 5000 psi (340 bar). Cleaning pressures in new brickwork manholes shall be limited to 5000 psi (340 bar) and in old brickwork manholes to 3500 psi (240 bar).

4. Higher pre-conditioning pressures in sewers and manholes prior to rehabilitation may be allowed at the sole discretion of the Engineer. The Engineer's agreement to use higher pressures shall not relieve the Contractor of his responsibilities for any resultant damage in accordance with the requirements of paragraph 3.16 above.

I. Where a jetter is fitted with an airflow suction unit for removal of silt and other material from the sewer, it shall be capable of removing materials such as sludge, silt and bricks from depths up to 32-feet with minimum suction of 2500-cfm. A tank with a minimum capacity of 175-cf shall be provided and be capable of decanting collected liquids and conveying them back to the sewer. The suction hose of such a system shall have a minimum internal diameter of 6-inches.

J. Jetting equipment shall be calibrated on an annual basis by an approved body and calibration certificates made available for inspection by the Engineer as requested. Such equipment shall be maintained on a regular basis in accordance with the manufacturer's Specification. The Contractor shall make available copies of his maintenance certificates and/or schedules to the Engineer as requested.

K. An automatic pressure relief valve shall be incorporated on the pump discharge chamber to prevent the pressure exceeding the safe maximum for the system as a whole. This may take the form of a pressure relief valve of the bursting disc type in holder or an automatic pressure regulating valve (unloading valve).

NOTE: The maximum working pressure is the lowest value of the maximum working pressure ratings of all individual components of the system.

4A.05 AIR DRIVEN, ELECTRO-MECHANICAL AND/OR MECHANICAL PRE-CONDITIONING AND CLEANING TOOLS

A. Where necessary, and additional to winching and pressure cleaning equipment, appropriate air driven, electrically driven and/or mechanical tools may be used to needle, hammer, scrape or grind off corroded concrete, scarify and remove compacted silt, chip-off spilt grout, detach encrustation, trim and cut laterals and roots, etc. The Contractor shall provide prior notification to the Engineer prior to the use of such equipment and techniques.

4A.06 VENTILATION OF CONFINED SPACES

A. The Contractor shall provide, operate, maintain and subsequently remove on completion, adequate ventilation apparatus in the form of blowers

and/or fans. The ventilation apparatus shall introduce a fresh air supply to support a safe environment for work in sewers, manholes and all other confined spaces, which shall be kept free from dangerous, toxic and/or explosive gases, whether generated from sewage, soil strata or other source.

PART 4B – GENERAL TECHNICAL EQUIPMENT SPECIFICATION - MANHOLES

4B.01 PRECONDITIONING AND CLEANING AS A GENERAL LEVEL OF SERVICE

A. With the exception of the “through flow” channel, all surfaces shall be thoroughly cleaned using high pressure water with sufficient pressure (minimum force of 3500 psi.(240 bar)) to achieve the specified level of preparation. Preconditioning and cleaning shall include the removal of all roots, corroded concrete, corroded rungs, intruding laterals and any other extraneous, loose material, debris or foreign matter using air driven, electrically driven or mechanical equipment as specified.

B. Before preconditioning and cleaning work commences, silt, sand and debris traps shall be installed at the entrance to the downstream sewer to capture all silt and debris material.

4B.02 PRECONDITIONING AND CLEANING PRIOR TO REHABILITATION AND REPAIR

A. All concrete and masonry surfaces to be rehabilitated or repaired shall be meticulously cleaned by water blasting utilizing a 210°F steam unit and appropriate nozzles to provide a contamination-free and sound surface. Other methods, such as wet or dry sand blasting, acid wash, concrete cleansers, degreasers or mechanical means, may be required to completely clean the manhole surface prior to rehabilitation or repair.

B. All surfaces on which preconditioning and cleaning methods outlined in Paragraph 4B.02.A above have been used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products before rehabilitation commences. Concrete surfaces shall be accepted for the purpose of rehabilitation when they are sound, surface dry, porous and free from dust, dirt, oil, grease, fat efflorescence, concrete hardening or sealing chemicals, previous coatings, rust, form-release agents, laitance, other penetrating contaminants, fins, surface projections, thin crusts, bridging voids, and loosely adhering concrete and dirt particles.

C. All manhole “runner” and “gusher” infiltration leaks shall be sealed in areas where linings are to be installed. The Contractor will not be allowed to commence rehabilitation work until these leaks have been sealed to the satisfaction of the Engineer.

D. Where required by the relevant manhole rehabilitation system, manhole surfaces to be rehabilitated shall have a pH of 7 to 10. Surfaces shall be tested in accordance with ASTM D4262.

E. Where instructed by the Engineer, the Contractor shall test prepared surfaces by Swiss impact hammer or other physical method to determine soundness.

PART 5 – QUALITY CONTROL/PRECONDITIONING AND CLEANING REPORT

5.01 GENERAL

A. A quality control video inspection of preconditioned and cleaned sewers shall be carried out as directed, immediately following completion of preconditioning and cleaning work. If a sewer or pipe line has not been preconditioned or cleaned as specified (by visual inspection, video review or field analysis) in the sole opinion of the Engineer, the sewer shall be re-preconditioned and cleaned in accordance with the Specification at no additional cost to the City.

B. The Contractor shall supply one copy of inspection video for each reach of sewer completed.

C. When required by the Engineer, the Contractor shall supply one copy of the full internal sewer condition assessment report, completed in accordance with the requirements of Specification Section 02752. This Specification includes a sample report sheet also reproduced at the end of this Specification. The sample report sheet shall be accurately and fully adopted in format and in detail and submitted by the Contractor immediately following the QA/QC inspection.

5.02 DAILY LOG

A. The Contractor shall provide a report of work completed each day. The report shall be submitted to the Engineer no later than one workday following completion of the work. The report shall contain a separate sheet for each manhole and sewer reach preconditioned. The report shall utilize the form provided at the end of this Specification.

B. The Contractor shall immediately notify the Engineer of any material such as bricks, concrete or broken clay pipe appearing in the materials removed from the sewers and/or manholes during preconditioning and cleaning activities.

(EXAMPLE)
CONFINED ENTRY LOG
MANHOLE/ SEWER SAFETY CHECK
(TO BE COMPLETED DAILY)

Date:_____ Supervisor: _____ Vehicle No._____

Time	Manhole No.	Manhole Location
1.		
2.		
3.		
4.		
5.		

Workers on site: _____
(Underline those with safety training certification)

Safety Apparatus on Site: (tick)

Multi Gas Monitor ☐ Lifting Harness ☐ Lifeline ☐

Helmet/ Safety Boots ☐ First Aid Kit ☐ Torch Light ☐

Aluminum Ladder (AL) ☐ Air Blower ☐ Breathing Apparatus ☐

Headphone ☐ Cell Phone ☐

Safety Check: (tick)

Manhole Vented by Blower? ☐ Manhole Tested for Gases? ☐

Oxygen Sufficiency OK? ☐ Protective Clothing Worn? ☐

Top Men Carrying BA? ☐ Ladder Used ☐

Traffic Signs and Cones OK? ☐ Blinkers and Beacons OK? ☐ Site Plans? ☐

Gas Monitoring Readings

Time	**Hydrogen Sulfide Level**		**Oxygen Level %**	**Carbon Monoxide Level**		**Methane Level**	
	Detected (PPM)	Not Detected		Detected (PPM)	Not Detected	Detected (PPM)	Not Detected

Manhole/ Sewer Safe to Enter? ☐ Yes ☐ No Incidents, if any:_____
(Append Lengthy Description)
Signature of Safety Officer/ Supervisor:_____ Date:_____

PRECONDITIONING & CLEANING REPORT SHEET FORM 'A'
(TO BE COMPLETED DAILY)

Date_____ **Sheet**____ **of** _____

Crew_____ Time of Arrival_____

Site_____ Time of Departure_____

Location (Street No., Easement Site)	**U/S Manhole (Ref)**	**D/S Manhole (Ref)**	**Sewer Length (feet)**	**Unit in Highway (Yes/No)**	**Sewer Material**	**Silt Depths @Manholes (inches)**	Sewer Size **(inches)**	**Length Cleaned (feet)**	**Upstream/ Downstream (U/S-D/S)**	**Comments**

Typical Comments (Initial)	Emergency **(**EM**)**	Urgent Repair **(*UR*)**	Bad Joints **(BJ)**	Excessive Silt/Grease **(DES/DEG)**	Intense Odor **(O)**	Concrete Debris **(DECO)**	Roots (Size) **(R)**	High Levels **(HWL)**	Clayware Debris **(DEC)**	Number of Intruding Laterals (Size) **(CNI)**

Note: Continue on next line where extensive comments or space is required

Signed_____ Signed_____
(Engineers Representative) (Contractors Representative)

END OF SECTION

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SECTION 02530

Concrete Walks

PART 1 – GENERAL

1.01 SCOPE

A. The extent of concrete walks is as shown on the Drawings or as required to replace existing walks damaged or destroyed by the Contractor's work.

B. Concrete walk construction includes, but is not limited to, the furnishing, placing, forming, finishing, curing and jointing of Portland cement concrete on prepared subgrade for walks, sidewalks, wheelchair and/or curb cut ramps, paved medians, and drive ramps.

1.02 RELATED SECTIONS

A. The Work of the following Sections specifically apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of Work.

1. Section 03300: Concrete Work

PART 2 – PRODUCTS

2.01 MATERIALS

A. Forms: Either full depth steel or wood forms of a size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use forms that are straight and free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends.

B. Concrete: Ready-mix concrete of 3,000 psi comprehensive strength conforming to ASTM C94 except where small quantities are needed. In which cases, small capacity batchers or mixers may be used.

C. Joint Filler: Preformed joint filler meeting AASHTO M153 or AASHTO M213.

2.02 CONCRETE MIX

A. Design the mix to produce standard-weight concrete consisting of Portland cement, aggregate and water to produce the following properties:

1. Compressive Strength: 3000 psi minimum at 28 days as determined by ASTM C39.

2. Slump: 4 inches maximum per ASTM C143.

3. Air Content: 3% to 6%.

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION

A. Remove loose material from compacted subgrade immediately before placing concrete.

3.02 FORM CONSTRUCTION

A. Set forms to the required grades and lines rigidly braced and secured.

B. Check completed formwork for grade and alignment to the following tolerances:

1. Top of form: Within 1/8 inch of design line and grade.

2. Vertical face: Not more than 1/4 inch in 10 feet from vertical.

C. Thoroughly clean forms and coat with form release agent as required, ensuring form separation from concrete without damage before placing concrete.

D. Slip form placement methods will be permitted provided completed walks meet requirements herein specified. Should slip form method not produce a product conforming to these specifications, the unacceptable work is to be removed and reconstructed, at no additional cost to the City, using fixed forms.

3.03 REINFORCEMENT

A. Locate, place and support reinforcement (if any), as indicated or specified.

3.04 CONCRETE PLACEMENT

A. Do not place concrete until subgrade and forms have been checked for line and grade. Moisten subgrade as required to provide a uniform dampened condition at the time concrete is placed. Do not place concrete on muddy or frozen subgrade.

B. Place concrete in one course, monolithic construction, for the full width and depth of walks.

C. Spread concrete as soon as it is deposited on the subgrade using methods that prevent segregation and separation of the mix, and with as little re-handling as possible. Consolidate concrete along the face of forms and adjacent to transverse joints.

3.05 JOINTS

A. General: Construct expansion and weakened plane contraction joints true to line with face perpendicular to surface of the walk, unless otherwise shown. Construct transverse joints at right angles or radial to the walk centerline, unless otherwise shown. When the walkway is abutting existing walks, place transverse joints to align with previously paved joints, unless otherwise indicated.

B. Contraction Joints: Provide weakened plane transverse joints as shown on the Drawings. Construct joints for a depth equal to at least 1/3 the walk thickness, using one of the following procedures:

1. Tooled Joints: Form joints in the fresh concrete by grooving the top portion of slabs and finishing edges to a ¼ inch radius.

2. Sawed Joints: Cut joints, approximately 3/16 inch wide, into hardened concrete as soon as the surface will not be torn, abraded, or otherwise damaged by the cutting action.

C. Expansion Joints: Form expansion joints with ½ inch thick pre-molded joint filler and install sealant after the concrete has hardened. Sealant shall be grey colored elastomeric polyurethane sealant equal to Sonneborn Sonolastic SL-1 as manufactured by Degussa Building Systems. Locate transverse expansion joints no more than 100 feet apart. Where walks abut cold joints, curbs, existing walks, walls, catch basins, manholes, or other structures, provide expansion joint. Furnish joint fillers in one-piece that extend the full width and recess to ½ inch depth from the surface to receive sealant of the joint. After concrete and sealant installation is complete, trim any excess joint material flush with concrete surface.

3.06 CONCRETE FINISHING

A. After striking off and consolidating concrete, smooth the exposed surface to a uniform finish by screeding and floating.

B. Before the surface is given the final finish, test the surface for trueness with a 10 foot straightedge. Correct any irregularities more than l/4 inch in l0 feet.

C. Round all edges to ¼ inch radius.

After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

1. Broom finish: by drawing a stiff-bristle broom across the concrete surface, perpendicular to walk centerline.

3.07 CURING

A. Protect and cure finished concrete walks with type 2 membrane curing compound.

3.08 REPAIR AND PROTECTION

A. Repair or replace broken or defective walks using methods acceptable to the Engineer. Where removal is required, remove and replace complete panels.

B. Protect completed walks from damage until final acceptance.

C. Clean concrete walks free of stains, discolorations, dirt, trash, leaves and other foreign material just prior to substantial completion and final acceptance.

3.09 TRAFFIC CONTROL

A. Refer to Specification Section 01500: Temporary Control of Construction Operations for requirements.

END OF SECTION

SECTION 02532

Concrete Curbs and Gutters

PART 1 – GENERAL

1.01 SCOPE

A. The extent of concrete curbs and gutters is as shown on the Drawings or as required to replace curbs and gutters damaged or destroyed by the Contractor's work.

1.02 RELATED SECTIONS

A. The Work of the following Sections specifically apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of Work.

1. Section 02530: Concrete Walks

2. Section 03300: Concrete Work

PART 2 – PRODUCTS

2.01 FORMS

A. Either full depth steel or wood forms of a size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use forms that are straight and free of distortion and defects.

B. Use flexible spring steel forms or laminated boards to form radius bends as required.

2.02 CONCRETE

A. Ready-Mix concrete, 3,000 psi compressive strength, conforming to ASTM C94.

2.03 JOINT FILLER

A. Preformed joint filler meeting AASHTO M153 or AASHTO M213.

2.04 CONCRETE MIX

A. Comply with applicable requirements of Section 03300 for concrete mix design, sampling and testing, and quality control, and as herein specified. Design the mix to produce standard-weight concrete consisting of Portland cement, aggregate and water to produce the following properties:

1. Compressive Strength: 3000 psi minimum at 28 days as determined by ASTM C39.

2. Slump: 4 inches maximum per ASTM C143.

3. Air Content: 3% to 6%.

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION

A. Remove loose material from compacted subgrade immediately before placing concrete.

3.02 FORM CONSTRUCTION

A. Set forms to the required grades and lines rigidly braced and secured.

B. Check completed formwork for grade and alignment to the following tolerances:

1. Top of Form: Within 1/8 inch of design line and grade.

2. Vertical Face: Not more than 1/4 inch in 10 feet from vertical.

C. Thoroughly clean forms and coat, with form release agent as required ensuring form separation from concrete without damage, before placing concrete.

3.03 REINFORCEMENT

A. Locate, place and support reinforcement, if any, as indicated or specified.

3.04 CONCRETE PLACEMENT

A. General: Comply with the applicable requirements of Section 03300 for mixing and placing concrete and as herein specified.

B. Do not place concrete until subgrade and forms have been checked for line and grade. Moisten subgrade as required to provide a uniform dampened condition at the time concrete is placed.

C. Place concrete using methods that prevent segregation and separation of the mix, and with as little re-handling as possible. Consolidate concrete along the face of forms with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Discontinue vibration before segregation or excessive surface grout occurs. Perform any necessary hand spreading and consolidation with hand tools that will not cause segregation and separation.

Deposit and spread concrete in a continuous operation between transverse joints, as far as possible.

Machine methods of placing and forming may be used at Contractor's option, provided that an acceptable finished product, true to line, grade and cross section and conforming to specified finish and jointing requirements, is consistently produced. If machine results are not acceptable, remove and replace with formed concrete as specified.

3.05 JOINTS

A. General: Construct contraction and expansion joints true to line with face perpendicular to surface of curb and gutter, unless otherwise shown. Construct transverse joints at right angles or radial to the curb centerline, unless otherwise shown.

When curb and gutter is constructed abutting concrete pavement, place transverse joints to align with pavement joints.

B. Contraction Joints: Provide contraction joints at intervals of 10 feet, except where a lesser interval is required for closure, but no section is to be less than 6 feet in length.

Contraction joints may be formed by metal divider plates or may be sawed. In either case, joint depth is to be 20 to 25 percent the depth of the concrete.

C. Expansion Joints: Form expansion joints with 1/2 inch thick premoulded joint filler. Locate expansion joints no further than 100 feet apart, unless otherwise shown, where curb and gutter is constructed adjacent to asphalt concrete paving. Match pavement expansion joints where curb and gutter is placed abutting concrete pavement.

Furnish joint fillers in one-piece that extend the full width and depth of the joint. After concrete is finished, trim any protruding joint material flush with concrete surface.

3.06 CONCRETE FINISHING

A. After striking off and consolidating concrete, smooth the exposed surface to a uniform finish by screeding and floating.

B. With the exception of sawed joints, round all joint edges to 1/4 inch radius.

C. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing as follows:

1. Broom finish, by drawing a fine-hair broom across the concrete, perpendicular to the line of traffic.

2. Trowel finish, smooth, and free of trowel marks, uniform in texture and appearance.

3.07 CURING

A. Protect and cure finished concrete curbs and gutters complying with applicable requirements of Section 03300.

3.08 REPAIR AND PROTECTION

A. Acceptably repair or replace broken or defective curbs and gutters.

B. After the concrete has set sufficiently, backfill and compact adjacent ground to design line and grade.

C. Protect completed curbs and gutters from damage until final project acceptance.

D. Clean concrete curbs and gutters free of stains, discolorations, dirt, trash, leaves, and other foreign material just prior to final inspection.

3.09 TRAFFIC CONTROL

A. Refer to Specification Section 01500: Temporary Control of Construction Operations for requirements.

END OF SECTION

SECTION 02575

Removing and Replacing Pavement

PART 1 – GENERAL

1.01 SCOPE

A. The work to be performed under this Section shall consist of removing and replacing existing pavement, sidewalks, steps, patios, curbs, and gutters in paved areas where such have been removed for construction of utilities and appurtenances.

B. Existing pavement, sidewalks, curbs, and gutters shall be replaced to meet the current City of Atlanta standards, or to match existing pavement sidewalk, curb, or gutters; whichever is more stringent.

1.02 SUBMITTALS

A. If required by the City or Engineer, provide certificates stating that materials supplied comply with Specifications. Certificates shall be signed by the asphalt producer and the Contractor.

1.03 CONDITIONS

A. Weather Limitations:

1. Apply bituminous tack coat only when the ambient temperature in the shade has been at least 50 degrees F for 12 hours immediately prior to application.

2. Do not conduct paving operations when surface is wet or contains excess of moisture that would prevent uniform distribution and required penetration.

3. Construct asphaltic courses only when atmospheric temperature in the shade is above 40 degrees F, when the underlying base is dry and when weather is not rainy.

4. Place base course when air temperature is above 35 degrees F and rising.

B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.

PART 2 – PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

A. Graded Aggregate Base: The sub-base shall be a minimum of 6-inches thick and a width equal to the width of the finished paving. Aggregate base shall be Class A, meeting the requirements of the Georgia Department of Transportation Specification Section 815.01. Compact to at least 95% Standard Proctor Density. (ASTM D-698)

B. Base: The base for all ashphaltic paved roadways shall conform to the requirements of the Georgia Department of Transportation Specifications for the Hot Mix Asphaltic Concrete Section 828, 19 mm Superpave mix design.

C. Tack Coat: Tack coat shall conform to Section 413 of the Georgia Department of Transportation Standard Specifications.

D. Surface Course: The surface course for all asphaltic pavement, including paint or tack coat when required by the Engineer, shall conform to the requirements of the Georgia Department of Transportation Specifications for Hot Mix Asphaltic Concrete, Section 828, 9.5mm Superpave, Level C mix design.

E. Concrete: Provide concrete and reinforcing for concrete pavement or base courses in accordance with the requirements of the Georgia Department of Transportation Standard Specifications, Section 430. Concrete shall be minimum 3,000 psi compressive strength or as otherwise shown on the Drawings.

F. Special Surfaces: Where pavement, sidewalks, steps, patios, curbs, or gutters are disturbed or damaged which are constructed of specialty type surfaces, e.g., brick or stone, these facilities shall be restored utilizing similar, if not original, materials. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition. Special surfaces shall be removed and replaced to the limits to which they were disturbed.

2.02 TYPES OF PAVEMENTS

A. General: All existing pavement removed, destroyed or damaged by construction shall be replaced with the same type and thickness of pavement as that existed prior to construction, unless otherwise directed by the Engineer. Materials, equipment and construction methods used for paving work shall conform to the Georgia Department of Transportation specifications applicable to the particular type required for replacement, repair, or new pavements.

B. Aggregate Base: Aggregate base shall be constructed in accordance with the requirements of the Georgia Department of Transportation Standard Specifications. The maximum thickness to be laid in a single course shall be 6-inches compacted. If the design thickness of the base is more than 6-inches, it shall be constructed in two or more courses of approximate equal thickness. After the material placed has been shaped to line, grade, and cross-section, it shall be rolled until the course has been uniformly compacted to at least 100 percent of the maximum dry density when Group 2 aggregate is used, or to at least 98 percent of maximum dry density when Group 1 aggregate is used.

C. Concrete Pavement: Concrete pavement or base courses shall be replaced with concrete. The surface finish, joint pattern and joint sealant of the replaced concrete pavement shall conform to that of the existing pavement. The surface of the replaced concrete base course shall be left rough. The slab depth shall be equivalent to the existing concrete pavement or base course, but in no case less than 6-inches thick. Transverse and longitudinal joints removed from concrete pavement shall be replaced at the same locations and to the same types and dimensions as those removed. Concrete pavements or concrete base courses shall be reinforced.

D. Asphaltic Concrete Base, Bituminous Tack Coat, and Surface Course: Asphaltic concrete base, tack coat, and surface course construction shall conform to Georgia Department of Transportation Standard Specifications. The pavement mixture shall not be spread until the designated surface has been previously cleaned and prepared; surface is intact, firm, properly cured, dry and the tack coat has been applied. Apply and compact the base in maximum layer thickness by asphalt spreader equipment of design and operation approved by the Engineer. After compaction, the black base shall be smooth and true to established profiles and sections. Apply and compact the surface course in a manner approved by the Engineer. Immediately correct any high, low, or defective areas by cutting out the course, replacing with fresh hot mix, and immediately compacting to conform and thoroughly bond to the surrounding area.

E. Surface Treatment Pavement: Bituminous penetration surface treatment pavement shall be replaced with the thickness indicated on the Drawings.

F. Gravel Surfaces: Existing gravel road, drive, and parking area replacement shall meet the requirements of graded aggregate base course. This surfacing may be authorized by the Engineer as a temporary surface for paved streets until replacement of hard surfaced pavement is authorized.

G. Temporary Measures: During the period between pavement removal and complete replacement of permanent pavement, maintain highways, streets, and roadways by the use of steel running plates anchored to prevent movement. The backfill above the pipe shall be compacted, as specified in Section 02200 of these Specifications, up to the existing pavement surface to

provide support for the steel running plates. All pavements shall be replaced within seven calendar days of their removal.

PART 3 – EXECUTION

3.01 LOCATIONS FOR PAVEMENT REPLACEMENT

A. Pavement Replacement:

1. All trenches for roadway crossings

2. All trench longitudinal installations

3. All locations where pavement must be removed or is damaged in the execution of the Work

B. "Graded Aggregate" pavement repair shall be used only where approved by the Engineer.

3.02 REMOVING PAVEMENT

A. General: Remove existing pavement as necessary for installing the pipeline and appurtenances. Existing pavement and sub-base shall be removed for trench construction and pipe installation.

B. Remove and replace pavement and base beyond pipeline trench to outer edge of existing pavement or roadway if remaining existing pavement width is 24-inches or less from side of trench to outer edge of pavement or roadway.

C. Marking: Before removing any pavement, mark the pavement neatly paralleling pipelines and existing street lines.

D. Saw Cutting: Under no circumstances shall the Contractor be allowed to remove concrete or asphalt without prior saw cutting. Asphalt pavement shall be saw cut along the marks using suitable equipment. The saw cutting shall be deep enough to produce an even, straight cut.

E. Machine Pulling: Do not pull pavement with machines until the pavement is completely broken and separated from pavement to remain.

F. Damage to Adjacent Pavement: Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.

G. Sidewalks and Patios: Remove and replace any sidewalks or patios disturbed by construction for their full width and to the nearest undisturbed joint.

H. Curbs and Gutters: Tunnel under or remove and replace any curb and/or gutter, which is disturbed by construction to the nearest undisturbed joint.

I. Steps: Completely remove and replace any steps, constructed of concrete or special surfaces, which are disturbed by construction.

3.03 REPLACING PAVEMENT

A. Preparation of Subgrade: Upon completion of backfilling and compaction of the backfill, arrange to have the compaction tested by an independent testing laboratory approved by the Engineer. Testing shall be paid for separately by the City directly to the testing laboratory. After compaction testing has been satisfactorily completed, replace all pavements, sidewalks, and curbs removed.

1. The existing street pavement or surface shall be removed or milled along the lines of the work from edge of pavement to edge of pavement. Pavement shall be replaced from edge of existing pavement to edge of existing pavement.

2. Trench backfill shall be compacted for the full depth of the trench as specified in Section 02200 of these Specifications.

3. Temporary trench backfill along streets and driveways shall include 6-inches of crushed stone or cherty clay as a temporary surfacing of the trenches. This temporary surface shall be maintained carefully at grade, dust-free, by the Contractor until the backfill of the trench has thoroughly compacted in the opinion of the Engineer, and permission is granted to replace the street pavement.

4. When temporary crushed stone or chert surface is considered by the Engineer to be sufficient surface for gravel pavement, the surface shall be graded smooth and to an elevation that will make the final permanent surfacing level with the adjacent surfacing that was undisturbed.

B. Pavement Replacement:

1. Replace and repave all street and roadway pavement from edge of pavement to edge of pavement as shown on the Exhibit “A”, Detail G-7, Type III Pavement Replacement Detail herein. Replace driveways, sidewalks, and curbs with the same material, to nearest existing

undisturbed construction joint and to the same dimensions as those existing.

2. If the temporary crushed stone or chert surface is to be replaced, the top 6-inches shall be removed and the crushed stone surfacing for unpaved streets or the base for the bituminous surface shall be placed.

3. Following this preparation, the chert or crushed stone base shall be primed with a suitable bituminous material and surfaced with the proper type of bituminous surface treatment.

4. Where the paved surface is to be replaced with asphaltic concrete pavement, concrete pavement or with a concrete base and a surface course, the temporary chert or crushed stone surface and any necessary backfill material, additional existing paving and new excavation shall be removed to the depth and width shown on the Drawings. All edges of the existing pavement shall be cut to a straight, vertical edge. Care shall be used to get a smooth joint between the old and new pavement and to produce an even surface on the completed street. Concrete base slabs and crushed stone bases, if required, shall be placed and allowed to cure for three days before bituminous concrete surface courses are applied. Expansion joints, where applicable, shall be replaced in a manner equal to the original joint.

5. Where driveways or roadways, constructed of specialty type surfaces, e.g., brick or stone are disturbed or damaged, these driveways and roadways shall be restored utilizing similar materials. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition. Special surfaces shall be removed and replaced to the limits to which they were disturbed.

C. Pavement Resurfacing:

1. After all pipe line installations are complete and existing pavement has been removed or milled from edge of pavement to edge of pavement, apply tack coat and surface course as specified.

2. Resurfacing limits shall be perpendicular to the road centerline. The limits of resurfacing shall be 10 feet beyond the edge of the pavement replacement on the main road being resurfaced.

3. Where pavement damaged with potholes, the Contractor shall remove all existing loose pavement material and fill the hole with black base, as specified, to the level of the existing pavement.

D. Pavement Striping: Pavement striping removed or paved over shall be replaced with the same type, dimension, and material as original unless directed otherwise by the Engineer.

E. Installation of Traffic Plates: Following completion of sewer works including backfilling but prior to replacement of pavement, steel plates shall be used to temporarily carry vehicular traffic as follows:

1. All Steel plates shall meet ASTM structural specifications having "A36" designation with minimum yield stress of 36 ksi (ksi = kilopounds per square inch).

2. Asphaltic patching material (cold mix) shall be used to secure the steel plate around its edges. Alternatively, all sides of the plate or plates must be secured to the ground surface with A.R.E.A. standard railroad spikes. No spikes shall be left lying on the highway.

3. Trench must be backfilled to within eight (8) inches from top of existing pavement prior to placing the steel plate.

4. No plate is allowed over a trench having a width greater than 48 inches when adequate soil conditions are present. When the trench is greater than 48 inches, the entire lane containing the trench shall be closed. Before closing a lane, a "Lane Closure Permit" must be obtained from the City of Atlanta, Department of Public Works, Bureau of Traffic and Transportation. At least 24 hours prior notification is required for the "Lane Closure Permit".

5. All necessary warning signs, barricades, and lights shall be adequately provided and placed for the safety of the public and in full conformity with the latest edition of the MUTCD at no additional cost to the City. Before closing a "Lane Closure Permit" must be obtained from the City of Atlanta. The Department of Public Works, Bureau of Traffic and Transportation must be notified at least 24 hours in advance.

6. The width of a trench is measured normal to the length of the trench. The largest reading of the measurements is the determining factor for width. For a series of steel plates on any continuous trench, all plates must have the same thickness.

7. Trench must be fully covered with a minimum of twelve (12) inches of asphalt taper on all sides of the plate.

8. Upon the completion of the work, the existing surface shall be cleaned and pavement restored to the City of Atlanta standards.

3.04 SIDEWALK, CURB, AND GUTTER REPLACEMENT

A. Construction:

1. All damaged concrete sidewalks, curbs, or gutters shall be replaced.

2. See Section 02530 for concrete walk construction.

3. See Section 02532 for concrete curb and gutter construction.

4. When a section is removed, the existing sidewalk, curb, or gutter shall be cut to a neat line, perpendicular to both the centerline and the surface of the concrete slab. Existing concrete shall be cut along the nearest existing construction joints; if such joints do not exist, the cut shall be made at minimum distances shown on the Drawings.

5. Existing concrete sidewalks, curbs, and gutters that have been cut and removed for construction purposes shall be replaced with the same width and surface as the portion removed. Sidewalks shall have a minimum uniform thickness of 4-inches. The new work shall be neatly jointed to the existing concrete so that the surface of the new work shall form an even, unbroken plane with the existing surfaces.

6. The subgrade shall be formed by excavating to a depth equal to the thickness of the concrete, plus 2-inches. Subgrade shall be of such width as to permit the proper installation and bracing of the forms. Subgrades shall be compacted by hand tamping or rolling. Soft, yielding or unstable material shall be removed and backfilled with satisfactory material. Place 2-inches of porous crushed stone under all sidewalks, curbs, and gutters and compact thoroughly, then finish to a smooth, unyielding surface at proper line, grade, and cross-section.

B. Joint for Curbs and Gutters:

1. Joints shall be constructed to match existing and as specified in Section 02532.

2. Expansion joints shall be required to replace any removed expansion joints or in new construction. Expansion joints shall be true and even, shall present a satisfactory appearance, and shall extend to within 1/2-inch of the top of finished concrete surface.

C. Finishing:

1. Strike off the surface with a template and finish the surface with a wood float using heavy pressure, after which, contraction joints shall be made and the surface finished with a wood float or steel trowel.

2. Finish the face of the curbs at the top and bottom with an approved finishing tool of the radius indicated on the Drawings.

3. Finish edges with an approved finishing tool having a 1/4-inch radius.

4. Provide a final broom finish by lightly combing with a stiff broom after troweling is complete.

5. The finished surface shall not vary more than 1/8-inch in 10 feet from the established grade.

D. Driveway and Sidewalk Ramp Openings:

1. Provide driveway openings of the widths and at the locations directed by the Engineer.

2. Provide sidewalk ramp openings in conformance with the applicable regulations and as directed by the Engineer.

3. Concrete shall be suitably protected from freezing and excessive heat. It shall be kept covered with burlap or other suitable material and kept wet until cured. Provide necessary barricades to protect the work. All damage caused by people, vehicles, animals, rain, the Contractor's operations and the like shall be repaired by the Contractor, at no additional expense to the City.

3.05 MAINTENANCE

A. The Contractor shall maintain the surfaces of roadways built and pavements replaced until the acceptance of the Project. Maintenance shall include replacement, scraping, reshaping, wetting, and re-rolling as necessary to prevent raveling of the road material, the preservation of reasonably smooth surfaces and the repair of damaged or unsatisfactory surfaces, to the satisfaction of the Engineer. Maintenance shall include sprinkling as may be necessary to abate dust from the gravel surfaces.

3.06 SUPERVISION AND APPROVAL

A. Pavement restoration shall meet the requirements of the regulatory agency responsible for the pavement. Obtain agency approval of pavement restorations before requesting final payment.

B. Obtain the Engineer's approval of restoration of pavement, such as private roads and drives that are not the responsibility of a regulatory agency.

C. Complete pavement restoration as soon as possible after backfilling.

D. Failure of Pavement: Should any pavement restoration or repairs fail or settle during the life of the Contract, including the bonded period, promptly restore or repair defects.

E. Prior to acceptance and approval of any asphaltic concrete binder and/or topping which is installed for the purpose of City maintenance, a representative of the City of Atlanta's Department of Traffic and Transportation may require one or all of the following tests: 1) coring, 2) extraction, 3) compaction, 4) density. The frequency and location of these tests will be left up to the discretion of the Inspector/Engineer. Testing shall be paid for separately by the City directly to the testing laboratory.

3.07 CLEANING

A. The Contractor shall remove all surplus excavation materials and debris from the street surfaces and rights-of-way and shall restore street, roadway, or sidewalk surfacing to its original condition.

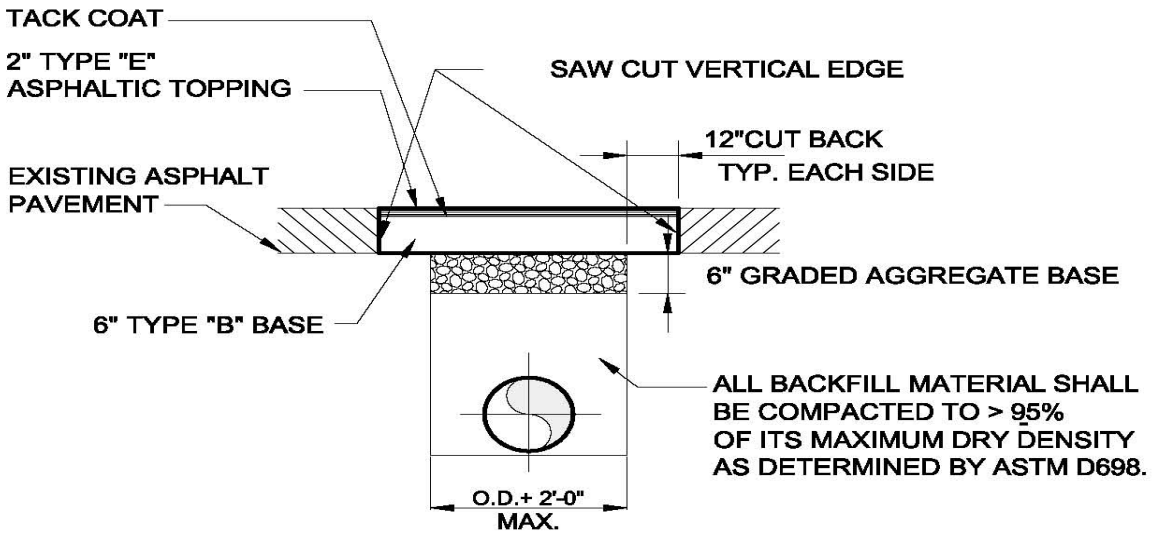
3.08 TRAFFIC CONTROL

A. Refer to Specification Section 01500: Temporary Control of Construction Operations for requirements.

ATTACHMENT A

STANDARD DETAILS

Attachment A



ASPHALT PAVEMENT

NOTE: PAVEMENT REPLACEMENT SHALL BE INSTALLED IN ACCORDANCE WITH GEORGIA DOT STANDARD SPECIFICATIONS

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City of Atlanta Department of Public Works	STANDARD DETAILS	
	TYPE III PAVEMENT REPLACEMENT	DATE : NOV 2004 SCALE : NONE DETAIL NO. G-7

END OF SECTION

SECTION 02730

Sewers and Accessories

PART 1 – GENERAL

1.01 SCOPE

A. This Section describes products to be incorporated into sewers and accessories and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.

B. General: Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. Latest revisions of all standards are applicable.

1.02 QUALIFICATIONS

A. If requested by the Engineer, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

1.03 SUBMITTALS

A. If required by the City or Engineer, complete product data and engineering data shall be submitted to the Engineer in accordance with the requirements of General Condition Section 28 of the Contract Documents.

1.04 TRANSPORTATION AND HANDLING

A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.

B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front loader. Do not use material damaged in handling.

C. Lined pipe shall be handled and transported to prevent damage to linings.

1.05 STORAGE AND PROTECTION

A. Make arrangements for the use of suitable storage areas for piping and other materials required for the Work.

B. Stored materials shall be kept safe from damage. The interior of all pipes, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.

C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated “bell, plain end,” “bell, plain end.” At least two rows of timbers shall be placed between tiers and chocks, affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipes in adjacent tiers.

D. Store joint gaskets in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

E. PVC pipe and fittings shall not be stored in direct sun light.

1.06 QUALITY ASSURANCE

A. Product manufacturers shall provide the Engineer with written certification that all products furnished comply with all applicable provisions of these Specifications.

B. If ordered by the Engineer, each pipe manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of five days during initial pipe installation.

C. Upon request by the Engineer, the Contractor shall furnish samples for material tests by the City’s independent laboratory demonstrating compliance with this Specification to verify the required physical properties and characteristics of supplied materials. The City shall pay for tests on pipe samples that meet specification requirements. Contractor shall pay for failed tests and re-testing of failed materials.

PART 2 – PRODUCTS

2.01 DUCTILE IRON PIPE (DIP)

A. Ductile iron pipe shall be utilized where shown on the Drawings or directed by the Engineer.

B. Ductile iron pipe shall be manufactured in accordance with AWWA C151. All pipes, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipes shall have a minimum pressure rating as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified, or shown on the Drawings. Pipe wall thickness shall be determined based on dead loads indicated on the Drawings and the anticipated live loads, assuming a minimum HS 20 live load.

Pipe Sizes (inches)	Pressure Class (psi)
4 - 12	350
14 - 20	250
24	200
30 - 60	150

C. Fittings and Accessories:

1. Fittings shall be ductile iron and shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53, with a minimum rated working pressure of 250 psi.

2. Flanged elbow fittings shall be ANSI pattern using short radius elbows, except where noted differently on the Drawings. Special fittings, ductile iron wall pipes and sleeves shall conform to the dimensions and details as shown on the Drawings.

D. Joints for Ductile Iron Pipe and Fittings:

1. General:

a. Joints for ductile iron pipe and fittings shall be mechanical joints, restrained, flanged or push-on joint as specified herein or in Section 02725.

b. Unless otherwise shown on the Drawings, specified or directed, all ductile iron pipe laid underground shall be joined using push-on type joints.

c. In all cases, gaskets shall be made of material that will not be damaged by the fluid being transported or by the environment in which the pipe is installed.

d. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.

2. Mechanical Joints:

a. Joints shall conform to AWWA C111/ANSI A21.11.

b. Bolts and nuts shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A 242 to the dimensions shown in AWWA C111/ANSI A21.11.

c. Gaskets shall be in accordance with AWWA C111/ANSI A21.11 and shall be constructed of plain rubber.

d. Mechanical joint glands shall be ductile iron.

3. Push-On Joints: Push-on joints and gaskets shall conform to AWWA C111/ANSI A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice such as ACIPCO "Fastite," McWane (Clow) "Bell-Tite," or U.S. Pipe "Tyton" joints.

E. Linings & Coatings: Sewer pipe and fittings shall be cement lined in accordance with ANSI/AWWA C104/A21.4.

F. Polyethylene Encasement: Polyethylene film shall meet the requirements of AWWA C 105.

G. Wall Sleeves and Wall Pipes:

1. Where piping passes through concrete structures, furnish and install wall sleeves unless wall pipes or other provisions are specifically shown on the Drawings. Wall sleeves shall be accurately located and securely fastened into position before concrete is poured.

2. Wall Sleeves:

a. For pipe sizes smaller than 3-inches, wall sleeves shall be steel oversize sleeves furnished with a full circle, integral or continuously welded waterstop collar. The sleeve seal shall be the mechanically expanded, synthetic rubber type. Provide all associated bolts, seals and seal fittings, pressure clamps, or plates necessary to achieve a watertight installation. Sleeves shall extend the full thickness of the concrete. Sleeves and seal shall be Link Seal.

b. For larger pipe sizes, wall sleeves shall be ductile iron mechanical joint wall sleeves. Unless specified or shown otherwise for a specific situation, wall sleeves shall be mechanical joint bell-plain end types with waterstop/thrust collar. The collar shall be capable of withstanding a thrust force caused by a 250 psi dead end load from either direction on that size pipe. Sleeves shall be constructed with studs and mechanical joint retainer gland on the air side of the concrete structure. Provide retainer gland where shown on the Drawings. Where the concrete structure is exposed to dirt on one side and is wet on the other side, construct with studs and glands on the dirt side. Wall sleeves shall be equal to ACIPCO A-10771.

3. Wall Pipes:

a. Wall pipes shall be either ductile iron with integral waterstop/thrust collar or centrifugally cast ductile iron with a continuously welded waterstop/thrust collar. The welded on collar shall be attached to the pipe by the manufacturer. The collar shall be capable of withstanding a thrust force caused by a 250 psi dead end load from either direction on that size pipe. Wall pipes shall be furnished uncoated on the outside and cement lined on the inside. Unless specified or shown otherwise, wall pipes shall be flange end types.

b. Wall pipes shall be cast and/or fabricated and lined in one manufacturer's facilities and delivered to the job site ready for use.

2.02 REINFORCED CONCRETE PIPE (RCP) (Not Used)

2.03 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE (Not Used)

2.04 HDPE PIPE

A. The pipe supplied under this specification shall be high performance, high molecular weight, high-density polyethylene pipe equal to Driscoplex as manufactured by Chevron Phillips Chemical Company. The pipe material shall be Type III, Class C, Category 5, P34 material as described in ASTM D 1248. Minimum cell classification values of the pipe material shall be (3 4 5 4 3 4 c) as referenced in ATSM D 3350. The SDR shall be 17. The fittings supplied under this specification shall be molded from a polyethylene compound having a cell classification equal to or exceeding the cell classification of the pipe supplied under this specification.

B. Physical Properties of Pipe of Pipe Compound:

1. Density: The density shall be 0.941 – 0.957 gms/cm when tested in accordance with ASTM D 1505.

2. Melt Flow: Melt Flow shall be no greater than 0.11 gm/10 min. When tested in accordance with ASTM D 1238 – Condition E.

3. Flex Modulus: Flexural Modulus shall be 110,000 psi to less than 160,000 psi when tested in accordance with ASTM D 790.

4. Tensile Strength at Yield: Tensile strength at yield shall be 3,200 PSI to less than 3,500 PSI when tested in accordance with ASTM D638.

5. ESCR: Environmental Stress Crack Resistance shall be in excess of 5,000 hours with zero failures when tested in accordance with ASTM D 1693 Condition C.

6. Hydrostatic Design: Basic shall be 1,600 psi at 23-C when tested in accordance with ASTM D 2837.

C. Deviations: If a supplier chooses to submit a bid that does not meet all the requirements of this specification, his bid shall include a written description of the deviation with data that shows the magnitude of the deviation and the justification for the deviation from this specification. The decision to accept material deviating from this specification shall be the responsibility of the specifying engineer.

D. Certification: The City or the specifying engineer may request certified lab data to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.

E. Rejection: Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

F. Pipe Dimensions: Pipe supplied under this specification may be iron pipe size (IPS) or ductile iron pipe size (DIPS) as produced by the manufacturer. IPS or DIPS nominal pipe sizes equal to the pipe dimension shown on the Drawings shall be provided for all pipe sizes equal to or less than 12 inches. IPS or DIPS actual inside diameter shall be provided which is equal to or greater than the pipe dimension shown on the Drawings for all pipe sizes greater than 12 inches. The SDR (Standard Dimension Ratio) of the pipe supplied shall be as specified by the Engineer.

G. Color: Material color shall be light gray. Light gray interior color of pipe shall allow easier/better viewing for television inspection.

H. Anti-flotation Measures: Where ground cover for HDPE pipe is less than four feet (4 ft), antiflotation devices are to be installed in order to overcome potential uplifting forces from groundwater. These devices may include, but are not limited to, precast concrete saddles, gravel-filled saddle bag pipeline weights, or cast-in-place anti-flotation collars (per Detail 21 on the Drawings). Wherever such a device is to be installed, the Contractor shall be responsible for performing the necessary calculations to ensure that the pipe will not float AND that the pipe and/or antiflotation device will not be overstressed. The pipe manufacturer's allowable shear stress, compressive stress due to buckling and thermal expansion shall be considered in the calculations. Minimum factor of safety against flotation is 1.5. These calculations shall be submitted with shop drawings for anti-flotation devices when such devices are required.

2.05 HDPE MANHOLES

A. Material: The material used under this specification shall be high performance, high molecular weight, high density polyethylene plastic compound having a cell classification of 334433C or higher. The material must have a proven capacity for sustaining long term stresses (radial loading, ring compressive thrust, bending, buckling, axial strain, axial buckling, and groundwater effects) as quantified under ASTM Test Method D2837 or other applicable testing procedures under ASTM.

B. Appurtenances:

1. Polyethylene Manhole Covers: Polyethylene flat-plate covers shall be designed to withstand light live-loads, such as light equipment and personnel. All manhole covers shall prove to meet this requirement through either physical testing or design calculations. If subject to

repeated vehicular loading, the cover should be capped or cast in concrete.

2. Risers: All riser sections shall be joined by thermal fusion or gasket joints. Where risers are joined by a gasket joint, the joints must meet the requirements of Specification D 3212.

3. Cones: Where gasket joints are required to seal the connection between a manhole cone or top, the gasket joint shall prove to provide an adequate seal against the maximum water-head expected for the joint in question.

4. Antiflotation Devices: Where manhole risers extend below the groundwater level, antiflotation devices are to be installed in order to overcome any foreseen uplifting forces. These devices may include, but are not limited to, anchoring to a concrete slab, or attaching a concrete ring to the base or riser. Wherever such a device is to be installed, the Contractor shall be responsible to perform the necessary calculations to ensure that both the manhole will not float AND that the antiflotation device will not be overstressed. These calculations shall be included with the shop drawing submittals.

5. Pipe Connection: Each HDPE manhole will have a stub for all pipes entering and leaving the chamber. The Contractor shall supply under this section all necessary connections, couplings, etc., to join adjacent pipe to HDPE stub pipe.

2.06 PRECAST CONCRETE MANHOLES AND PRODUCTS

A. Precast Concrete Sections:

1. Precast concrete sections shall meet the requirements of ASTM C 478 or ASTM C 913. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi.

2. Wall thickness shall be as shown on the Drawings.

3. Transition slabs or cones that convert bases larger than four feet in diameter to four foot diameter risers shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the slab.

4. Seal joints between precast sections by means of rubber O-ring gaskets or flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of AASHTO M-198. Sealant shall be pre-formed type with a minimum nominal diameter of 1-inch. Butyl

rubber sealant shall be equal to Kent Seal No. 2 or Concrete Sealants CS202.

5. Each section of the precast manhole shall have not more than two (2) holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers or mortar after installation.

6. Polypropylene plastic manhole steps shall be installed in each section of the manhole in accordance with the City of Atlanta standard details.

B. Brick and Mortar: Brick shall be whole and hardburned, conforming to ASTM C 32 Grade MS. Mortar shall be made of one part Portland cement and two parts clean sharp sand. Cement shall be Type 1 and shall conform to ASTM C 150. Sand shall meet ASTM C 144.

C. Foundations: A prepared foundation shall be placed for all brick structures after the foundation excavation is completed and accepted. Unless otherwise specified, the base shall consist of reinforced concrete mixed, prepared, and placed in accordance with the requirements of Section 03300. The foundation shall be built to the correct elevation and shall be finished to cause the least possible resistance to flowing water.

D. Laying Brick: All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid. All brick shall be laid in freshly made mortar. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it, which can be readily closed by the laying of the brick. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made to squeeze out mortar at the top of the joint. Any bricks that may be loosened after the mortar has taken its set shall be removed, cleaned, and relaid with fresh mortar. No broken or chipped brick shall be used in the face, and no spalls or bats shall be used except where necessary to shape around irregular openings or edges; in which case, full bricks shall be placed at ends or corners where possible, and the bats shall be used in the interior of the course. In making closures, no piece of brick shorter than the width of a whole brick shall be used; and wherever practicable, whole brick shall be used and laid as headers.

E. Joints: All joints shall be slushed with mortar at every course, but slushing alone will not be considered adequate for making an acceptable joint. Exterior faces shall be laid up in advance of backing. Exterior faces shall be

back plastered or pargeted with a coat of mortar not less than ½ -inch thick before the backing is laid up. Prior to pargeting, all joints on the back of face courses shall be cut flush. Unless otherwise noted, joints shall be not less than ¼-inch or more than ½-inch wide and whatever width is adopted shall be maintained uniform throughout the work.

F. Pointing: Face joints shall be neatly struck, using the weather joint. All joints shall be finished properly as the laying of the brick progresses. When nails or line pins are used, the holes shall be immediately plugged with mortar and pointed when the nail or pin is removed.

G. Cleaning: Upon completion of the work, all exterior surfaces shall be thoroughly cleaned by scrubbing and washing down with water and, if necessary to produce satisfactory results, cleaning shall be done with a 5 percent solution of muriatic acid, which shall then be rinsed off with liberal quantities of clean fresh water.

H. Curing and cold weather protection: In hot or dry weather, the brick masonry shall be protected and kept moist for at least 48 hours after laying the brick. Brick masonry work or pointing shall not be done when there is frost in the brick or when the air temperature is below 50 degrees F, unless the Contractor has on the project, ready to use, suitable covering and an artificial heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 60 degrees F for the duration of the curing period.

I. Iron Castings:

1. Cast iron manhole frames and covers shall meet the requirements of ASTM A 48 for Class 30 gray iron and all applicable local standards. All castings shall be tough, close grained, smooth, and free from blow holes, blisters, shrinkage, strains, cracks, cold shots and other imperfections. No casting will be accepted which weighs less than 95 percent of the design weight. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking.

2. Manhole frames and covers shall be as shown on the Standard Details.

3. All frames and covers shall have machined horizontal bearing surfaces.

4. All manholes shall have standard frames and covers except where specifically shown otherwise on the Drawings.

5. Watertight covers shall be bolt-down type and shall be equipped with four 1/2-inch stainless steel bolts and a 1/8-inch red rubber or rubber O-ring gasket. Covers shall be rotatable and interchangeable. Bolt holes shall be bored through so that debris entering the bolt hole will fall into the manhole. Bolt holes shall have the full 360 degree circle within the cover's radius when bored through the cover.

J. Boots: Provide preformed rubber boots and fasteners equal to those manufactured by Kor-N-Seal or Press Seal Gasket Corporation. Boots may be mechanically attached to the manhole or cast into the walls of the manhole.

2.07 MISCELLANEOUS

A. Flexible Adapter Couplings:

1. Couplings for pipe sizes 15-inches in diameter and less shall be elastomeric plastic sleeves designed to connect pipes of dissimilar materials. Adapters shall provide a positive seal against infiltration and exfiltration and remain leakproof and rootproof up to 4.3 psi. The adapter manufacturer shall provide all stainless steel clamps and required accessories.

2. Couplings shall be products equal to Fernco and shall be installed in accordance with the manufacturer's recommendations.

B. Inside Drop Connections:

1. Where a sewer entering an existing manhole is more than 24-inches above the manhole invert, an inside drop inlet shall be constructed to lower the inlet elevation of the sewer to coincide with the invert elevation of the manhole. If required, the manhole invert and bench shall be re-built in conjunction with the installation of the drop connection to ensure a smooth flow path for the incoming sewer drop. The inside drop connection shall be field fabricated with Schedule 80 PVC fittings and piping, or may be shop fabricated with different materials by a specialty manufacturer subject to approval by the Engineer (e.g. molded polyethylene inside drop inlet by GU International). The top fitting of the inside drop connection shall be a tee fitting or a 90-degree bend with a clean out attachment at the opposite end of the incoming flow opening (to facilitate future sewer inspection and/or cleaning). The bottom fitting of the drop shall be a 90-degree bend into the manhole invert, or a plain end may be used where a concrete fillet is constructed to transition flow from the plain end into the manhole invert. All pipe to manhole connections must conform to ASTM

C923. Anchor straps and bolts shall be 304 stainless steel, minimum, with 4 vertical feet maximum spacing (2 straps minimum).

C. Chemical Root Treatment:

1. Chemical Root treatment shall be utilized where indicated to kill invasive roots and to prevent root re-growth in small diameter sewers. Chemical treatment shall be non-carcinogenic, herbicidal type and applied by professional applicator personnel licensed by the Georgia Department of Agriculture. The applicator shall have a minimum of one year experience and having successfully treated a minimum of one hundred thousand lineal feet of sewer main piping in the continental United States of America.

2. Preconditioning or cleaning of the sewer main shall not be required before or after application of chemical root control unless specifically indicated by the Engineer (e.g. to remove large blockages or debris, which may be surcharging the sewer). Root masses do not generally require cutting by mechanical means prior to application of chemical root treatment and shall not be performed unless directed by the Engineer. In such an event, the contractor shall coordinate root cutting with application of the chemical root treatment in accordance with the manufacturer recommendations to meet the desired level of performance stated below.

3. Each treatment application shall progress from the downstream manhole (whenever practical) at such a rate and pressure so as to provide full chemical contact of the entire interior surface of the sewer main while providing penetration of all piping joints, cracks, holes and service connections. The retention time and concentration of the chemical shall be sufficient to kill all roots in the sewer and prevent root re-growth for a period of two years after the application. If re-growth is evident prior to expiration of the aforementioned two-year period, the Contractor shall provide additional chemical root treatment to the satisfaction of the City at no additional cost.

4. Acceptable products are diquat based herbicides equal to those manufactured by Dukes Root Control, Inc.

PART 3 – EXECUTION

3.01 EXISTING UTILITIES AND OBSTRUCTIONS

A. The Contractor shall call the Utilities Protection Center (UPC) (1-800-282-7411) as required by Georgia law (O.C.G.A. §§25-9-1 through 25-9-13) and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site, at least 72 hours (three business days) prior to construction, to verify the location of the existing utilities.

B. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.

1. Provide the required notice to the utility owners and allow them to locate their facilities according to Georgia law. Field utility locations are valid for only ten days after original notice. The Contractor shall ensure, at the time of any excavation that a valid utility location exists at the point of excavation.

2. Expose the facility to verify its true location and grade for a distance of at least 200 feet in advance of pipeline construction to verify its true location and grade. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.

3. Avoid utility damage and interruption by protecting it with means or methods recommended by the utility owner.

4. Maintain a log identifying when phone calls were made, who was called, area for which utility relocation was requested and work order number issued, if any. The Contractor shall provide the Engineer an updated copy of the log bi-weekly, or more frequently if required.

C. Conflict with Existing Utilities:

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed water main does not permit safe installation of the sewer by the use of sheeting, shoring, tying-back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the sewer to avoid horizontal conflicts if the new alignment remains within the available right-of-way or easement and complies with regulatory agency requirements after a written request to and subsequent approval by the Engineer. Where the Engineer does not approve such relocation of the sewer, the Contractor shall arrange to have the utility, main, or service relocated.

2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed sewer does not permit the crossing without immediate or potential future damage to the utility, main, service, or the sewer. The Contractor may change the proposed grade of the sewer to avoid vertical conflicts if the changed grade provides minimum required capacity, maintains adequate cover and complies with regulatory agencies requirements, after written request to and subsequent approval by the Engineer. Where the Engineer does not approve such relocation of the sewer, the Contractor shall arrange to have the utility, main, or service relocated.

D. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

E. Water and Sewer Separation:

1. Sewers should maintain a minimum 10-foot edge-to-edge separation from water mains. Where the sewer crosses a water main, an 18-inch vertical separation shall be maintained where possible. Where possible, a full joint of sewer pipe shall be centered over the water main. Any deviation shall be requested in writing to the Engineer.

2. No water main shall be permitted to pass through or come in contact with any part of a manhole.

F. Installation: The covers of all manholes shall be at least 30” above grade after installation, except in grassed/landscaped or paved areas. After completion of the manhole survey, the contractor shall submit finish grades of all manhole covers and submit with shop drawings.

G. Rock Excavation: When rock is encountered in trenches, it shall be removed to a depth of at least six inches (6”) below the pipe bell, and a width of three inches (3”) on each side of the pipe bell, except for a minimum required trench width of twenty-four inches (24”). Refer to Section 02200 for rock classification and measurement.

3.02 CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS

A. Refer to Specifications Section 01500 – Construction Facilities and Temporary Controls for requirements

3.03 PIPE DISTRIBUTION

A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.

B. No pipe shall be strung further along the route than 1,000 feet beyond the area in which the Contractor is actually working without written permission from the City. The City reserves the right to reduce this distance to a maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.

C. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.

D. No distributed pipe shall be placed inside drainage ditches.

E. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge-to-edge.

3.04 LOCATION AND GRADE

A. The slope shown on a pipeline profile and/or called for in the Specifications is the slope of the invert of the pipe.

B. Prior to clearing and grubbing, construction staking shall be performed.

C. Construction shall begin at the low end of the sewer and proceed upstream without interruption. Multiple construction sites shall not be permitted without written authorization from the Engineer for each site. At a minimum, cut sheets between construction sites shall be submitted and approved before multiple construction sites will be permitted.

D. The Contractor shall be responsible for any damage done to reference points, base lines, center lines and temporary bench marks, and shall be responsible for the cost of re-establishment of reference points, base lines, center lines and temporary bench marks as a result of the operations.

3.05 LAYING AND JOINTING PIPE AND ACCESSORIES

A. Lay all pipe and fittings to accurately conform to the lines and grades established by the Engineer.

B. Pipe Installation:

1. Proper implements, tools and facilities shall be provided for the safe performance of the Work. All pipe, fittings and valves shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to sewer materials and protective coatings and linings. Under no circumstances shall sewer materials be dropped or dumped into the trench.

2. All pipe, fittings and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.

3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe that contains dirt shall be laid.

4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.

5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.

6. It is common practice to lay pipe with the bells facing the direction in which work is progressing; however, it is not mandatory.

7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted.

8. Polyethylene Encasement: For Ductile Iron Pipe, installation of encasement, when directed by the Engineer, shall be in accordance with AWWA C105 and the manufacturer's instructions. All ends shall be securely closed with tape and all damaged areas shall be completely repaired to the satisfaction of the Engineer.

C. Alignment and Gradient:

1. Lay pipe straight in alignment and gradient or follow true curves, where shown on the Drawings, as nearly as practicable. Do not deflect any joint more than the maximum deflection recommended by the manufacturer.

2. Maintain a transit, level and accessories on the job to lie out angles and ensure that deflection allowances are not exceeded.

3. The Contractor shall check the invert elevation at each manhole and the pipe invert elevation at each bell in open cut areas of pipe installation

4. The Contractor shall check the horizontal alignment of the sewer and ground surface elevations at the same schedule as for invert elevations.

D. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible, as determined by the Engineer. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint or as approved by the Engineer.

E. Joint Assembly:

1. Joints shall be assembled in accordance with the manufacturer's recommendations.

2. The Contractor shall internally inspect each pipe joint to insure proper assembly for pipe 30-inches in diameter and larger after the pipe has been brought to final alignment.

3. On reinforced concrete pipe, diameters 30-inches and larger, the Contractor shall fill the voids, on the pipe joint interior, with grout.

F. Cutting Pipe:

1. Cut ductile iron pipe using an abrasive wheel saw.

2. Cut PVC/HDPE pipe using a suitable saw.

3. Remove all burrs and smooth the end before jointing.

4. The Contractor shall cut DIP pipe and bevel the end, as necessary, to provide the correct length of pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location. Only push-on or mechanical joint pipe shall be cut. Plastic and HDPE Pipe shall be cut precisely square.

3.06 SEWER SERVICE CONNECTIONS (Not Used)

3.07 CONSTRUCTION PRACTICES FOR POLYETHYLENE PIPE

A. Handling of Pipe: Pipe shall be stored on clean, level ground to prevent undue scratching or gouging of the pipe. If the pipe must be stacked for storage, such stacking should be in accordance with the pipe manufacturer's recommendations. The pipe should be handled in such manner that it is not damaged by being dragged over sharp objects or cut by chokers or lifting equipment.

B. Repair of Damaged Sections: Segments of pipe having cuts or gouges in excess of 10% of the wall thickness of the pipe shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the butt fusion joining method.

C. Pipe Joining: Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedure shall be capable of meeting all conditions recommended by the pipe temperature, alignment, and fusion pressure.

D. Handling of Fused Pipe: Fused segments of pipe shall be handled so as to avoid damage to the pipe. When lining fused sections of pipe, chains or cable-type chokers should be avoided. Nylon slings are preferred. Care should be exercised to avoid cutting or gouging the pipe.

E. Trenching and Backfill: All trenching and backfill shall be in accordance with Section 02200 and standard details on the Drawings and as indicated below:

1. Trench Construction: The trench and trench bottom should be constructed in accordance with ASTM D 2321 – Section 7.

2. Embedment Material: Embedment materials should be Class I, Class II, or Class III materials as defined in ASTM D 2321 – Section 6. The use of Class IV and/or Class V materials for embedment are not recommended and should be allowed only with the approval of the engineer.

3. Bedding: Bedding of the pipe should be performed in accordance with ASTM D 2321 –Section 8. Compaction should be specified in ASTMD 2321. Deviation from the specified compaction shall be approved by the engineer.

4. Haunching and Initial Backfill: Haunching and initial backfill should be as specified in ASTM D 2321- Section 9 using Class I, Class II, or Class III materials. Materials used and compaction shall be as specified by the engineer. Compaction 85% Standard Proctor Density must be maintained in unpaved areas. Paved areas will require a higher level of compaction in accordance with the pavement design criteria.

5. Special Conditions: ASTM D 2321 – Section 11.2, Minimum Cover for Load Application, Section 11.3, Use of Compaction Equipment and Section 11.4, Removal of Trench Protection, should apply unless directed otherwise by the engineer.

3.08 MANHOLE AND PRECAST CONCRETE PRODUCT CONSTRUCTION

A. Construct manholes as shown on the Drawings.

B. Precast Concrete: Handle sections carefully to prevent cracking or chipping. Provide uniform bedding of the bottom section to prevent uneven loading. Install gaskets and joint sealants in accordance with manufacturer's recommendations to produce a watertight structure.

C. Brick: Bed the bottom and sides of every brick in mortar. Apply a smooth coat of mortar, 3/4-inch thick, on the inside and outside.

D. Pipe Connections: Seal the connection between the pipe and the manhole as follows:

1. Pipe 36-Inch Diameter and Less: Connect pipe to manhole utilizing rubber boots.

2. If rubber boots are damaged, replace Type I boots with a new boot and repair Type II boots by constructing a manhole collar.

3. If preformed openings must be enlarged or altered, or if new openings must be made in the field, minimize the amount of material removed to provide closely matched surfaces for grouting.

E. Inverts: Form channels as shown on the Drawings, rounded, and troweled smooth with brick faces exposed. Maintain consistent grade through the invert.

F. Top Elevations: Build manholes outside of paved areas to 30-inches above finished grade, unless otherwise shown on the Drawings or directed by the Engineer. Build manholes in paved areas to existing grades.

G. Drop Connections: Replace existing manholes that contain drop connections, where required, with a similar drop connection. Construct drop connections of the same materials as the upstream sewer and in accordance with the details shown on the Drawings.

H. Frames and Covers: Unless frame and cover is at grade, the frame shall be cast into the cone section. Covers shall be solid, cast-iron, without ventilation holes.

I. Seal all manhole joints and lift holes, both inside and out, with grout. Between precast sections, this is in addition to joint sealant.

3.09 CONCRETE ENCASEMENT

A. Provide concrete encasement of pipe when directed by the Engineer or to protect the pipe when any one of the following conditions are encountered:

1. Pipe crosses under a creek;

2. The top of the pipe would have less than 30 inches of ground cover;

3. The trench bottom consists of unstable material.

3.10 INSPECTION AND TESTING

A. Clean and test lines before requesting final acceptance. Where any obstruction is met, clean the sewers by means of rods, swabs, or other instruments. When requested by the Engineer, flush out lines and manholes before final inspection. The costs for inspection and testing shall be included in the unit prices for pipe replacement and point repairs.

B. Alignment: Pipe lines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.

C. Watertightness: A watertightness test shall be performed on all new sewers constructed and lined sewers (prior to cutting the liner to reinstate lateral

connections) as indicated below. All visible leaks, including those found via television inspection, shall be repaired.

1. Low-Pressure Air Test: Sewer diameters less than or equal to 24-inches.

   a. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25 feet or less) using inflatable balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.3 psi. After this pressure is reached and the pressure allowed to stabilize (approximately two to five minutes), the pressure may be reduced to 3.5 psi before starting the test. If a 1.0 psi drop does not occur within the test time, then the line has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs, and retest the line. Minimum test time for various pipe sizes and types is as follows:

Nominal Pipe Size, inches	Time (Min/100 feet)	
	VCP, RCP	DIP, PVC, HDPE
6	0.7	5.7
8	1.2	7.6
10	1.5	9.4
12	1.8	11.3
15	2.1	14.2
18	2.4	17.0
21	3.0	19.8
24	3.6	22.8

   b. Required test equipment, including inflatable balls, braces, air hose, air source, timer, rotameter as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi pressure gauge with gradations in 0.1 psi and accuracy of + two percent, shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air-Loc Testing Systems.

c. The Contractor shall keep records of all tests made. Copy of such records will be given to the Engineer or the City. Such records shall show date, line number and stations, operator, and such other pertinent information as required by the Engineer.

d. The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

D. Deflection Test:

1. All PVC pipe gravity sewers.

a. Test PVC and gravity sewer for excessive deflection by passing a mandrel through the pipe. Deflection of the pipe shall not exceed ten percent.

b. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable manufacturing tolerances of the pipe. The mandrel shall have an odd number of legs, or vanes, with a quantity of such equal to or greater than nine. The legs of the mandrel shall be permanently attached to the mandrel. A mandrel with variable sizes shall not be allowed. The mandrel shall be constructed of steel, aluminum or other material approved by the Engineer, and shall have sufficient rigidity so the legs of the mandrel will not deform when pulling through a pipe. The mandrel dimensions shall be checked by the Engineer before use by the Contractor.

c. Excavate and install properly any section of pipe not passing the test. Re-test until results are satisfactory.

d. The test shall be performed twice:

1) Once within the first 30 days of installation

2) Once during final inspection, but no sooner than 30 days after pavement backfill done, at the completion of this contract.

E. Closed Circuit Television: The interior of the gravity sewers shall be subjected to a televised inspection. The audio/video shall provide an audio description of what is being viewed; provide a continuous running footage indicator between manholes; and be prepared in the presence of the City's representative. Prior to Final Acceptance, the City shall be provided with one copy of the TV inspection report and video showing the entire length of gravity sewer being tested. The report shall contain the condition of pipe, type of pipe, depth, location of services, length, type joint, roundness, and distance between manholes. Any pipe found to be cracked, leaking, misaligned, bellied or otherwise defective shall be removed and replaced. CCTV inspection shall conform to the requirements of Section 02752. The post-installation CCTV inspection shall take place as shortly after completion of each section as is feasible, but in no case more than ten (10) calendar days thereafter. The contractor is required to submit the post-installation CCTV videos within ten (10) calendar days of completing the rehabilitation of a segment of the sewer.

All costs associated with the CCTV inspection shall be considered incidental to the pipe installation work and shall be included in the unit prices.

F. Manholes:

1. The costs for vacuum testing of lined and new manholes shall be included in the unit price for the manhole work. Prior to testing manholes for watertightness, all liftholes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced.

2. Vacuum Tests: The manhole, after proper preparation as noted above, shall be vacuum tested prior to or after backfilling. The test head shall be placed at the inside of the top of the cone section and the compression head inflated to 40 psi to affect a seal between the vacuum base and the manhole structure. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time is greater than that specified in the table below. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc.

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS AND DEPTHS			
Depth **(feet)**	**Minimum Test Times with a 4 ft. Diameter**	**Minimum Test Times with a 5 ft. Diameter**	**Minimum Test Times with a 6 ft. Diameter**
8	20	28	33
10	25	33	41
12	30	39	49
14	35	48	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

3.11 PROTECTION AND RESTORATION OF WORK AREA

A. General: Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is started.

1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.

2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.

3. Handwork, including raking and smoothing, shall be required to ensure that the removal of roots, sticks, rocks, and other debris is removed in order to provide a neat and pleasing appearance.

4. The Engineer shall be authorized to stop all work by the Contractor when restoration and cleanup are unsatisfactory and to require appropriate remedial measures.

B. Man-Made Improvements: Protect, or remove and replace with the Engineer's approval, all fences, walkways, mail boxes, pipe lines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the work. Fences crossing the easement shall be gated.

C. Cultivated Growth: Do not disturb cultivated trees or shrubbery unless approved by the Engineer. Any such trees or shrubbery that must be removed shall be heeled in and replanted under the direction of an experienced nurseryman.

D. Cutting of Trees: Do not cut trees for the performance of the work except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage from equipment. Do not store spoil from excavation against the trunks. Remove excavated material stored over the root system of trees within 30 days to allow proper natural watering of the root system. Repair any damaged tree over 3-inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, woodpiles, or trash piles will be permitted on the work site. The Contractor may chip and grind vegetation and spread over the disturbed area if approved by the City.

E. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the project in accordance with the applicable codes and rules of the appropriate City of Atlanta, state and federal regulatory agencies. All debris and rubbish from clearing operations shall be removed from site within one (1) week after cutting.

F. Swamps and Other Wetlands:

1. The Contractor shall not construct permanent roadbeds, berms, drainage structures or any other structures that alter the original topographic features within the easement.

2. All temporary construction or alterations to the original topography will incorporate measures to prevent erosion into the surrounding swamp or wetland. All areas within the easement shall be returned to their original topographic condition as soon as possible after work is completed in the area. All materials of construction and other non-native materials shall be disposed by the Contractor.

3. The Contractor shall provide temporary culverts or other drainage structures, as necessary, to permit the free migration of water between portions of a swamp, wetland or stream that may be temporarily divided by construction.

4. The Contractor shall not spread, discharge or dump any fuel oil, gasoline, pesticide, or any other pollutant to adjacent swamps or wetlands.

END OF SECTION

SECTION 02735

Sewer Service Connections

PART 1 – GENERAL

1.01 SCOPE

A. The work covered by this Section shall consist of installing new sewer service connections and/or performing re-connections, furnishing and installing materials and piping of the size and type shown on the Drawings and specified herein, and furnishing and installing sewer cleanouts on each service pipeline.

B. Where practical, the Contractor is encouraged to use low impact construction techniques, including trenchless technologies such as vacuum excavation, to complete the work covered in this section.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Service connection (lateral) piping shall be PVC or ductile iron material and shall be of the same diameter as the existing service.

B. The sewer cleanouts shall be installed as indicated in the standard detail drawings. Sewer cleanouts will be positioned at the edge of the property on the service line or at the edge of the easement within 5 feet of the sewer main, as directed by the Engineer.

C. Service re-connections associated with replacing sanitary sewer by open cut or horizontal directional drilling shall be made at the top or from the side at an angle of 45 degrees to the sewer line. Connection shall be by means of standard tees or wyes, or as indicated in the Drawings.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Existing services shall be re-connected to sewer pipeline installed as part of the pipeline Work. The slope of the existing service toward the new pipeline shall be maintained at the existing percent slope. Installation of new service connection lines shall be in accordance with Section 02730 – “Sewers and Accessories”. New service connections shall be installed at a minimum slope of one percent (1%) or as specified by the Engineer.

B. Execution of service re-connections associated with CIPP liners is described in Specification Section 02520 – “Cured-in-Place Pipe Liner (CIPP)”.

C. Execution of service re-connections associated with pipe bursting is described in Specification Section 02725 – “Pipebursting Method”.

D. If directed to do so by the Engineer, a two-way cleanout will be installed at the right-of-way or easement boundary on service reconnections in accordance with the detail shown on the drawings. The cleanout shall incorporate all appropriate and necessary couplings to both the service connection and house connection. Excavation for the cleanout and all appropriate and necessary couplings shall be included in the cost of the cleanout.

END OF SECTION

SECTION 02750

Wastewater Flow Control

PART 1 – GENERAL

1.01 SCOPE

A. The objective of flow bypass and/or diversion pumping is to:

1. Maintain an efficient and uninterupted level of service to wastewater collection system users while maintenance or construction operations (including rehabilitation, repair or replacement) are facilitated on the segment or segments being bypassed and/or from which flow is being diverted, within the wastewater collection system

2. Ensure all levels of sewage flow are continuously and effectively handled around the segment or segments of sewer being bypassed and/or from which flow is being diverted by:

a. Ensuring that bypass and diversion pumps are adequately fueled, lubricated and maintained

b. Ensuring backup spare parts are expeditiously applied to the flow bypass and/or diversion pumping system in the event of component breakdown

c. Ensure an emergency backup plan is smoothly implemented in the event of system failure

d. Preventing backup, spillage, flooding or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways, while flow bypass or diversion pumping takes place and ensure that installation, startup and subsequent disassemby of the flow bypass and diversion pumping system is smoothly transitioned

B. When pumps are operating, an experienced bypass/diversion pump maintenance operator/mechanic and/or assistant shall continuously be on site to monitor the operation of the entire bypass/diversion system. The operator/mechanic and/or assistant shall comprehensively, methodically and continuously:

1. Adjust pump speed as appropriate so as not to adversely impact upstream or downstream flow condition levels

2. Check that the effectiveness and security of bulkheads, dams, diaphragms, plugs, valves, weirs, and all other flow control devices are working effectively and according to plan

3. Check the integrity of hoses and couplings along the entire bypass/diversion system

4. Monitor fuel tanks and refuel as necessary

5. Monitor lubrication levels and provide additonional lubrication as

6. Facilitate minor repairs as required

7. Report on potential problems arising

8. Inspect bypass-pumping system at least hourly to ensure that the system is working correctly.

9. Maintain adequate supply of spare parts on site as required.

C. Bypass pumping systems shall include a maximum of 600 lineal feet discharge piping length.

1.02 SUBMITTALS

A. The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor that can demonstrate to the Engineer that the vendor specializes in the design and operation of temporary bypass pumping systems. The vendor shall provide at least three (3) references of projects of a similar size and complexity as this project, which were successfully performed by the vendor's firm within the past three years. The reference shall include the name of the agency, the name of the project, the date of the project, and the agency contact (telephone, fax, and e-mail). The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction. **(Submit at Pre-Construction Meeting)**

B. During the course of the project, the detailed, work-specific Bypass Pumping/Flow Diversion Plan for any bypass utilizing multiple pumps, or a single pump greater than 4" discharge, shall be submitted to the Engineer at least 10 days before required. This plan shall outline all provisions and precautions, to be taken by the Contractor, regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities. The Plan shall also include details of protection of the access and bypass pumping locations

from damage due to the discharge flows, compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed and authorized by the Engineer.

C. The Contractor shall submit two copies of the Flow Bypass Pumping/Flow Diversion Plan, described in Item 1.02(B) above, for each sewer bypass set-up with sufficient detail to show:

1. Staging areas for pumps

2. Sewer plugging method and types of plugs

3. Number, size, material, location, and method of installation of suction piping

4. Bypass pump sizes, capacity, number of each size to be on site and power requirements

5. Calculations for selection of bypass pump size

6. Standby power generator size, location

7. Downstream discharge plan

8. Method of protecting discharge manholes or structures from erosion and damage

9. Thrust and restraint block sizes and locations

10. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill where required

11. Method of noise control for each pump and/or generator

12. Any temporary pipe supports, including rollers and elevated rollers, as well as anchoring required

13. Design plans and computation for access to bypass pumping locations indicated on the drawings

14. Schedule for installation of and maintenance of bypass pumping lines

15. Plan indicating selection location of bypass pumping line locations

16. The Plan shall indicate the means by which flows from service laterals will be accommodated

D. All proposed flow control arrangements, including flow bypass and/or diversion pumping plans for sewers, shall also include an emergency response plan to be followed in the event of a failure of the bypass pumping and/or diversion system. Contractor's emergency response plan shall be in accordance with the City's Emergency Response Plan.

E. The Contractor shall notify the Engineer 24 hours prior to commencing actual flow bypass and/or diversion pumping operations. The Contractor flow control proposal shall be agreed to by the Engineer before the Contractor shall be allowed to commence sewerage bypass pumping and/or diversion.

1.03 RELATED SECTIONS

A. The Work of the following Sections apply to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of Work.

1. Section 02752: Internal Sewer Condition Assessment
2. Section 02511: Preconditioning and Cleaning Manholes and Sewers
3. Section 02757: Sanitary Sewer Point Repair
4. Section 02725: Pipebursting Method
5. Section 02491: Rehabilitation of Sanitary Sewer Manholes

1.04 RESPONSIBILITY FOR OVERFLOWS OR SPILLS

A. It shall be the responsibility of the Contractor to schedule and perform his work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from the sewer system.

B. In the event of overflows caused by the Contractor’s work activities, the Contractor shall immediately take appropriate action in accordance with the City’s Emergency Response Plan (ERP), to contain and stop the oveverflow, clean up the spillage, disinfect the area affected by the spill, and notify the designated Engineer in a timely manner. The Contractor shall prepare his own written Standard Operating Procedure (SOP) for handling and reporting spills, which shall be compatible with the City’s ERP.

C. Contractor will indemnify and hold harmless the City for any fines or third-party claims for personal or property damage arising out of a spill or

overflow that is fully or partially the responsibility of the Contractor, including the legal, engineering and administrative expenses of the City in defending such fines and claims.

PART 2 – PRODUCTS

2.01 PUMPING EQUIPMENT

A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.

B. The Contractor shall provide the necessary stop/start controls for each pump.

C. The Contractor shall include one stand-by pump of each size to be maintained on site for each by pass set up unless otherwise agreed with the Engineer.

D. The Contractor shall design all piping, joints, and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater. The back-up pump, appropriate piping, fuel, lubrication and spare parts shall be incorporated into the bypass arrangement at the site, ready for use in case of breakdown. A bypass “drill” shall be carried out by the Engineer before the bypass arrangement is accepted on all sewers > 12” diameter, at no cost to the City. The drill shall demonstrate the incorporation of all standby equipment to handle flows when the main pump set is switched off. The Engineer’s instructions following the drill shall be adhered to in full at no additional cost to the City.

E. No more than two (2) pump discharge hoses shall be used for the bypass/diversion over the length of the line of segment(s). If the flow exceeds the capacity of 2 “hoses”, then rigid piping shall be used. The rigid piping shall consist of HDPE or steel pipes with suitably pressure rated couplings to withstand twice the maximum system pressure or 50 psi, whichever is greater.

F. Under no circumstances will aluminum “irrigation” type piping or glued PVC pipe by allowed. Discharge hose will only be allowed in short sections and by specific permission from the Engineer.

2.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Bypass pumping systems shall have sufficient capacity to pump a peak flow in the pipes that are being rehabilitated or repaired. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle wet weather peak flows, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the section to be repaired. Bypass pumping system will be required to be operated 24 hours per day.

2. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.

3. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow, up to full available flow, into the work area as necessary for satisfactory performances of work.

4. The Contractor shall make all arrangements for bypass pumping during the time when the main is shut down for any reason. System must overcome any existing force main pressure on discharge.

B. Performance Requirements:

1. It is essential to the operation of the existing sewerage system that there is no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work, and return it to the existing sewer downstream of his work.

2. The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

3. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The contractor will not be

permitted to stop or impede the main flows under any circumstances.

4. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding.

5. The Contractor shall protect water resources wetlands and other natural resources.

PART 3 – EXECUTION

3.01 PLANNING

A. The Contractor shall be solely responsible for planning and executing sewer flow control, bypass, and diversion pumping operations. The Contractor shall be entirely liable for damages to private or public property that may result from his operations and for all cleanup, disinfection, damages, and resultant fines in the event of a spillage, flooding or overflow.

3.02 GENERAL

A. If, during normal rehabilitation work on manholes and sewers, where flow control devices, including flow bypass and diversion pumping have not been deployed, and wastewater flow depth exceeds the workable levels, the rehabilitation work shall be discontinued immediately. Rehabilitation work shall only resume when minimum flow levels prevail– normally between 2:00 am to 5:30 a.m. Under these circumstances, one or more of the following flow control systems shall be deployed at no additional cost to the City:

1. Plugging or blocking

2. High-velocity jet nozzles

3. Bypass and/or diversion pumping

B. Before any flow control arrangement is installed, the Contractor shall arrange to desilt the segment of sewer to be bypassed while still under flow. Subsequent jetting and final cleaning before rehabilitation or repair shall be undertaken while the segment of sewer is bypassed.

C. Precautions:

1. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbances to existing utilities and shall obtain approval of the pipeline locations from the City and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.

2. During all bypass-pumping operations, the Contractor shall protect mains, manholes, and all local sewer lines from damage caused by any equipment. The Contractor shall be responsible for all physical damage to mains, manholes, and all local sewer lines caused by human or mechanical failure.

3.03 PLUGGING OR BLOCKING

A. Insert sewer line plug into the line at a manhole upstream from the manhole or sewer that is to be rehabilitated and tested. For manhole rehabilitation, the plug shall be designed so that a portion of the sewage can be released downstream. During this portion of the operation, shut off or substantially reduce flows so that the manhole can be properly cleaned, prepared, and rehabilitated. Flow shall be shut off as required, to properly rehabilitate the manhole or sewer.

B. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

3.04 FLOW BYPASS AND/OR DIVERSION PUMPING SCHEDULING

A. If the City is operating or maintaining conventional pumping facilities and/or flow bypass and/or diversion pumping in the construction area of the present Contract, the Contractor shall coordinate with the City as necessary to determine and effect optimum working arrangements.

B. The Contractor shall immediately cease bypass and/or diversion pumping when so ordered by the City.

3.05 ENVIRONMENTAL PROTECTION MEASURES

A. During flow bypass and/or diversion pumping, the Contractor is prohibited from allowing any sewage to be dumped, or spilled in or onto the ground or any area outside of the existing wastewater collection system. In addition, due care and attention shall be given to prevent vehicular or pump fuel or lubrication oil to be leaked.

3.06 PIPE RESIDUE

A. When flow bypass and diversion pumping operations are complete, the residual contents of sewage in piping shall be drained into the existing sewer prior to disassembly.

END OF SECTION

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SECTION 02752

Internal Sewer Condition Assessment

PART 1 – GENERAL

1.01 SCOPE

A. It is the intent of this contract to assess the internal structural and service condition of sewers prior to preconditioning or rehabilitation. Assessment will be performed using high-resolution, 360-degree pan and tilt or rotating head with a wide viewing angle lens color camera-CCTV. In those circumstances where depth of flow is too great for CCTV, sonar or a combination of sonar and CCTV shall be used.

B. It is also the intent of this contract to inspect individual sewer lines that have been preconditioned to further assess condition and record findings.

C. It is the responsibility of the Contractor to comply with OSHA regulations, the City of Atlanta's Safety Guidelines, and the City of Atlanta's Confined Space Guidelines as applicable. The Contractor shall provide written documentation that all workers have received the training required under these regulations and guidelines.

D. The form of internal condition assessment that is required as part of this Contract as follows:

1. Sewer inspection – Viewing the sewer ("pull-through") pursuant to investigative work possibly incorporating a radio-sonde transmitter for locating purposes and/or following other operational activity including:

    a. Locating manhole(s) and/or lateral(s) with or without radio-sonde

    b. Sewer preconditioning and cleaning activities

    c. Sewer rehabilitation, including point repairs

    d. Such other similar purposes as may be required by the engineer

    e. Sewer inspection shall be carried out manually or with the aid of CCTV and/or sonar equipment utilizing Pipeline Assessment Certification Program (PACP) version 6.0.2 protocols, to assess overall condition.

3. Service lateral inspection – Assess and document the internal condition of all Connections and Junctions pursuant to investigative work and/or following other operational activity including:

a. Locating lateral(s) with or without radio-sonde

b. Sewer preconditioning and cleaning activities

c. Service lateral rehabilitation, including point repairs

d. Such other similar purposes as may be required by the Engineer

e. Service lateral inspection shall be carried out manually or with the aid of CCTV and/or Sonar equipment, if required by one of the four conditions above, to assess overall condition.

1.02 SUBMITTALS

A. The Contractor shall provide to the Engineer the following information in writing prior to the set deadline, or at the indicated frequency, whichever is applicable.

Type of Submittal	Time/Frequency of Submittal
Experience Record of Contractor and/or Subcontractor(s)	**With the Bid Documents**
Copies of National Association of Sewer Service Companies (NASSCO) certification for all field staff conducting PACP inspections	**With the Bid Documents**
Listing of CCTV and SONAR Equipment	Before the Work Begins
Sample of PACP V.6.0.2 compliant television survey log in PDF format (tabular format)	Before the Work Begins
Sample of PACP V.6.0.2 standardized digital exchange file in MS Access format	Before the Work Begins
Sample of PACP V.6.0.2 compliant video inspection in MP4 (Web optimized) format	Before the Work Begins
1 Copy of CCTV and SONAR findings (1 hard copy of fully detailed PACP logs incorporating a summary statistical breakdown of defects and main findings, 1 electronic copy of PDF reports of fully detailed logs, 1 PACP V.6.0.2 database and external hard drive(s) of video output)	14 days following the Completion of Pipeline Inspection(s)
Daily Logs and Progress Reports	Daily

Confined Space Entry Logs Bi-Weekly

B. Daily reports shall be provided via e-mail to the designated engineer. Daily reports shall be provided no later than 5:00PM on the second day following the survey. Weekly reports shall be provided no later than 5:00PM on the first Monday following the week of the survey.

C. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the contract. The Contractor shall include in his daily record, reference to:

1. Delays: e.g. Dense traffic, lack of information, sickness, labor or equipment shortage

2. Weather: conditions, e.g. rain, etc.

3. Equipment: on site, e.g. specialist cleaning, by-pass equipment, etc.

4. Submittals: to the designated engineer representative

5. Personnel: on site by name, e.g., all labor, Specialist Services, etc.

6. Accident: report, e.g. all injuries, vehicles, etc.

7. Incident: report, e.g. damage to property, property owner complaint, etc.

8. Major defects encountered, including collapsed pipe, if any: e.g. cave-ins, sink holes, etc.

9. Visitors: on site

D. The designated Engineer on site shall certify receipt of the daily record noting any items and adding any observations with reference to claims for payment to the Contractor. The Engineer may at his discretion, for which the Contractor must receive direction in writing, an exception to this requirement for weekly submission of progress rather than for daily submission.

1.03 REQUIREMENTS AND EXTENT OF INSPECTION

A. The Contractor shall inspect pipelines with color pan and tilt CCTV imagery and sonar and or combined color pan and tilt CCTV/Sonar (TISCIT) as specified so as to record all relevant features and to confirm their structural and service condition. Inspections of pipelines shall be carried out in accordance with the reporting format determined by the Engineer. A sample report sheet is attached to this specification (Attachment B) and

includes the recording of both target total length of sewer inspected between manholes as well as actual length inspected.

B. All CCTV/sonar operator(s) responsible for direct reporting of sewer condition shall have a minimum of 3 years previous experience in surveying, processing, and interpretation of data associated with CCTV and sonar inspections. The Contractor shall provide the designated Engineer with written documentation that all CCTV and sonar survey operators meet these experience requirements which shall include a list of projects undertaken as well as client name and telephone number for reference.

C. All approved Contractors will be required to provide certification that they have undergone NASSCO's PACP training prior to undertaking internal condition assessment work in the City of Atlanta. Material, Shape and Lining Coding used throughout the project will conform to PACP version 6.0.2 protocols and are included in the attached listing (Attachment C). General inspection logging requirements are also included with this Section (Attachment D). Training will be carried out at the Contractor's expense. No charge will be levied for the training.

D. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the Contract.

1.04 INSPECTION UNITS

A. The Contractor shall provide sufficient PACP compliant CCTV inspection units and all relevant ancillary equipment, including standby units in the event of breakdown, in order to complete all sewer and manhole inspections as specified. The software and hardware for the electronic capture of the inspection defects and recorded observations must be Version 6.0.2 NASSCO PACP compliant.

1.05 INSPECTION VEHICLE

A. The inspection vehicle shall comprise two totally separate areas. One of these, designated as the viewing area, shall be insulated against noise and extremes in temperature, include the provision for air conditioning, and shall be provided with means of controlling external and internal sources of light in a manner capable of ensuring that the monitor screen display is in accordance with the specification. Seating accommodation shall be provided by the Contractor to enable two people, in addition to the operator, to view clearly the on-site monitor, which shall display the inspection as it proceeds.

B. The working area shall be reserved for equipment, both operational and stored, and no equipment utilized within the sewer shall be allowed to be stored in the viewing area.

C. The Contractor shall allow in the rates and provide at no additional cost, a vehicle when required by the City, together with a driver, to assist with visual reconnaissance surveys and/or inspections. The vehicle shall be suitable for carrying the survey team and laborers and shall be equipped with the following:

1. Equipment for easing and lifting manhole covers.

2. Sewer safety equipment.

3. Road safety equipment.

4. Protective clothing for the survey/inspection teams comprising coveralls, boots, gloves, hard hat etc.

1.06 CCTV INSPECTION AND OPERATIONAL EQUIPMENT REQUIREMENTS

A. The inspecting equipment shall be capable of inspecting a length of sewer up to at least 1500 ft. when entry onto the sewer may be obtained at each end and up to 100 ft. by rodding or up to 750 ft. where a self propelled unit is used, where entry is possible at one end only. The Contractor shall maintain this equipment in full working order and shall satisfy the designated Engineer at the commencement of each working shift that all items of equipment have been provided and are in full working order.

B. Each inspection unit shall contain a means of transporting the CCTV camera and/or sonar equipment in a stable condition through the sewer under survey and/or inspection. Such equipment shall ensure the maintained location of the CCTV camera or sonar equipment when used independently on or near to the central axis of a circular shaped sewer when required in the prime position.

C. Where the CCTV camera and/or Sonar head are towed by winch and bond through the sewer, all winches shall be stable with either lockable or ratcheted drums. All bonds shall be steel or of an equally non-elastic material to ensure the smooth and steady progress of the CCTV camera and/or Sonar equipment. All winches shall be inherently stable under loaded conditions.

D. Each unit shall carry sufficient numbers of guides and rollers such that, when surveying or inspecting, all bonds are supported away from pipe and manhole structures and all CCTV/Sonar cables and/or lines used to measure the CCTV camera's/sonar head location within the sewer are maintained in a taut manner and set at right angles where possible, to run through or over the measuring equipment.

E. Each unit shall carry a range of flow control plugs or diaphragms for use in controlling the flow during the inspection. A minimum of one item of each size of plug or diaphragm ranging from 6 inches to 2 feet diameter inclusive shall be carried.

F. Each inspection unit shall have on call equipment available to carry out the flushing, rodding and jetting of sewers as and when such procedures are deemed to be necessary.

1.07 FIELD SUPERVISION BY CONTRACTOR

A. The Contractor shall maintain on site at all times a competent field supervisor in charge of the inspection, see item 3.1 below. The field supervisor shall be approved in writing by the designated Engineer prior to commencement of Work. Any change of supervision must also be approved in writing by the designated Engineer prior to the change. The field supervisor shall be responsible for the safety of all site workers and site conditions as well as ensuring that all work is conducted in conformance with these specifications and to the level of quality specified.

1.08 APPLICATION OF INSPECTION TYPE

A. The following guidelines concerning the use of CCTV and sonar shall be followed, subject to the review and approval of the designated Engineer:

1. Generally CCTV alone shall be used for internal condition assessment where the depth of flow of sewage is less than 25% of overall sewer diameter at the start of the survey. The Contractor will make an informed decision to continue should the depth of flow increase beyond the 25% level but no greater than 40% of overall sewer diameter at any time throughout the length.

2. Generally CCTV combined with sonar shall be used for internal condition assessment where depth of flow of sewage varies from 25% to 75% of overall sewer diameter for sewers greater than 24-inches in diameter. Where the sewer is less than 24-inches in diameter and depth of flow of sewage exceeds 25% and is less than 75% of overall sewer diameter the designated Engineer shall instruct Contractor to either: (a) continue using CCTV (where depth of flow is only marginally greater than 25% of overall diameter) or (b) use sonar (by damming or plugging the sewer so that depth of flow exceeds 75% of overall diameter).

3. Generally sonar alone shall be used where depth of flow in the sewer exceeds 75% of overall diameter and the level of the flow will be artificially increased, without the risk of flooding, to ensure that the pipe is completely surcharged.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 CLEANING PRIOR TO INTERNAL CONDITION INSPECTION

A. Where required by the City and only when instructed in writing, the Contractor shall clean the sewer prior to internal condition inspection. Cleaning shall be carried out in conformance with Section 02511 – Preconditioning and Cleaning of Manholes and Sewers.

3.02 SEWER CLEANING UNITS AND EQUIPMENT

A. The Contractor shall provide sufficient sewer cleaning units and equipment, including standby units in the event of breakdown, in order to complete cleaning operations as specified.

3.03 CCTV/SONAR – GENERAL

A. CCTV Camera/Sonar Head Prime Position: The CCTV camera/sonar head shall be positioned to reduce the risk of picture distortion. In circular sewers the CCTV camera lens and/or sonar head shall be positioned centrally (i.e. in prime position) within the sewer. In non- circular sewers, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally. In all instances the camera lens/sonar head shall be positioned looking along the axis of the sewer when in prime position. A positioning tolerance of ± 10% of the vertical sewer dimension shall be allowed when the camera is in prime position.

B. CCTV Camera/Sonar Head Speed: The speed of the CCTV camera in the sewer shall not exceed 30 feet per minute for surveys to enable all details to be extracted from the ultimate video recording. Similar or slightly higher speed as agreed by the designated Engineer shall be provided for inspections. The speed of scanning sonar shall be limited to 4 inches per second.

C. CCTV Color Camera: The Contractor shall provide a color pan and tilt camera(s) to facilitate the survey and inspection of all laterals, including defects such as hydrogen sulfide corrosion in the soffit of sewers and benching or walls of manholes over and above the standard defects that require reporting, where required by the designated Engineer. These will be carried out as part of the normal CCTV assessment as the survey or inspection proceeds when instructed by the designated Engineer. A 360˚ rotational scan indicating general condition must be implemented at every 50 feet interval (min.) along sewers, and at manholes and any salient, specified, defect features. The tilt arc must not be less than 225°.

D. Linear Measurement:

1. The CCTV/Sonar monitor display shall incorporate an automatically updated record in feet and tenths of a foot of the footage of the camera or center point of the transducer, whichever unit is being metered, from the cable calibration point. The relative positions of the two center points should also be noted.

2. The Contractor shall use a suitable metering device, which enables the cable length to be accurately measured; this shall be accurate to ±1% or 3 inches whichever is the greater.

3. The Contractor shall demonstrate compliance with the tolerance in Sub-clause 3.7 D.2 is being complied with, using one or both of the following methods in conjunction with a linear measurement audit form which shall be completed each day during the survey:

   a. Use of a cable calibration device

   b. Tape measurement of the surface between manholes

   A quality control form will be completed and submitted by the Contractor depicting the level of accuracy achieved.

4. If the Contractor fails to meet the required standard of accuracy, the designated Engineer shall instruct the Contractor to provide a new device to measure the footage. The designated Engineer retains the right to instruct the Contractor in writing, to re-survey those lengths of sewer first inspected with the original measuring device using the new measuring device.

E. Data Display, Recording and Start of Inspection:

1. At the start of each sewer length being inspected and each reverse set-up, the length of pipeline from zero footage, the entrance to the pipe, up to the cable calibration point shall be recorded and reported in order to obtain a full record of the sewer length. Only one survey shall be indicated in the final report. All reverse set-ups, blind manholes, and buried manholes shall be logged on a separate log. Video digits shall be recorded so that every recorded feature has a correct tape elapsed time stamp. Each log shall make reference to a start and finish manhole unless abandonment took place because of blockage. Manhole number shall be indicated in the remark's column of the detail report.

2. The footage reading entered on to the data display at the cable calibration point must allow for the distance from the start of the

inspection to the cable calibration point such that the footage at the start of the survey is zero.

3. In the case of inspecting through a manhole where a new header sheet must be completed, the footage shall be set at zero with the camera focused on the outgoing pipe entrance.

4. At the start of each manhole length a data generator shall electronically generate and clearly display on the viewing monitor and subsequently on the video recording a record of data in alpha-numeric form containing the following minimum information:

   a. Automatic update of the camera's footage position in the sewer line from adjusted zero

   b. Sewer dimensions

   c. Manhole/pipe length reference numbers

   d. Date of inspection

   e. Road name/location

   f. Direction of inspection

   g. Time of start of inspection

   h. Sewer use (SS-Sanitary Sewer, CB-Combined Sewer, etc)

   i. Material of construction of the pipe

5. The size and position of the data display shall be such as not to interfere with the main subject of the picture.

6. Once the survey of the pipeline is under way, the following minimum information shall be continually displayed:

   a. Automatic update of the camera's footage position in the sewer line from adjusted zero (see Sub-clause A4)

   b. Sewer dimensions in inches

   c. Manhole or pipe segment reference number (PSR). General convention allows USMH number + “T” + DSMH number to be designated PSR.

   d. Direction of survey, i.e., downstream or upstream

7. Correct adjustment of the recording apparatus and monitor shall be demonstrated by use of the test tape or other device approved by the Contractor. Satisfactory performance of the camera shall be demonstrated by the recording of the appropriate test device at the commencement of each day for a minimum period of 30 seconds.

8. Footage and corresponding time elapsed video digit shall be given throughout inspection for all construction features encountered unless otherwise agreed.

9. Where silt encountered is greater than 10 percent of the diameter of the pipe, the depth of silt shall be measured and recorded at approximately 50-foot intervals.

10. Data for a single facility asset will not be split across multiple hard drives. No unrecorded gaps shall be left in the recording of a segment between surveys/inspections as the original video tape.

11. Only segments between manholes on the same sewer reach or basin shall be included on one external hard drive. There shall be no “split surveys” or “split-basins” between external hard drives.

12. All continuous defects shall incorporate a start and finish abbreviation in the log report

F. Coding: Material, Shape, and Lining Coding, and conventions used throughout the project will be NASSCO’s PACP V.6.0.2 protocol. See Attachments to this Section. The CCTV Contractor must ensure that all operators conform to the detailed requirements of the reporting procedure concerning feature description and feature definition.

3.04 CCTV AND SONAR SURVEY DATA SPECIFICATION

A. CCTV Reporting:

1. No later than fourteen days following the completion of a pipeline inspection, Contractor shall submit to the Engineer one hard copy of all details, i.e. PACP CCTV Tabular reports including one external hard drives containing the PACP V.6.0.2 Standard Exchange Database, PACP tabular reports in PDF format, digital photographs and MP4 (Web optimized) videos. The supplied data and information shall remain the property of the City.

2 The report shall be PACP V.6.0.2 Tabular, or equivalent approved by the designated Engineer, and presented on one external hard drive to provide a summary listing of the number and type of features including defects found for each section of pipeline. The report format is shown in the Attachments to this Section. This report sheet shall be accurately and fully adopted in style, format and in detail.

3. When requested, the Contractor shall provide hard copy output or manually completed site PACP V.6.0.2 compliant coding sheets at

the time of the inspection and shall forward copies of these sheets to the designated Engineer, preferably each day, but at least every other day, together with a daily report on progress.

4. Inspection reports shall contain all header information. A summary observation shall be included as a comment in the header indicating the general condition of the segment for which the inspection was required. The detailed section of the report will include coding for the start manhole (AMH), water level (MWL), and where appropriate, finish manhole (AMH) or survey abandoned (MSA) as appropriate, together with all the supplemental information otherwise required for the “survey”.

B. Site Coding Sheets: Each sewer length, i.e. the length of sewer between two consecutive manholes, shall be entered on a separate coding sheet or entered separately electronically. Thus where a Contractor elects to "pull through" a manhole during a CCTV and/or Sonar inspection a new coding sheet shall be started at the manhole "pulled or walked through" and the footage re-set to zero on the coding sheet. Where a length of sewer between consecutive manholes is inspected from each end (due to an obstruction) two coding sheets should be used. Where a length of sewer between two consecutive manholes cannot be inspected or attempted for practical reasons a (complete header) coded sheet shall be made out defining the reason for abandonment. At uncharted manholes a new coding sheet must be started and the footage re-set to zero.

C. Measurement Units: All dimensions shall be in feet and inches. Measurement of sewers shall be to the nearest inch.

D. CCTV Photographs:

1. Photographs shall be taken of all defective laterals and pipeline defects where requested in writing. Where a defect is continuous or repeated the photographs shall be taken at the beginning of the defect and at not less than 10 foot intervals thereafter. Where photographs are not otherwise required a general condition photograph shall be taken not more than 50 feet after the previous photograph.

2. CCTV Photographs must clearly and accurately show what is displayed on the monitor, which shall be in proper adjustment.

3. Photographs must be durable and 3"x5" size and shall be supplied in a suitable album or storage drawer the standard of which shall be to the satisfaction of the designated Engineer.

4. Still photographs shall be durable and clearly identified in relation to the photograph number (cross referenced to the site survey sheet)

street location, sewer dimensions, manhole start and finish numbers, survey direction, footage and date when the photograph was taken.

5. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 14 point, and be type printed in upper case.

6. The annotation shall be positioned so as not to interfere with the subject of the photograph.

7. The Contractor shall provide color photographs using digital camera or such other mutually agreed upon hard copy color image together with electronic copy.

E. Control Sample Photographs and/or External Hard Drives: The designated Engineer may issue a written instruction to the Contractor to provide a sample of the photographs and/or CCTV/Sonar video taken during the contract period which the Contractor shall provide within 5 working days of receiving the written instruction.

3.05 SERVICE LATERAL INSPECTION DATA SPECIFICATION

A. All service line inspections, whether launched from the mainline, the manhole or the cleanout, will follow NASSCO's Lateral Assessment Certification Program (LACP) V.6.0.2 protocol.

B. For service line inspections launched from the mainline during a mainline inspection:

1. Contractors will assess and document the internal condition of all Connections and Junctions using the previously described procedures.

2. A number will be entered into the "Photo No." field that represents a sequential numbering of the services found. The services will be numbered 01, 02, 03, etc. When the inspection is a reverse setup and the number of services has not exceeded 50, the numbering shall begin with 51 on the reverse. (It is unlikely that there will be more than 50 services on the first survey that is abandoned, however, should this occur, numbering shall continue on the reverse with the same sequence begun on the first survey.)

3. The end of the inspection of the service line at the property line shall be entered "MSA", along with the service line number in the "Photo No." column, and the distance to the end of the survey in the "Remarks" column. The "Distance" will also be the same as for the Connection or Junction. When a survey is abandoned, the code

"MSA" shall be used and the reason for the abandonment stated in the "Remarks" column.

4. Measurements shall be taken from the wall of the mainline pipe.

C. For service line inspections conducted from a cleanout (or as a separate inspection launched from the mainline), the inspection shall be recorded as a normal mainline inspection with the following exceptions:

1. When the mainline is inspected or surveyed, all services shall be numbered using a number in the "Photo No." field, as explained above.

2. The "Start Manhole" shall be entered as the upstream manhole followed by "_01", "_02", etc. Where the "_01" corresponds to the service number assigned when the mainline was surveyed.

3. The PipeID (USMH number + "T" + DSMH number) shall be entered as the PSR.

4. The "Address" shall be the address of the house connected by the service line.

5. If the inspection begins at a cleanout, the "Direction" is entered as "D". If the inspection begins from the mainline or the manhole, the "Direction" is entered as "U".

6. "=Service Line=" shall be entered in the "Location Details" field.

3.06 CCTV/SONAR PERFORMANCE

A. Color CCTV/Sonar: All CCTV and/or Sonar work shall use color CCTV/sonar reproduction.

B. CCTV Picture Quality:

1. An approved test device shall be provided and be available on site throughout the Contract, enabling the tests specified in this clause to be checked.

2. The test card shall be Marconi Regulation Chart No. 1 or its approved derivatives with a color bar, clearly differentiating between colors, with no tinting, to show the following: White, Yellow, Cyan, Green, Magenta, Red, Blue, and Black.

3. At the start of each and every working shift, the camera shall be positioned centrally and at right angles to the test card at a distance where the full test card just fills the monitor screen. The Contractor

shall ensure that the edges of the test card castellations coincide with the edges of the horizontal and vertical scan (raster). The card shall be illuminated evenly and uniformly without any reflection. The illumination shall be to the same color temperature as the color temperature of the lighting that recorded for subsequent use by the designated Engineer, the recording time to be at least 30 seconds. The type of camera used is to be identified on the test recording. The recording must show the camera being introduced into the test device and reaching its stop position. Other test devices may be used subject to approval by the designated Engineer. Test recordings shall also include the time and date of the recording. Test recordings shall be delivered to the Engineer on a weekly basis. The test recordings shall be delivered on external hard drives in MP4 (Web optimized) format.

4. The electronic systems, television camera and monitor shall be capable of producing a high resolution color digital inspection record of such quality as to enable the following to be achieved:

C. Shades of Gray: The gray scale shall show equal changes in brightness ranging from black to white with a minimum of five clearly recognizable stages.

D. Color: With the monitor adjusted for correct saturation, the six colors plus black and white shall be clearly resolved with the primary and complementary colors in order of decreasing luminance. The gray scale shall appear in contrasting shades of gray with no tint.

E. Linearity: The background grid shall show squares of equal size, without convergence/divergence over the whole of picture. The center circle shall appear round and have the correct height/width relationship (± 5%).

F. Resolution: All cameras used shall be digital format color CCTV units specifically designed and constructed for use in sewer pipe inspection work. The cameras shall be operable in 100 percent humidity conditions.

G. Color Constancy: To ensure the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure color constancy, generally no variation in illumination shall take place during the survey.

1. The Contractor shall note that the designated Engineer may periodically check both the live and picture color consistency against the color bar. Any differences will require re-survey of the new length or lengths affected, at the Contractor's expense.

H. Playback and Video/External Hard Drive Labeling:

1. Digital recording playback shall be at the same speed that it was recorded. Inspection videos shall be delivered in MP4 (Web optimized) format. External hard drive playback imaging shall be linked to electronic output of alpha-numeric data so that if necessary direct interrogation of database can take place with simultaneous viewing of CCTV/sonar images.

2. The sewer inspection digital record shall be free of steam, fog, vapor, or other headspace distortion that degrades the quality of the picture from the intended purpose of evaluating the sewer for structural and watertight integrity.

3. Each external hard drive shall be labeled by reference to the header record for the survey section completed together with the following information:

   a. Client Name: "City of Atlanta"

   b. Project Name

   c. Contractor's Name

   d. Contractor's logo is optional

   e. Survey date(s)

   f. Survey Method: "CCTV – Internal Sewer Condition Assessment"

   g. CD Volume Label – "XXXXXXYYZZTT", where:

      i. XXXXXX is the Sewershed abbreviation, as provided by the City

      ii. YY is the Company abbreviation, as provided by the City

      iii. ZZ is the unique crew leader initials

      iv. TT is a sequence number maintained for the crew leader

   h. Video Filename(s): Alphanumeric using any convention. Filename is to be included in the header field as specified. Filename is limited to 5 characters (e.g. "00001" to "00004")

I. CCTV Focus/Iris/Illumination: The adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be automatically or remotely operated. The adjustment of focus and iris shall provide a minimum focal range from 6 inches in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer. The illumination must allow an even distribution of the light around the sewer perimeter without the loss of contrast picture, flare out or shadowing.

Camera lighting shall be sufficient for use with digital color inspection cameras and for the manhole and pipe diameters identified in the Contract.

J. Sonar Survey Requirements:

1. Rates shall allow for:

   a. Complete structural and service assessment to the equivalent standard as that obtained through conventional CCTV imagery

   b. The means of attenuating flow, where necessary, to facilitate appraisal of the full sewer cross section

   c. Measurement of flow depth and silt depth.

2. Rates shall allow for continuous output on conventional annotated external hard drive format of all sewers surveyed, supported by complete defect code sheets. Additionally, silt levels shall be assessed as a percentage depth of sewers at 25 foot intervals for each pipeline surveyed. To facilitate this requirement, and in addition, to assist in diametrical measurement particularly where a sewer is deformed and/or where a sewer has suffered hydrogen sulfide corrosion; screen graphic facilities shall be made available to enable measurements to be taken in any position across the diametrical profile of the sewer as the sonar survey proceeds and where specifically directed by the designated Engineer.

3. Where combined CCTV and Sonar imagery is required the output shall display combined CCTV and Sonar images of the sewer being surveyed. The sonar image shall be superimposed on the real CCTV image as a combined operation.

4. Rates shall allow for a comprehensive final report on the findings concerning major defects, including fractures, displaced joints, deformation, corrosion and lateral intrusions, as well as dominant surface features, including encrustation and silt depths.

5. The monitor display resolution shall be a minimum of 512 x 512 pixels. The color palette shall have a minimum of 16 colors with text.

6. The picture update speed shall not compromise compliance with Sub-clause A (1) or result in unsatisfactory picture resolution.

7. The range of resolution shall be ± 1/10 inch.

8. The maximum beam width of sonar energy pulse shall be no greater than 2 degrees from the center of the transducer.

9. The transducer shall be of the continuous scanning type.

K. Contractor's Data Quality Control Procedure:

1. The Contractor shall operate a quality control system, to be approved by the designated Engineer, which will effectively gauge the accuracy of all survey reports produced by the operator.

2. The system shall be such that the accuracy of reporting is a function particularly of:

   a. The number of faults not recorded (omissions).

   b. The correctness of the coding and classification of each fault recorded.

3. The minimum levels of accuracy to be attained under the various survey headings are as follows:

   a. Header Accuracy 95%

   b. Detail Accuracy 85%

L. The Contractor's data quality control program shall include routine outside auditing of the work completed by a qualified subcontractor. The qualified subcontractor shall meet the minimum specified Contract requirements for the performance of the work and shall be approved in writing by the Engineer. The accuracy of the Contractor's data shall be based on the percentage of the data confirmed correct by the subcontractor. The minimum acceptable accuracy of the data shall be 85%. The general sequence of the auditing shall be as follows:

1. The Engineer shall randomly select one day per month, typically in the first week of the month, and the work performed during this day shall be reviewed and/or repeated by the qualified subcontractor.

2. If the work is greater than or equal to 85% accurate, no further outside auditing will be required for the month unless requested by the Engineer at his sole discretion. The cost for this audit is included in the allowances specified in the Bid Form.

3. If the work is less than 85% accurate, the Contractor shall at his own expense repeat and/or correct the work and have the work re-audited by the qualified subcontractor.

4. If this work is still less than 85% accurate, the Contractor shall repeat and/or correct and have the work re-audited, at his own expense, until the work is greater than or equal to 85% accurate.

5. When this re-audited work is found to be greater than or equal to 85% accurate, the Contractor shall have the work of another randomly selected day in the same month reviewed and/or repeated by the qualified subcontractor at the Contractor's own expense.

6. Steps 2 through 5 shall be repeated at the Contractor's own expense until the selected day is 85% accurate on the initial audit.

7. The occurrence of five randomly selected days not achieving 85% accuracy on initial subcontractor review will constitute cause for dismissal.

8. If the Contractor successfully meets the 85% accuracy requirement for the initial randomly selected day for two consecutive months (Step 2 above), the Contractor may subsequently audit one day every other month. The Contractor may continue auditing one day every other month until the initial randomly selected day does not meet 85% accuracy, at which time it must resume auditing one day every month.

M. Data Delivery:

1. All Data should be included within a Folder for each Sewershed.
   Folder Name:
   SEWERSHED_PACP_XYZ_20180801

2. CCTV Database:
   a. The inspection database deliverables will include a Microsoft Access database containing CCTV Inspections per submittal; database files should be named as follows:

      PACP_XYZ_20180801.mdb

   b. Contractor name can be abbreviated, but should be used consistently and special characters should be avoided. Data Delivery Date formatted as YYYYMMDD. The Delivery ID to be used only if multiple files are delivered in a single day.

   c. Contractor should deliver a single MS Access file for PACP deliverable containing all inspection data for the entire SewerShed. Specifically, data from all field crews should be included in one set of database tables.

3. Inspection Video Files:
   The digital video recordings must be delivered in MP4 format and shall document the visual record of the facility inspection. Digital video file naming must be consistent using the following convention:

PipeID_Date of Inspection (YYYYMMDD)_ Sequence number.

23350305601T23350315501_20180801_01.mp4

Note: Sequence number is used when more than one video of the pipe is recorded on the same day (e.g. reversal).

4. Inspection Report Files:
Inspection reports (.pdf format) shall document the overall finding of each inspection. Report file naming must be consistent using the following convention:

PipeID, Inspection Type, Contractor Name, and Date of Inspection (YYYYMMDD) _ Sequence number.

23350305601T23350315501_PACP_XYZ_20480801_01.pdf

Note: Sequence number is used when more than one video of the pipe is recorded on the same day (e.g. reversal).

3.07 COLLAPSED SEWERS/DEFECTIVE MANHOLES

A. Any sewer found with greater than 10% deformation (i.e. collapsed or near to collapse) must be reported to the designated Engineer immediately for remedial action. In the event of emergency phone (404)-624-0751.

B. Any manhole found broken, cracked, with missing covers or surcharged, must be reported to the designated Engineer immediately for remedial action. In the event of emergency phone (404)-624-0751.

C. Any sewer found where the existing conditions pose a threat of personal injury to the public, such as a collapsed sewer with attendant depression to roadway, must be protected by the Contractor until the Engineer arrives at the job site. In the event of emergency phone (404)-624-0751.

D. Any manhole found where the existing conditions pose a threat of personal injury to the public, such as broken, cracked or missing covers or covers found in traveled portions of any sidewalk or roadway must be protected by the Contractor until the Engineer arrives at the job site. In the event of emergency phone (404)-624-0751.

3.08 TRAFFIC CONTROL

A. Refer to Specification Section 01500: Temporary Control of Construction Operations for requirements.

ATTACHMENT A

DEFINITIONS

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DEFINITIONS

Notes:

- Features that are visible in the sewer during surveys/inspections and other key items are defined below.
- Sewer defects are categorized under the following headings: Structural, Service, Protective Lining, and Constructional.
- Normal parts of speech abbreviations apply (e.g., (n) for noun, (v) for verb, etc.)

Sewer Defects - Structural

Angular Joints: Adjacent conduit sections are angularly displaced at the joint.

Break: Pieces of the sewer conduit are noticeably displaced and have moved from the original position.

Crack: Crack line visible on the sewer wall, with the pieces of the wall still in place. The crack may be either longitudinal (i.e., following the longitudinal axis of the sewer), circumferential (i.e., around the periphery of the sewer), or spiral (i.e. helically around the sewer). Cracks are not themselves serious defects, but are indicative of the initial stages of sewer deterioration. Multiple cracks are a combination of both longitudinal and circumferential cracks.

Collapse: Structural integrity of the sewer conduit has been completely lost and deformation is greater than 40 percent. Percentage loss of cross-section is estimated to the nearest 5 percent.

Corrosion: The destruction of a cementitious or metal wastewater component and its material properties, because of a reaction with its surroundings (the sewage environment). Corrosion is usually a defect observable specifically in the soffit, and generally above the springings of the sewer conduit and in the proximity of force main discharges. Four levels of corrosion are identifiable:

- *Light Corrosion* is characterized by a slightly depressed pH (<6.0), and a concrete surface that can be penetrated with a sharp instrument under moderate hand pressure with the removal of some concrete material. The original concrete surface is fully recognizable and aggregate may or may not be exposed.
- *Moderate Corrosion* is characterized by some concrete loss with aggregate slightly exposed, but the original concrete surface is still distinguishable. The surface may have a thin covering of pasty material that is easily penetrated. There is generally a depressed wall pH (<5.0).

- *Severe Corrosion* is characterized by significant measurable concrete loss or active corrosion. Aggregate and, occasionally, reinforcing steel is exposed. The original concrete surface is not distinguishable. The surface is covered with soft, pasty corrosion products where active scouring is not present. There is generally a depressed wall pH (<0.3) indicating active corrosion.

- *Extreme Corrosion* is characterized by corrosion so extensive that the wall of the sewer has been completely corroded and earth can be observed behind the sewer wall.

Normal pH ranges (around 6.0) are applicable. A normal concrete surface is defined as that which cannot be penetrated or removed by a sharp instrument under moderate hand pressure. The surface of the concrete may have biological growth (slime build) and moisture but the concrete is normal and aggregate is not exposed.

Deformation: A measure of the vertical and horizontal reduction or change in cross-section of a sewer as a result of self-weight or external forces. Three levels of deformation are normally reported. These are:

- 0-5 percent deformation is acceptable, may not need structural upgrading, and normally may require periodic monitoring.

- 5-40 percent deformation requires some form of structural enhancement, possibly a lining;

- >40 percent deformation is a collapse condition and the sewer needs replacing.

Brick sewers may have some irregular or misshapen cross-sections built into the original sewer. Plastic pipes can deform without structural defects. Normally a built-in deformation of 6 percent is allowable in plastic sewers.

For inspection purposes, deformation is normally recorded to the nearest 5 percent.

Fracture: Wall of sewer visibly separated along the length and/or circumference of the sewer with the pieces of the sewer wall in place. The fracture may be either longitudinal (i.e., following the longitudinal axis of the sewer), circumferential (i.e., around the periphery of the sewer, or spiral (i.e. helically around the sewer). The sewer may be seen to suffer from some distortion. The defect is indicative of the secondary stage of sewer deterioration and constitutes a more serious problem than a crack. Multiple fractures are a combination of both longitudinal and circumferential fractures.

Hole: Pieces of the sewer conduit have completely dislodged from the pipe wall.

Offset (Displaced) Joint: Adjacent conduit sections are not concentric at the joint. Displacements are recorded as a fraction of the wall thickness of the conduit (t) as follows:

- *slight* - < t
- *medium* - 1 <= t <= 1.5
- *large* - > 1.5 t

Separated (Open) Joint: Adjacent conduit sections are open at the joint. Displacements are recorded as a fraction of the wall thickness of the conduit (t) as follows:

- *slight* - < t
- *medium* - = t
- *large* - > t

Surface Damage: Surface of sewer conduit is damaged by spalling, wear, erosion, or any other deleterious mechanism other than corrosion (see **Corrosion**).

Sewer Defects - Service

Debris: Obstructions in a sewer line, excluding items mechanically attached to the line such as protruding service connections, protruding pipe and joint materials. Percentage loss is normally given to the nearest 5 percent. (See also Silt)

- Debris is normally identified by the following characteristics:
- *Debris.* Pebbles, pieces of concrete, wood chippings, sticks, brick, and other extraneous material that could cause turbulence and/or reduction in hydraulic capacity
- *Ragging*. Paper and sanitary products

Encrustation: Mineral deposits left on the wall or joint of a sewer by the effect of infiltrating groundwater containing dissolved salts. Normally characterized by loss of percentage cross-sectional area.

Ground Water Infiltration: Water entering sewers and manholes via defective joints and connections, broken pipes, fractured manholes, etc., due to the effects of a high ground water table. Various levels of ground water infiltration are identified, namely as follows:

- Stain – No moisture present during the inspection but a watermark indicates water has entered in the past

- Weeper - The slow ingress of infiltration through sewer/manhole joints or structural defects, identified by glistening effect of the water under the influence of survey lighting apparatus

- Dripper - Infiltration characteristically dripping into the wastewater system through sewer/ manhole joints or structural defects

- Runner - Infiltration running into the wastewater system through sewer/manhole joints or structural defects

- Gusher - Infiltration rapidly entering the wastewater system under hydrostatic pressure through sewer/manhole joints or structural defects

Line Deviation: Vertical or horizontal divergence of alignment of sewer conduit line encountered during inspection, also known as "change in direction" or "change in alignment."

Obstruction:An obstruction in the sewer conduit resulting in stoppage of the inspection or survey. Obstructions can be:

- *General*, e.g., shopping cart, ball, or rock
- *Mechanical*, e.g., water main installed through sewer
- *Structural*, e.g., support mechanism such as a pile or tie back anchor
- *Strata*, e.g., rock or stone which has become dislodged and fallen onto the invert

Roots: Intrusion of roots through defects in sewer conduits, laterals, or manholes. Described as fine, medium, or tap roots, depending on severity as follows:

- *Fine roots:* slender or thin fibrous roots that are insufficient to cause an overall reduction in flow capacity
- *Medium roots:* mass of fine roots where cross sectional area lost is 50% or less
- *Tap roots:* individual root strands more than 1/2 inch thick.
- Ball roots: mass of roots more than 50% of the area of the pipe

Silt: Any and all solid or semi-solid materials, including fine and granular material such as sand, grit, gravel and rock, as well as grease, sludge, slime, debris or any other loose material or encrustation lodged in the manhole or sewer.

Water Level: The depth of water at the observed point in the sewer conduit, in percentage to nearest 5 percent.

Sewer Defects - Protective Lining

Blister: A concentrated swelling of the *protective coating* over the host conduit.

Bulge: A concentrated swelling of the *protective liner* over the host conduit.

Degradation: Break down by biological action of the protective liner, protective coating, or host conduit.

Delamination: Separation of internal layers of the protective lining material. Loss of internal bonding, chemical or mechanical.

Detached: Extensive separation of the protective lining material or protective coating from the host conduit.

Missing: Where the sewer conduit has no protective coating or protective lining through the sewer conduit as indicated on as-built drawings, or on job files.

Tear: When the protective lining has become torn.

Weld Failure: The opening up of the weld between adjacent pieces of protective lining due to physical or chemical breakdown.

Wrinkle: The incorporation of a longitudinal or circumferential fold, typically in a CIPP lining due to stretching or excessive material. Normally the wrinkle should not exceed more than 1 percent of diameter for protective linings equal to or greater than 24 inches, and more than 2 percent of diameter for protective linings in sewers less than 24 inches. (Establish using 3-dimensional templates or similar.)

Sewers - Construction

Battens: Anchoring strips used to attach PE, PVC, or HDPE liners to the host sewer conduit (the sewer being treated) or annulus grout. Battens are normally made of plastic or stainless steel.

Buried Manhole: A manhole on a sewer, which is not visible at ground surface. A buried manhole may or may not be designated for assessment.

Chimney: The cylindrical, variable height access portion of the manhole structure. The chimney extends from the top of the corbel above the manhole chamber to the base of the manhole frame, and is used for adjusting the finished level of the manhole frame.

Coal Tar Epoxy:A chemically cured, two component coal tar coating which has been in use since the 1950's. In order to be successful as a coating, the surface preparation has to be of a very high order that is difficult, if not impossible, to achieve in the context of sewer conduits.

Connection: A sewer tap including break-in/hammer tap or saddle connection, of lateral sewer to another sewer.

Construction Exit: A stone-stabilized pad located at any point where traffic will be leaving a construction site to a public right-of-way, street, alley, sidewalk, or parking area.

Corbel or Cone: That portion of a manhole structure that slopes upward and inward from the barrel of the manhole to the frame diameter or required chimney (access shaft).

Corbel refers to the oversailing brickwork that supports the cover and frame. Cone refers to a precast section.

Critical Path Method (CPM): A planning and scheduling technique involving the charting of all events and operations to be encountered in completing a given process, rendered in a form permitting determination of the relative significance of each event and establishing the optimum sequence and duration of operations.

Crown: The external elevation at the top of the sewer conduit (see also **Invert, Soffit**).

Cured-in-Place (CIPP): A pipe rehabilitation system in which the flexible lining (either epoxy resin or polyester resin) impregnated felt is water or air inverted or winched and inverted into an existing sewer and subsequently heat cured. The reformed pipe fits snugly into, and follows closely, the contours of the existing (host) pipe. The work also involves the reconnection of the existing sewer service property connections and television inspection of the lined pipeline.

Designated Manhole (s): Manholes identified by Engineer to be assessed.

Drop Pipe: The pipe that vertically connects the upstream sewer conduit to the invert of the through flow channel in a manhole. The drop pipe is strapped to the inside of the manhole, or surrounded in concrete if immediately outside the manhole.

Float: Float or slack time associated with one chain of activities is defined as the amount of time between earliest start date and latest start date or between earliest finish date and latest finish date for such activities, as calculated as part of the accepted Schedule Submittal.

Flow bypass: The transfer of flow from an upstream section or segment of sewer to the same sewer downstream (generally downstream of the section being rehabilitated) via temporary piping. Generally flow bypass and diversion pumping may be described as the efficient and effective installation and operation of bulkheads, plugs, hoses, piping, and pumps to maintain sewage flow and prevent backup, spillage, flooding or overflow.

Flow diversion: The transfer of sewage from an upstream section or segment of the originating sewer to another sewer. The flow is generally not returned to the originating sewer but may in some cases be transferred to another service area. Generally flow bypass and diversion pumping may be described as the efficient and effective installation and operation of bulkheads, plugs, hoses, piping, and pumps to maintain sewage flow and prevent backup, spillage, flooding or overflow.

Fold and Form Pipe: A pipe rehabilitation system in which the plastic pipe (either PVC or HDPE) is manufactured in folded shape of reduced cross-sectional area and is pulled into an existing sewer and subsequently expanded with pressure and heat. The reformed pipe fits snugly into and follows closely the contours of the existing (host) pipe.

HDPE Liner: The high density polyethylene (HDPE) pipe or sheeting that is used to renovate sewer conduits subject to structural and corrosive defects.

Hobas Pipe: Proprietary Glass Fiber Pipe used for sewer conduit renovation purposes.

Invert: The internal elevation at the bottom of the sewer (see also **Soffit, Crown**).

Joints: The means of connecting sectional lengths of sewer pipe into a continuous (flexible jointed or articulated) sewer line using various types of jointing materials. The number of joints depends on the lengths of the pipe sections used in the specific sewer construction work. See pipe manufactures catalogue.

Junction: A factory-made tap.

Junction Box: A subsurface structure normally constructed in reinforced concrete in which two or more sewer conduits meet.

Lateral: Building or house service connection to sewer or sewer to sewer connection.

Lining: (n) Also termed "insitu lining," is an internal lining material applied to the wall of an existing sewer for structural and/or protective reasons. (v) Active renovation (i.e., by insertion) of a prefabricated lining into an existing sewer.

Manhole: A subsurface structure in which two or more pipes meet, with person access from the ground surface.

Manhole Structure: Reference to and all activities relevant to manhole structures throughout the text shall also be taken to include junction boxes, inspection chambers, drop shafts, sumps, and all other auxiliary structures appurtenant to the sewerage system.

Mapped Manhole: A manhole that appears on the City's sewer system map. A mapped manhole may or may not be designated for assessment.

Cured-In-Place Pipe (CIPP): A system by which a burster unit splits the existing pipe while simultaneously installing a new polyethylene pipe. The new pipe may be of the same size or larger size. The work also involves the reconnection of the existing sewer service property connections and television inspection of the polyethylene pipe.

Raised manhole: A manhole in which the cover and frame are above normal levels above ground. A raised manhole may or may not be designated for assessment.

Schedule of Record: The Schedule of Record will be the Official Project Schedule for this Contract. All updates and/or revisions relating to coordinating the Work, scheduling the Work, monitoring the Work, reviewing the progress payment requests, evaluating time extension requests, and all other objectives shall be made to this Schedule. No other schedule will be recognized for this Contract.

Sewer Inspection: Viewing the sewer pre- or post preconditioning and/or pre-or post rehabilitation with the aid of CCTV and/or sonar equipment, and/or manually, to assess overall condition. No data logging is required.

Sewer Survey: Viewing the sewer with the aid of CCTV and/or sonar equipment, and/or manually, to assess internal structural and/or service condition as well as assess the structural and/or service condition of laterals. Data logging is required.

Soffit: The internal elevation at the top of the sewer (see also **Crown, Invert**).

Stream crossing: A temporary structure installed across a perenial or nonperenial stream or watercourse for use by construction equipment. Stream crossing shall be in accordance to detail in the Contract Arawings and the Georgia Erosion and Sedimentation Act of 1975 and its amendments.

Tap (Connection): Factory tap, break-in/hammer tap or saddle connection of lateral sewer to another sewer.

Through Flow Channel: The channel that passes sewage directly through the (concrete) manhole base from the upstream sewer to the downstream sewer, also called the manhole invert.

T-Lock: HDPE sheeting used specifically for protecting sewer conduits against corrosion.

Unburied Manhole: A manhole on a sewer to be assessed formerly buried below ground surface. An unburied manhole may or may not be designated for assessment

Unmapped Manhole: A manhole not included on the City's sewer system map. An unmapped manhole is also known as an uncharted manhole.

Wet Well: The wet side or inlet side of a wastewater pumping station.

Sewers - General

Abrasion: Hydraulic wear or scour on the wall of a sewer, through-flow channel or manhole wall.

Above Ground Sewer (Aerial Sewer): An unburied sewer (generally a sanitary sewer), supported on piers, pedestals or bents to provide a suitable grade line.

Aggressive: A property of the sewage conveyed that results in accelerated corrosion of the conveying sewer conduit.

Building Sewer: The conduit that connects building wastewater sources to the public or street sewer, including lines serving homes, public buildings, commercial establishments

and industry structures. Referred to also as house sewer, building connection, service connection or lateral connection.

Cleaning: Techniques used to clean sewer lines either hydraulically or mechanically. *Hydraulic cleaning* involves using water, such as water pumped at a high velocity spray and water flowing by gravity or head pressure. Devices include high-velocity jet cleaners, cleaning balls (or pigs) and hinged-disc cleaners. *Mechanical cleaning* includes methods utilizing rodding machines, bucket machines, kites, winch-pulled brushes and wheelbarrows with spades.

Collector Sewer: A sewer located in the public way that collects wastewater discharges through building sewers, and conducts such flows to larger interceptor sewers, lift stations and treatment works.

Combined Sewer: A sewer that is designed to serve as both a sanitary sewer and a storm sewer.

Conduit: A pipe or other opening, buried or above ground, for conveying hydraulic traffic, pipelines, cables or other utilities.

Core Area: That essential part of a sewer network containing critical sewers and other sewers where hydraulic problems are likely to be most severe, and that require detailed definition within a flow simulation model.

Corrosion Rate: The rate (usually an average) at which corrosion of a component of the wastewater network progresses; expressed as though it were linear in units of mdd (millimeters per square decimeter day) for weight change, or mpy (millimeters per year) for thickness changes.

Corrosion Resistance: Ability of a material to withstand corrosion within the wastewater network.

Creep: The dimensional change, with time, of a sewer renovation material (lining) under continuously applied stress after the initial elastic deformation.

Critical Sewers: The major sewers in a wastewater network that would exhibit the most significant consequences in the event of structural collapse.

Critical Soils: Appraisal of the nature of soils surrounding sewers. Soils of *High-Criticality* are composed of silts and sands. Those of *Medium-Criticality* consist of low plasticity clays and gravel. Soils of *Low-Criticality* consist of medium to high plasticity clays and all clays where the sewer was constructed in tunnel.

Deflection: Reduction in vertical diameter and/or distortion in shape of a conduit as a result of self-weight or external forces.

Degradation: Breakdown in chemical resilience of a plastic product.

Effluent: Outflow or discharge from a sewer or wastewater treatment product.

Elastic Modulus: Characteristic of the stress build-up associated with a given strain in a conduit or lining (see also **Flexural Modulus**). Typically a feature of the strength characteristics of lining materials in sewers.

Elongation: The increase in length of a material stressed in tension.

Embrittlement: Loss of ductility of a material, resulting from a chemical or physical change.

Environmental Stress Crackling: The visible manifestation of a material's susceptibility to crack under the influence of specific chemical or mechanical stresses.

Epoxy: Resin formed by the reaction of bisphenol and epichlorohydrin.

Erosion: Deterioration of the surface of a component of the wastewater system resulting from the action of harder material suspended in sewage on the wastewater component.

Exfiltration: The leakage or egress of sewage from the wastewater system into the surrounding area, usually the ground, through leaks in pipes, joints, manholes, or other sewer system structures and components; the reverse of infiltration.

External Structural Condition: Appraisal of a length of sewer between manholes in to identified external forces (e.g., from traffic load if less than 4 feet below highway; ground water pressure if below the water table, etc.) and nature of ground (e.g., soil criticality, chemical inertness, etc.).

Flexural Modulus: The slope of the elastic strain curve defined by flexural load versus resultant strain. A high flexural modulus indicates a stiffer material.

Flexural Strength: The strength of a material in bending expressed as the tensile stress of the outermost fibers at the instant of failure.

Flow Attenuation: The process of reducing the peak flow rate in a sewer system by redistributing the same volume of flow over a longer period.

General Corrosion: Uniform corrosion, usually a phenomenon observed above the flow line in the sewer.

Ground Water Table (Level): Upper surface of the zone of saturation in permeable strata. Of special relevance to sewer survey or inspection if immediately above or below the sewer. The sewer is more susceptible to ground water infiltration if above the sewer. (See also **Ground Water Infiltration**).

Grout: (1) A fluid mixture typically consisting of cement, water and sand that can be poured or pumped easily. (2) Chemical mixtures that have the capability of stopping water infiltration through small holes and cracks in sewers and manholes.

Grouting: (1) The joining together of loose particles of soil in such manner that the soil so joined becomes a solid mass impervious to water. (2) The process of introducing (typically by pumping) a cement and water grout into the annular space between a host pipe and a slipline pipe.

Header: All reference data at the head of the coding sheet, other than sewer condition data, attaching to the sewer being inspected.

Hydraulic Gradient: An imaginary line through the points to which water would arise in a series of vertical tubes connected to the sewer.

Hydrogen Sulfide Corrosion: Hydrogen sulfide corrosion is the attack of cementitious materials caused by the microbiological conversion of sulfates within sewage to gaseous sulfides and then to sulfuric acid. The corrosion causes a reduction in the sewer wall thickness and a loss of structural integrity.

Infiltration: See **Ground Water Infiltration.**

Infiltration/Inflow (I/I): Pertaining to the study and understanding of the undesirable ingress of infiltration and inflow into the wastewater system.

Inflow: The rain-induced water entering the sewerage or wastewater system from areas not intended to drain to the sewerage or wastewater system. Inflow is thus distinguished from infiltration. (See also **Ground Water Infiltration**).

Interceptor Sewer: A sewer that receives flow from collector sewers and conveys the wastewater to treatment facilities.

Internal Condition Grade (ICG): The relative state of the internal service or structural performance of the sewer in relation to specified criteria. In broad structural terms, it is a measure of the sewer's probability to collapse.

Internal Sewer Service Condition: The ability of a length of sewer between manholes to perform its intended function of conveying sewage, determined by the degree of non-structural defects within the sewer.

Man Entry Sewers: Those sewers considered to be large enough for safe manual (physical) inspection, survey and work activities (e.g., manual renovation and repair). Generally considered to be greater than 1,000 millimeters (around 40 inches) in size. Safety considerations are important before contemplating and undertaking such a survey.

Manholes Length, Section or Segment: The length of sewer between two adjacent manholes.

Non-Man Entry Sewers: Those sewers considered to be too small for manual inspection, survey and work activities (e.g., renovation and repair). Generally considered to be less than 1,000 millimeters (around 40 inches) in size. Normally, these sewers are inspected and surveyed using CCTV, and repairs are carried out robotically.

Non-uniform Corrosion: Corrosion that attacks small, localized areas of the sewer, usually resulting in material loss. Characteristic of poorly made non-uniform concrete.

Overflow: (a) The excess water that flows over the ordinary limits of the sewer, manhole, or containment structure. (v) An outlet, pipe, or receptacle for excess water.

Oxidation: Loss of electrons, as when metal goes from the metallic state to the corroded state.

PH: A measure of the acidity or alkalinity of sewage, expressed as the logarithm, base 10, of the inverse of the hydrogen ion concentration (the weight of the hydrogen ions multiplied by the activity coefficient, which is close to unity in most fresh waters and in other waters of relatively low ionic strength). Most aqueous solutions have pH values in the range 0-14, with pure water (which is neutral) having a pH value of 7. Values above or below 7 indicate alkalinity or acidity, respectively.

Pipeline: An alternative definition of a length of sewer that exists as a single branch within the wastewater network. It consists of many pipes and extends from manhole to manhole.

Pipe Sealing: Sealing of existing circumferential pipe crack or pipe joint using grouting materials under air pressure.

Pipe Repair: Repair of fracture, break or longitudinal crack or fracture in a pipeline by manual (in Man entry sewers) or robotic (in Non-man entry sewers) structural repair techniques.

Pitting: Localized corrosion resulting in deeper penetration of the concrete surface in only a few spots.

Pitting Factor: Depth of the deepest pit divided by the average penetration calculated from weight loss.

Sanitary Sewer: A sewer intended to carry only sanitary or sanitary and industrial wastewater from residences, commercial buildings, industrial parks, and institutions.

Scaling: Thin layer of deposit or remnant of sewer material observed during the course of inspection/ survey.

Serviceability of the Sewer or Sewer System: Continued service life with high degree of confidence that failure will not occur during its long-term service.

Sewer: An underground conduit designed to carry wastewater. A sewer can take the form of a pipe or tunnel and can be of many shapes (e.g., circular, ovoid, u-shaped, rectangular, oval, etc.) and materials (e.g., concrete, asbestos cement, truss, clayware, brick, steel, cast iron, etc.). Sewers convey either storm water or wastewater.

Sewer Infiltration: See **Infiltration.**

Sewer Inflow: See **Inflow.**

Sewer Inspection: Viewing the sewer primarily with the aid of sewer CCTV equipment, and or manually, to assess overall condition. No data logging is required. Inspection is normally carried out as an adjunct to other activities in the sewer such as preparatory cleaning or pre/post renovation measures. (See also **Sewer Survey**).

Sewer Structural Condition: Assessment of the structural integrity of the sewer.

Sewer Service Condition: Assessment of the service condition of the sewer, reflecting the sewer conduit's capacity, potential for blockage, and water tightness.

Sewer Springings: The imaginary points on the wall of the sewer at the ends of the horizontal diameter. Normally considered to be the position where the arch, or top half, of the sewer commences.

Sewer Survey: Viewing and appraising the sewer with the aid of:

Internally:

- *Sewer CCTV equipment*, and/or manually to assess internal structural and/or service condition of the sewer (as well as assess the structural and/or service condition and location of laterals). Data logging is required and the depth of flow is not more than 25 percent of the vertical dimension of the sewer;

- *Sewer profiling equipment*, to establish the dimensional configuration of the sewer (including percentage deformation). Flow is normally bypassed;

- *Sonar equipment*, when the sewer is flooded or partially flooded to assess internal structural and/or service condition of the sewer (as well as assess the structural and/or service condition and location of laterals). Data logging is required, though not with the same resolution as with CCTV;

- *A combination of sonar and CCTV equipment,* when the depth of flow is between 25 percent and 75 percent in sewers larger than 18 inches; and/or

- *Thermographic sensor-equipment*, to determine the position of laterals in lined sewers.

Externally:

- Ground probing radar antennae, to assess external conditions (e.g., voids) immediately relating to the sewer;

- Seismic resonance testing equipment, to assess stratification and nature of the ground between the ground surface and the sewer; and/or

- Such other equipment that provides insights into the nature of the sewer and its surrounding conditions.

A sewer survey normally forms the basis of an engineering interpretation of the internal condition of the sewer (see also **Sewer Inspection**).

Springing: See also **Sewer Springing**.

Standard Dimension Ratio (SDR): Ratio of the pipe diameter to wall thickness.

Surcharge: Occurs and is witnessed when the sewer flow exceeds the hydraulic capacity of the sewer line.

Uniform Corrosion: Corrosion that results in an equal amount of material loss over an entire sewer surface

ATTACHMENT B

INTERNAL SEWER CONDITION ASSESSMENT SAMPLE REPORTS

(For use with City of Atlanta Database)

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Tabular Report of PSR 23150205301 X **for** **CITY OF ATLANTA**

Setup 1	**Surveyor** CJBM	**Certificate #** u-707-5390	**System Owner** CITY OF ATLANTA		
Drainage UTC07D1A	**Survey Customer** LAYNE				
P/O # UT07AXCJBM01	**Date** 2018/08/06	**Time** 11:46	**Street** 991 DIMMOCK STREET SW		
City ATLANTA	**Further location details** DIMMOCK ST SW				
Up 23150205301	**Rim to invert** 7.80	**Grade to invert**	**Rim to grade**	**Ft**	
Down 23150218301	**Rim to invert** 15.30	**Grade to invert**	**Rim to grade**	**Ft**	
Use Sanitary	**Direction** Down	**Flow control** Not Controlled	**Media No** 00001		
Shape Circular	**Height** 8	**Width** ins	**Preclean** J	**Date Cleaned** 2018/08/06	
Material Vitrified Clay Pipe	**Joint length** 3.00 **Ft**	**Total length** 290.0 **Ft**	**Length Surveyed** 290.0 **Ft**		
Lining	**Year laid**	**Year rehabilitated**	**Weather** Damp		
Purpose Routine Assessment	**Cat** Not known		**Pressure**		
Additional info AGM 250 UTC07D1A CURED IN PLACE FC-9779 SG3 C	Structural O & M Constructional Miscellaneous				
Location Light Highway					
Project 08-06-18 PACP	**Work Order** (GA18-06)				
Northing	**Easting**	**Elevation**			
Coordinate System	**GPS Accuracy**				

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								23150205301
0.0			MWL	Water Level			5					5%
7.0			TFD	Tap Factory Defective	4.000				10			LIVE/VC FM
32.4			TFD	Tap Factory Defective	4.000				02			LIVE/VC, JDM
39.5			TSA	Tap Saddle Active	4.000				09			LIVE/PVC
57.7			TFA	Tap Factory Active	4.000				10			LIVE/VC
62.2			TSD	Tap Saddle Defective	4.000				03			LIVE/PVC, OVERCUT
82.9			TFA	Tap Factory Active	4.000				02			LIVE/VC
108.6			TFA	Tap Factory Active	4.000				09			LIVE/VC
134.0			TFA	Tap Factory Active	4.000				03			LIVE/VC
147.6			FM	Fracture Multiple					12	09		
159.6			TFA	Tap Factory Active	4.000				09			LIVE/VC
183.4			TSA	Tap Saddle Active	4.000				03			LIVE/PVC
189.1			RFJ	Roots Fine Joint				J	07			
195.3			TFD	Tap Factory Defective	4.000				02			LIVE/VC, B 6
208.2			TFA	Tap Factory Active	4.000				10			LIVE/VC
229.7			RFJ	Roots Fine Joint				J	08	09		
239.9			B	Broken					05	08		
252.5		S01	RFJ	Roots Fine Joint				J	12	12		
253.8			TBI	Tap Break-in Intruding	4.000	1.000			02			CO, REMOVED
259.0			TFA	Tap Factory Active	4.000				09			LIVE/VC
260.1			B	Broken					12	12		
264.3			TFA	Tap Factory Active	4.000				02			LIVE/VC
290.0		F01	RFJ	Roots Fine Joint				J	12	12		
290.0			AMH	Manhole								23150218301
290.0			FH	End of Survey								

290.0 **Ft** **Total Length Surveyed**

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ATTACHMENT C

DEFECT, MATERIAL, SHAPE, AND LINING CODES

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DEFECT CODES SORTED ALPHABETICALLY

ACB	Catch Basin
ACOH	Cleanout House
ACOM	Cleanout Mainline
ACOP	Cleanout Propertyline
ADP	Discharge Point
AEP	End of Pipe
AJB	Junction Box
AM	Meter
AMH	Manhole
AOC	Special Chamber
ATC	Tee Connection
AWA	Wastewater Access Device
AWW	Wet Well
B	Broken
BSV	Broken Soil Visible
BVV	Broken Void Visible
CC	Crack Circumferential
CH2	Crack Longitudinal Hinge, 2
CH3	Crack Longitudinal Hinge, 3
CH4	Crack Longitudinal Hinge, 4
CL	Crack Longitudinal
CM	Crack Multiple
CS	Crack Spiral
D	Deformed
DAE	Deposits Attached Encrustation
DAGS	Deposits Attached Grease
DAR	Deposits Attached Ragging
DAZ	Deposits Attached Other
DB	Displaced Brick
DH	Deformed Horizontal
DI	Dropped Invert
DNF	Deposits Ingressed Fine
DNGV	Deposits Ingressed Gravel
DNZ	Deposits Ingressed Other
DSC	Deposits Settled Compacted
DSF	Deposits Settled Fine
DSGV	Deposits Settled Gravel
DSZ	Deposits Settled Other
DV	Deformed Vertical
FC	Fracture Circumferential

FH2	Fracture Longitudinal Hinge, 2
FH3	Fracture Longitudinal Hinge, 3
FH4	Fracture Longitudinal Hinge, 4
FL	Fracture Longitudinal
FM	Fracture Multiple
FS	Fracture Spiral
GRT	Grout done at Location
GTFJ	Grout Air Test Fail Joint
GTFL	Grout Air Test Fail Lateral
GTPJ	Grout Air Test Pass Joint
GTPL	Grout Air Test Pass Lateral
GTUJ	Grout Air Test Unable Joint
GTUL	Grout Air Test Unable Lateral
H	Hole
HSV	Hole Soil Visible
HVV	Hole Void Visible
ID	Infil Dripper
IG	Infil Gusher
IR	Infil Runner
IS	Infil Stain
ISGT	Intruding Sealing Grout
ISSR	Intruding Sealing Ring
ISSRB	Intruding Sealing Ring Broken
ISSRH	Intruding Sealing Ring Hanging
ISSRL	Intruding Sealing Ring Loose/Poorly Fitting
ISZ	Intruding Sealing Other
IW	Infil Weeper
JAL	Joint Angular Large
JAM	Joint Angular Medium
JOL	Joint Offset Large
JOM	Joint Offset Medium
JSL	Joint Separated Large
JSM	Joint Separated Medium
KD	Buckling Dimpling
KI	Inverse Curvature
KW	Buckling Wall
LD	Alignment Down
LFAC	Lining Failure Abandoned Connection
LFAS	Lining Failure Annular Space
LFB	Lining Failure Blistered
LFBK	Lining Failure Buckled

LFBU	Lining Failure Bulges
LFCS	Lining Failure Connection Cut Shifted
LFD	Lining Failure Detached
LFDC	Lining Failure Discoloration
LFDE	Lining Failure Defective End
LFDL	Lining Failure Delaminating
LFOC	Lining Failure Overcut Connection
LFPH	Lining Failure Pinhole
LFRS	Lining Failure Resin Slug
LFUC	Lining Failure Undercut Connection
LFW	Lining Failure Wrinkled
LFZ	Lining Failure Other
LL	Alignment Left
LLD	Alignment Left Down
LLU	Alignment Left Up
LR	Alignment Right
LRD	Alignment Right Down
LRU	Alignment Right Up
LU	Alignment Up
MB	Missing Brick
MCU	Camera Underwater
MGO	General Observation
MGP	General Photo
MJL	Joint Length Change
MLC	Lining Change
MMC	Material Change
MML	Mortar Missing Large
MMM	Mortar Missing Medium
MMS	Mortar Missing Small
MSA	Abandoned Survey
MSC	Shape or Size Change
MWL	Water Level
MWLS	Water Level Sag
MWM	Water Mark
MYN	Dye Test Not Visible
MYV	Dye Test Visible
OBB	Obstacle Brick
OBC	Obstacle Thru Connection
OBI	Obstacle Intruding Thru Wall
OBJ	Obstacle In Joint
OBM	Obstacle Pipe Material

OBN	Obstacle Construction Debris
OBP	Obstacle External Pipe or Cable
OBR	Obstacle Rocks
OBS	Obstacle Built Into Structure
OBZ	Obstacle Other
RBB	Roots Ball Barrel
RBC	Roots Ball Connection
RBJ	Roots Ball Joint
RBL	Roots Ball Lateral
RFB	Roots Fine Barrel
RFC	Roots Fine Connection
RFJ	Roots Fine Joint
RFL	Roots Fine Lateral
RMB	Roots Medium Barrel
RMC	Roots Medium Connection
RMJ	Roots Medium Joint
RML	Roots Medium Lateral
RPL	Repair Localized Liner
RPLD	Repair Localized Liner Defective
RPP	Repair Patch
RPPD	Repair Patch Defective
RPR	Repair Point Pipe Replaced
RPRD	Repair Point Defective
RPZ	Repair Other
RPZD	Repair Other Defective
RTB	Roots Tap Barrel
RTC	Roots Tap Connection
RTJ	Roots Tap Joint
RTL	Roots Tap Lateral
SAM	Surface Aggregate Missing
SAMC	Surface Aggregate Missing Chemical
SAMM	Surface Aggregate Missing Mechanical
SAMZ	Surface Aggregate Missing Unknown
SAP	Surface Aggregate Projecting
SAPC	Surface Aggregate Projecting Chemical
SAPM	Surface Aggregate Projecting Mechanical
SAPZ	Surface Aggregate Projecting Unknown
SAV	Surface Aggregate Visible
SAVC	Surface Aggregate Visible Chemical
SAVM	Surface Aggregate Visible Mechanical
SAVZ	Surface Aggregate Visible Unknown

SCP	Surface Corrosion Metal Pipe
SMW	Surface Missing Wall
SMWC	Surface Missing Wall Chemical
SMWM	Surface Missing Wall Mechanical
SMWZ	Surface Missing Wall Unknown
SRC	Surface Reinforcement Corroded
SRCC	Surface Reinforcement Corroded Chemical
SRCM	Surface Reinforcement Corroded Mechanical
SRCZ	Surface Reinforcement Corroded Unknown
SRI	Surface Roughness Increased
SRIC	Surface Roughness Increased Chemical
SRIM	Surface Roughness Increased Mechanical
SRIZ	Surface Roughness Increased Unknown
SRP	Surface Reinforcement Projecting
SRPC	Surface Reinforcement Projecting Chemical
SRPM	Surface Reinforcement Projecting Mechanical
SRPZ	Surface Reinforcement Projecting Unknown
SRV	Surface Reinforcement Visible
SRVC	Surface Reinforcement Visible Chemical
SRVM	Surface Reinforcement Visible Mechanical
SRVZ	Surface Reinforcement Visible Unknown
SSS	Surface Spalling
SSSC	Surface Spalling Chemical
SSSM	Surface Spalling Mechanical
SSSZ	Surface Spalling Other
SZ	Surface Other
SZC	Surface Other Chemical
SZM	Surface Other Mechanical
SZZ	Surface Other Unknown
TB	Tap Break-in
TBA	Tap Break-in Active
TBB	Tap Break-in Abandoned
TBC	Tap Break-in Capped
TBD	Tap Break-in Defective
TBI	Tap Break-in Intruding
TF	Tap Factory
TFA	Tap Factory Active
TFB	Tap Factory Abandoned
TFC	Tap Factory Capped
TFD	Tap Factory Defective
TFI	Tap Factory Intruding

TR	Tap Rehabilitated
TRD	Tap Rehabilitated Defective
TRI	Tap Rehabilitated Intruding
TS	Tap Saddle
TSA	Tap Saddle Active
TSB	Tap Saddle Abandoned
TSC	Tap Saddle Capped
TSD	Tap Saddle Defective
TSI	Tap Saddle Intruding
VC	Vermin Cockroach
VR	Vermin Rat
VZ	Vermin Other
WFC	Weld Failure Circumferential
WFL	Weld Failure Longitudinal
WFM	Weld Failure Multiple
WFS	Weld Failure Spiral
WFZ	Weld Failure Other
XB	Collapse Brick Sewer
XP	Collapse Pipe Sewer

HEADER CODES SORTED BY TYPE

Pipe Material Codes:

AC	Asbestos Cement
BR	Brick
CAS	Cast Iron
CT	Clay Tile
CP	Concrete Pipe (non-reinforced)
CSB	Concrete Segments (bolted)
CSU	Concrete Segments (unbolted)
CMP	Corrugated Metal Pipe
DIP	Ductile Iron Pipe
FRP	Fiberglass Reinforced Pipe
GRC	Glass Reinforced Cement
XXX	Not Known
ZZZ	Other
OB	Pitch Fiber (Orangeburg)
PSC	Plastic/Steel Composite
PE	Polyethylene
PP	Polypropylene
PVC	Polyvinyl Chloride
PCCP	Pre-stressed Concrete Cylinder Pipe
RCP	Reinforced Concrete Pipe
RPM	Reinforced Plastic Pipe (Truss Pipe)
SB	Segmented Block
SP	Steel Pipe
TTE	Transite Pipe
VCP	Vitrified Clay Pipe
WD	Wood

Pipe Shape Codes:

A	Arched
B	Barrel
C	Circular
E	Egg Shaped
H	Horseshoe
O	Oval
R	Rectangular
S	Square
T	Trapezoidal
U	U-Shaped
Z	Other

Pipe Liner Codes:

CP	Cured in Place
FF	Fold and Form or Deform/Reform
SN	Segmented Panel
SP	Segmented Pipe
SW	Spiral Wound
ZZ	Other

Pipe Use Codes: **Error! Not a valid link.**

Purpose Codes:

A	Maintenance Related
B	Infiltration/Inflow Investigation
C	Post Rehabilitation Survey
D	Pre-Rehabilitation Survey
E	Pre-Acceptance
F	Routine Assessment
G	Capital Improvement Program Assessment
H	Resurvey
V	Reversal
Z	Not Known

Location:

A	Main Highway - Urban
B	Main Highway - Suburban/Rural
C	Light Highway
D	Easement/Right of Way
E	Woods

F	Sidewalk
G	Parking Lot
H	Alley
I	Ditch
J	Building
K	Creek
L	Railway
M	Airport
Y	Yard
Z	Other

Weather Codes:

1	Dry
2	Heavy Rain
3	Light Rain
4	Snow
5	Saturated
6	Damp
7	Very Dry

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ATTACHMENT D

GENERAL INSPECTION LOGGING REQUIREMENTS

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The following tables identify the minimum data fields required by NASSCO. They also identify data fields that are additionally required by the City of Atlanta to support the required condition analysis and local conditions. Non-required fields are to be populated if applicable to the specific situation and/or provide useful information. NASSCO defined look-up values must be used if applicable.

Sewer Main PACP Inspections (Note: not all NASSCO tables are listed here)

ID	PACP Inspection	NASSCO Required	COA Required	Description
INSPECTIONS Table				
	InspectionID		Y	This field is automatically populated when any inspection information is entered. The number generated must be entered in the InspectionID field of the Conditions table for all conditions recorded during the inspection
1	Surveyed_By	Y		Name of individual conducting survey (3-Character- Contractor Name / Inspector's Name)
1a	Certificate_Number	Y		NASSCO PACP # of Surveyor
2	Owner		Y	Owner of collection system surveyed (COA)
3	Customer			Entity commissioning the survey (Please leave empty)
4	Drainage_Area		Y	Common name of drainage area (example: PTC35; PRC03)
5	Sheet_Number	~~Y~~		Number used to identify individual inspection surveys done within a group (Please leave empty)
6	PO_Number		Y	Contract number (example 780001)
7	Pipe_Segment_Reference			Client provided segment number (UpstreamMH+"T"+DownstreamMH)
8	Date	Y		Inspection Date
9	Time		Y	Time of inspection (military time format)
10	Street	Y		Street Number and Name
10a	City	Y		City name where sewer located
11	Location_Details		Y	Descriptive explanation of sewer location
12	Upstream_MH	Y		Client provided designation for US manhole
13	Up_Rim_to_Invert		Y	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from rim to invert of upstream manhole
14	Up_Grade_to_Invert		Y	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from average grade to invert of upstream manhole
15	Up_Rim_to_Grade		Y	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from rim to average grade of upstream manhole
16	Downstream_MH	Y		Client provided designation for DS manhole
17	Down_Rim_to_Invert		Y	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from rim to invert of downstream manhole
18	Down_Grade_to_Invert		Y	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from average grade to invert of downstream manhole
19	Down_Rim_to_Grade		Y	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from rim to average grade of downstream manhole
20	Sewer_Use		Y	Purpose of sewer
21	Direction	Y		Direction of survey (upstream or downstream)
22	Flow_Control		Y	Type restriction of flow used
23	Height	Y		Diameter of sewer (or height if non-circular) to nearest inch(999) or nearest mm(99999)
24	Width	Y		Width of non-circular sewer to nearest inch(999) or nearest mm(99999)
25	Shape	Y		Type of Pipe Shape
26	Material	Y		Type of Pipe Material
27	Lining_Method			Method of lining (required if lined)
28	Pipe_Joint_Length			Length of pipe joint sections measured to one decimal place whether in feet or meters
29	Total_Length		Y	Distance between the exit of the start manhole and the entrance of the finish measured to one decimal place whether it is feet or meters
30	Length_Surveyed		Y	If the survey is abandoned, enter the actual length surveyed to one decimal place whether it is feet or meters
31	Year_Laid			Year sewer surveyed was constructed

ID	PACP Inspection	NASSCO Required	COA Required	Description
32	Year_Renewed			Year sewer surveyed was renewed
33	Media_Label		Y	Unique identifier for tape/media
34	Purpose			Reason for conducting survey (Please leave empty)
35	Sewer_Category			Importance of sewer, to be provided by client (Please leave empty)
36	Pre-Cleaning	Y		Type of preparatory cleaning conducted prior to survey
36a	Date_Cleaned		Y	Date when sewer was cleaned prior to survey
37	Weather		Y	Weather conditions when survey conducted
38	Location_Code		Y	General description of ground cover of surveyed segment
39	Additional_Info		Y	Supplemental info regarding survey or segment (at minimum enter the Above Ground Measurement when available)
	Reverse_Setup		Y	Specifys that a second survey has been done on the pipe segment--use inspection ID from matching survey
	IsImperial			Used to identify whether units are metric or imperial. Defaults to imperial.
42	PressureValue			Grouting pressure value
40	WorkOrder			Work order or Project reference for Asset Management
41	Project			Project reference for Asset Management
	Northing			Y Coordinate - Latitude at the center point of the Starting Access Point - If value exists, Easting and Coordinate System are also required
	Easting			X Coordinate - Longitude at the center point of the Starting Access Point- If value exists, Northing and Coordinate System are also required
	Elevation			Z Coordinate - Height at the center point of the Starting Access Point
	Coordinate_System			Datum or reference system used for the gps coordinates - If value exists, Northing and Easting are also required
	GPS_Accuracy			Describes degree of accuracy obtained from coordinates
	ReportFileName		Y	COA added field: Name of the inspection report file corresponding to data file
CONDITIONS TABLE			* All fields should be completed as applicable based on defects observed	
	ConditionID	*		This field is automatically populated when any condition information is entered.
	InspectionID	*		Software provided designation for this inspection (THIS FIELD USED TO JOIN TABLES)
	Distance	*		Distance from start of pipe to defect in feet to nearest tenth
	Counter	*		Time into the video of the identified condition, in seconds
	PACP_Code	*		Combination of Group/Descriptor and Modifier/Severity in a single data field
	Continuous	*		Continuous defect number with start (S) and finish (F) records
	Value_1st_Dimension	*		Dimensions of defects to nearest Inch
	Value_2nd_Dimension	*		Used for intrusion of tap or width of non-circular connecting pipe to nearest inch
	Value_Percent	*		Used to express percentage value of defects
	Joint	*		Indicates a defect located near a joint
	Clock_At_From	*		Clock At/From Position of defect/observation
	Clock_To	*		Clock To Position of defect/observation
	Remarks	*		Additional info to describe defect/coding
	VCR_Time	*		Time into the video of the identified condition in HHMMSS format with 0 used as space holder.

ATTACHMENT E

SERVICE LATERAL DOCUMENTATION

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Example from NASSCO's LACP Program:

SEWER, Inc.
1800 Main Avenue
New York, GA 99999

LACP Inspections and Scoring

Surveyed by:	Certificate number:	Owner:	Customer:	Drainage area:	P/O number:	Sheet number:
Peter NASSCO	123456		Orlando NASSCO			

Lateral segment ref.:	Start date/time:	Street:	Building address:
LACP-1	20160831 15:51	5566 Main Street	

City:	Location details:	Pipe segment ref.:	Work order no.:
Orlando		PACP1-2	

Upstream MH No:	Downstream MH No:	Start manhole:	Sewer use:	Direction:	Size:	Material:	Lining method:
MACP1	MACP2		SS	D	6 in.	PVC	

Total length:	Length surveyed:	Year laid:	Media label:	Purpose:	Pre-cleaning:	Date cleaned:	Weather:	Location code:
40.0 ft.	40.0 ft.						1	

Property line:	Clean out:	CO Rim invert:	Tap location:	Project name:	Additional info:
				LACP Test	

Pressure value:	Northing:	Easting:	Elevation:	Coordinate system:	GPS accuracy:

Grade	Structural: Amount of Defects	Segment Grade	Pipe Rating	Quick Rating	Pipe Rating Index	O&M: Amount of Defects	Segment Grade	Pipe Rating	Quick Rating	Pipe Rating Index	Overall: Pipe Rating	Pipe Rating Index
1	0	0				0	0					
2	0	0				0	0					
3	0	0	4	4100	4.00	0	0	0	0000	0.00	4	4.00
4	1	4				0	0					
5	0	0				0	0					

Observations

Distance	Video Ref.	LACP Code	Continuous	S/M/L	Value Inches (mm) 1st	Value Inches (mm) 2nd	%	Joint	Circumferential Location At/From	Circumferential Location To	Rating	Image Ref.	Remarks
0.0 ft.	00:00:57	ACOH						☐	/				
0.0 ft.	00:02:37	MWL					0	☐	/				
20.0 ft.	00:00:09	B						☐	4 / 6		4		
40.0 ft.	00:01:15	AML						☐	/				

SECTION 02757

Point Repair of Sanitary Sewers

PART 1 – GENERAL

1.01 SCOPE

A. This Section describes repairs to sections of existing sanitary sewers that require correction of isolated major defects, misalignments or collapses.

B. External Point repairs include necessary external corrective action by means of open cut trench pipe replacement/renewal construction, both as an independent solution to a specific problem or to facilitate other rehabilitation methods such as pipe-bursting or lining.

C. Internal Point Repairs include necessary internal corrective action using a short length tightly fitting cured-in-place (CIPP) liner for the local repair of an isolated defect or several adjacent defects that can be encompassed within the material length of an internal CIPP point repair within a sanitary sewer pipeline. The liner shall be smooth, hard, strong, chemically inert and free from blemishes.

D. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.

1.02 APPLICABLE REHABILITATION METHODS

A. This specification applies to the following repair methods, varying only in length and purpose of repair as described below.

1. Pipe Blockage External Point Repair - This rehabilitation method is for correcting a major offset, blockage or other type of restriction of a pipeline that would reasonably impede or prohibit pipe-bursting or push-bursting operations. Pipe Blockage Repair includes excavation, maintaining the trench until the new HDPE piping is in place after pipe-bursting, backfill and site restoration.

2. Sanitary Sewer Sag External Point Repair - This rehabilitation method is for correcting a sag in a mainline so that pipe-bursting, horizontal directional drilling or push-bursting may proceed to line and grade. A Sag Repair means correcting a sag in a segment of pipeline where the lowest point of the “Sag” is subject to ponding that is greater than 25% of the diameter of the pipeline. Sag Repair includes excavation, maintaining the trench until the new piping is installed, backfill and site restoration including disposal of all excavated waste material.

3. External Point Repair - This rehabilitation method is for correcting a defect on a mainline that requires excavation. Pipe defect(s) may include collapsed pipe (>10% deformation), severely broken pipe, major dropped joint, major offset joint, or a severely defective service line connection. This type of repair shall include excavation, replacing a section of pipe up to sixteen (16) linear feet in length; replacing up to one (1) service connection, installation of flexible repair couplings or boots as applicable, backfill, disposal and site restoration

   All pipe and fittings furnished for this work must comply with the requirements of Section 02730 of the Contract Documents. The replacement pipe section shall be the same size and material as the existing pipe unless the existing pipe is vitrified clay. In such case, PVC shall be used as the pipe section material unless otherwise directed by the Engineer.

   It is the Contractor's sole responsibility to establish elevation and/or survey controls necessary to attain true line and grade for the replacement pipe section for all External Point Repairs. No abrupt deflections in line or grade will be allowed.

4. Internal CIPP Point Repair - This rehabilitation method is for correcting a defect on a mainline that can be rectified internally. Pipe defect(s) may include multiple cracks, fractures, deformed pipe (<10% deformation), minor dropped joint, minor offset joint, or a minor defective service line connection. This type of repair shall include lining a limited section of pipe up to seven (7) linear feet in length. Several internal point repairs may be installed in a single segment (length of sewer between manholes) to be determined by the Engineer.

   All pipe and fittings furnished for this work shall comply with the requirements of Section 02730 of the Contract Documents.

B. Point repairs are made at specific locations and involve relatively short lengths of sewer. Isolation of affected reaches of sewer, by plugging and/or bypass pumping if required, shall be performed in accordance with Section 02750 of the Contract Documents.

C. After each designated Point Repair has been made, the Contractor will perform a CCTV inspection in accordance with Section 02752. The CCTV video and inspection report will be submitted to the City for review. The cost of the CCTV inspection shall be included in the unit price for the Point Repair. If a repaired joint or section should subsequently prove to be defective, the Contractor shall re-perform the work at no additional cost to

the City and shall also be responsible for the costs of any re-inspection required by the City to document the success of the re-work.

D. Excavation, backfill, resolution of conflicts with other utilities, and miscellaneous work shall conform to the requirements of Sections 02730 and 02200 of the Contract Documents as appropriate.

1.03 SUBMITTALS

A. The Contractor shall submit shop drawings for external point repair pipe material, couplings, CIPP point repair material and delineate staging, traffic control, and access arrangement when the complexity of the repair warrants, as determined by the Engineer and in accordance with Section 01340 of the Contract Documents **(30 Calendar Days before the Point Repair).**

B. All internal CIPP point repair submittals shall comply with the related requirements of Section 02520.

C. Pre installation CCTV inspection reports and videos. Pre installation reports and videos shall be provided no later than 30 calendar days before the point repair installation **(30 Calendar Days before the Point Repair)**.

D. Post installation CCTV inspection reports and videos. Post installation reports and videos shall be provided within 10 calendar days after the point repair and reinstatement of all laterals **(Within 10 Calendar Days of the Point Repair)**.

PART 2 – PRODUCTS

2.01 PIPE AND PIPE FITTINGS

A. All pipe and fittings for external point repairs shall be PVC, reinforced concrete pipe (RCP) or ductile iron pipe (DIP) as specified in Section 02730.

B. All related sections for internal CIPP point repairs, materials, specifications, trial tests, warranty and standards for CIPP point repairs shall comply with the requirements of Section 02520, where applicable with the exception that only epoxy resins shall be used with internal CIPP point repairs.

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall furnish all labor, tools, materials, and equipment necessary for installation and jointing of the pipe. All piping and lining shall be installed in accordance with the Contract Documents in a neat workmanlike manner and shall be set for accurate line and elevation. All piping shall be thoroughly cleaned before installation, and care shall be taken to keep the piping clean throughout the installation.

3.02 PREPARATION

A. Flow Control: Flow control shall be exercised as required to ensure that no flowing sewage comes into contact with sections of the sewer under repair or replacement in accordance with Section 02750 of the Contract Documents.

B. Preconditioning and Cleaning (Manholes and) Sewer – Prior to installation of the CIPP point repair the entire sewer shall be preconditioned and cleaned in accordance with the requirements of Section 02511. Installation of CIPP point repair shall not proceed without the Engineers written permission.

C. The engineers permission to proceed will be contingent on the acceptance of an internal condition assessment video of the prepared sewer to confirm that the sewer is free from all debris and inherent conditions that may adversely affect the smooth introduction of the CIPP point repair into the sewer to be repaired. The internal condition assessment shall accurately portray the position of defects and laterals affected by the proposed remediation. Any lateral introduced into the sewer being treated at the location of the CIPP point repair shall be introduced within the middle third of the repair. Internal condition assessment prior and post lining shall be included in the cost of the repair.

REQUIREMENTS SPECIFIC FOR THE CONSTRUCTION OF EXTERNAL POINT REPAIRS.

3.03 REMOVAL AND REPLACEMENT OF SEWER

A. After the limits of a particular portion of the existing sewer have been established on the ground, operations shall progress generally as follows:

1. Carefully remove or protect surface features in work area. Expose a full section of existing pipe, including the joints at each end. Take adequate precautions not to disturb any other existing underground facilities. Handle all excavated materials as described in Section 02200 of the Contract Documents.

2. That section of pipe to be replaced shall be isolated by plugging and/or bypass pumping as described in Sections 02750 of the Contract Documents, or by any other method proposed by the Contractor and acceptable by the City.

3. After the defect is located and exposed, the defective pipe or fitting shall be removed by cutting each side along lines perpendicular to longitudinal axis of pipe so as to leave "spigot ends" to be connected to replacement pipe and dispose of the existing pipe and concrete encasement, if any.

4. Excavate the trench to a minimum of 8-inches below the proposed pipe bottom, place bedding material in the trench and shape to form continuous uniform support for the pipe barrel.

5. Pipe shall be installed and jointed, normally beginning at its low or outlet end and proceeding upstream, with the bell ends facing upstream toward the direction of flow. Make connections to existing manholes or existing pipe remaining in place. Install wyes or tees, with branches temporarily plugged, to make reconnections to existing service laterals, if any. Complete bedding or encasement and place compacted backfill as necessary to avoid flotation if water should enter the trench. Encasement will only be allowed if the Engineer confirms that future pipe-bursting will not be required.

6. Complete placement and compaction of backfill. For purposes of the external point repair, the material excavated is considered suitable backfill, provided the excavated material meets the requirements of section 02200 for suitable backfill.

7. Restore surface features to at least as good condition as existed before construction began, including landscaping, grass, roadways, driveways and walks.

8. For External Point Repairs only, perform leakage test in accordance with Section 02730.

3.04 EXCAVATION AND BACKFILL

A. The Contractor shall excavate and backfill in accordance with Section 02200 of the Contract Documents. Under no circumstances shall the

Contractor be allowed to remove concrete or asphalt without prior saw cutting. The saw cutting shall be deep enough to produce an even, straight cut.

3.05 LAYING PIPE

A. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall, in general, agree with manufacturer's recommendations. At the time of laying, the pipe shall be examined carefully for defects, and should any pipe be discovered to be defective after being laid, it shall be removed and replaced with sound pipe by the Contractor at his expense.

B. Upon satisfactory completion of the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells, or couplings, shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure shall be exerted on the pipe joints from the trench bottom.

C. Pipe shall be installed in accordance with the manufacturer's recommendation. Before being lowered into the trench, the pipes and accessories shall be carefully examined and the interior of the pipes shall be thoroughly cleaned of all foreign matter and other methods acceptable to the City.

D. Lines shall be laid straight and depth of cover shall be maintained uniform with respect to finish grade, whether grading is completed or proposed at time of pipe installation. No abrupt changes in direction or grade will be allowed.

E. After pipe has been laid, reviewed and found satisfactory, sufficient backfill shall be placed along the pipe barrel to hold the pipe securely in place during the test. No backfill shall be placed over the joints until the test is satisfactorily completed, leaving the exposed joints to view for the detection of visible leaks. Upon satisfactory completion of the test, backfilling of the trench shall be completed.

3.06 INSTALLATION OF PIPE

A. PVC, RCP and DIP shall be installed in accordance with Section 02730.

3.07 PIPE-TO-PIPE CONNECTIONS

A. Pipe-to-pipe connections shall be made in accordance with Section 02730 by using flexible banded couplings or adapters, couplings with compression joints in compliance with ASTM C 425.

3.08 PIPE-TO-MANHOLE CONNECTIONS

A. When a sound pipe stub-out exists from a manhole to which connection is to be made, a pipe-to-pipe connection shall be made as described above. If one is not present or is faulty, an opening shall be cut in the manhole wall and the connection, consisting of a pipe stub-out with an EPDM rubber boot assembly grouted into the opening with non-shrink grout shall be made to form a corrosion resistant, watertight seal. The invert, benches and floor inside the manhole shall be cut and reshaped as necessary.

3.09 TELEVISION INSPECTION

A. Post Construction CCTV inspection in accordance with Section 02752 of the Contract Documents is required for all Internal and External Point Repairs on sanitary sewers. The post-installation CCTV inspection shall take place as shortly after completion of each section as is feasible, but in no case more than ten (10) calendar days thereafter. The contractor is required to submit the post-installation CCTV videos within ten (10) calendar days of completing the rehabilitation of a segment of the sewer. The repairs shall demonstrate the full and effective rectification of the extant defect and/or obstruction, including infiltration etc., to the complete satisfaction of the Engineer. The Post Construction CCTV inspection is not required for Pipe Blockage Repairs or Sanitary Sewer Sag Repairs performed prior to pipe-bursting or pipe replacement.

3.10 TRAFFIC CONTROL

A. Refer to Specification Section 01500: Temporary Control of Construction Operations for requirements.

END OF SECTION

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SECTION 02900

Landscaping

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide landscaping and appurtenant work, complete and in place, in accordance with the Contract Documents. All existing landscaping features and products removed or damaged in the performance of the Work shall be restored to original condition or better.

B. Trees and shrubs removed or damaged in the performance of the Work shall be replaced with plantings of the same species and equivalent diameter-inch.

1.02 DEFINITIONS

A. The terms "plant material" or "plants" refer to all vegetation, whether trees, shrubs, ground cover, or herbaceous vegetation.

B. "Quality" refers to structure and form, as evidenced by density and number of canes and branches, compactness, symmetry, and general development without consideration of size or condition. "Standard quality" indicates the least acceptable quality. "Standard quality" plants shall be typical of the species and variety of good average uniform growth, shall be well formed and uniformly branched, and shall have the minimum number of canes indicated, free from irregularities, or shall conform to minimum quality index. Where the number of canes is not specifically stated in describing this grade, the "Horticultural Standards" as adopted by the American Association of Nurserymen shall apply. In such a case, the number of canes and other factors for the appropriate classification under "quality definition" in the Horticultural Standards shall be the Quality Index. Plant material below this standard will be considered "culls" and are not acceptable. Plants shall be nursery grown.

C. "Specimen" means an exceptionally heavy, symmetrical, tightly-knit plant, so trained or favored in its development and appearance as to be outstanding, superior in form, number of branches, compactness, and symmetry.

D. "Size" is the factor controlled by dimensions representing height or spread, or both, without consideration of quality or conditions. For

standard quality, a dimension is given for height or container size, or a dimension is given for height as well as container size.

E. "Height" is usually indicated with a tolerance. The smaller dimension is the minimum acceptable. The larger dimension represents the maximum permissible. The average dimension of all plants shall equal the average of the tolerance figures for each item.

F. "Condition" is the factor controlled by vitality and ability to survive, thrive, and be comparable with normal plants of the same species and variety in the vicinity at the same season of the year. Plants shall be free from physical damage or adverse conditions that would prevent thriving. "Condition" also sometimes refers to state of growth, i.e., whether "dormant condition" or "growing condition," and this state shall be comparable to plants of similar species in the vicinity for leaves, formation of buds, and the like.

G. "Cane" means a primary stem which starts from the ground, or close to the ground, at a point not higher than 1/4 the height of the plant.

H. "Caliper" shall be measured 12 inches above the finish grade or ground, as a guide, or where the trunk appears to form the head of the tree.

I. "Foliage line" is maximum dimension in case of specimen plants. It measures from ground to lowest part of body of plant.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications:

1. FS O-F-241D Fertilizer, Mixed, Commercial

B. Commercial Standards:

1. ASTM D 422 Method for Particle-Size Analysis of Soils

2. ANSI Z60.1 Nursery Stock

3. American Association of Nurserymen, Inc.

4. Rules and Grading Provisions

1.04 CONTRACTOR SUBMITTALS

A. General: Submittals shall be furnished in accordance with General Conditions, Section 28.

B. Product Information:

1. Manufacturer's product information on fertilizer, peat moss, mulch, seed mixtures, sod, and tree paint.

2. Topsoil Analysis Report: A report certified by an analytical laboratory that shows results of analyzing representative samples of topsoil proposed for use. Approval of the report does not constitute final acceptance of the topsoil.

C. Certificate:

1. Certificates shall accompany each delivery stating source, quantity, and type of material. All certificates shall be submitted at the time of delivery.

2. Certificates of inspection of plant material, as may be required by federal, state, or other authorities having jurisdiction, which accompany the shipment, shall be submitted at delivery.

1.05 QUALITY ASSURANCE

A. General: All plants shall be true to type or name as indicated in the Contract Documents and shall be tagged in accordance with standard practice; however, determination of plant species or variety will be made by the Engineer.

B. All plants shall comply with federal and state laws requiring inspection for plant diseases and infestations.

C. Inspections will be made by the Engineer or its representative. The Contractor shall request inspection at least 24 hours in advance of the time inspection is required. Inspection is required on the following stages of the Work:

1. During preliminary grading, soil preparation, and initial weeding.

2. When trees are spotted for planting, but before planting holes have been excavated.

3. When finish grading has been completed.

4. When all Work except the maintenance period has been completed.

5. Final inspection at the completion of the maintenance period.

D. Plants shall be subject to inspection and approval or rejection by the Engineer at place of growth and upon delivery to the Site at any time before or during progress of the Work based on:

1. Quantity, quality, size, and variety;

2. Ball and root condition; and

3. Latent defects and injuries resulting from handling, disease, and insects.

E. Plants approved at pre-planting inspection are subject to rejection during planting if found to be defective.

F. Rejected plants shall be identified as such in an obvious manner, shall be removed from the Site, and be replaced with acceptable plants.

1.06 CLEAN-UP

A. Upon completion of all planting operations, the portion of the Site used for a work or storage area by the Contractor shall be cleaned of all debris, superfluous materials, and equipment. All such materials and equipment shall be entirely removed from the Site.

B. All walks or pavement shall be swept or washed clean upon completion of the Work of this Section.

C. During the entire Contract period, plant containers that have been cut or removed from plant materials shall be removed from the Site daily.

1.07 MAINTENANCE OF LANDSCAPING PLANTING PRIOR TO ACCEPTANCE OF PROJECT

A. General: The Contractor shall be responsible for protecting, watering, and maintaining all planting and irrigation systems until final acceptance of all Work under the Contract.

B. At time of acceptance of the complete project, the lawn shall be totally established with no bare spots, have been mowed a minimum of 4 times, and the grass shall be at least 1-1/4 to 2 inches in height.

C. Watering: Trees and shrubs shall be thoroughly soaked after planting and provided with additional water at intervals as necessary to provide for good health and growth of the planting.

D. Upon completion of lawn seeding, the entire area shall be soaked to saturation by a fine spray. The new planting shall be kept watered by the

sprinkling system existing on the Site during dry weather or whenever necessary for proper establishment of the lawn. Care shall be taken to avoid excessive washing or puddling on the surface and any such damage caused thereby shall be repaired.

E. Protection: The Contractor shall provide adequate protection to all newly seeded areas, including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until the end of the correction of defects period.

F. The Contractor shall replace any materials or equipment or which its employees or Subcontractors have damaged.

G. Partial utilization of the project shall not relieve the Contractor of any of the requirements contained in the Contract Documents.

H. Mowing of Lawn Areas: First mowing of lawn areas shall begin as soon as the grass has reached a height of 3 inches and subsequent mowing shall be at least once a week, or as often as necessary to maintain all lawn areas at a uniform height of 1-1/2 to 2 inches.

I. All lawns shall be fertilized every 3 weeks with 6 lb of 16-16-8 commercial fertilizer per 1000 sq ft for the first 7 weeks and be fertilized thereafter once each 5 months prior to acceptance.

J. Plants shall be maintained in a vigorous, thriving condition by watering, cultivating, weeding, pruning, spraying, and other operations necessary. No trees or shrubs will be accepted unless they are healthy and show satisfactory foliage conditions.

K. All planted areas shall be cultivated at least every 2 weeks and be raked smooth to present a neat appearance, and additional mulch shall be added where necessary.

L. Maintenance shall include, in addition to the foregoing, cleaning, edging, repairs to stakes, wire, and wrappings, the repair of erosion, and all other necessary work of maintenance. Sidewalks and other paved areas shall be kept clean while planting and maintenance are in progress.

M. Any existing sprinkler lines broken or disrupted shall be replaced to proper working order prior to work under this Contract Dnd shall be acceptable to the City.

1.08 FINAL INSPECTION AND GUARANTEE

A. Inspection of lawns and planting will be part of final inspection under the Contract.

B. Written notice requesting inspection shall be submitted to the Engineer at least 10 days prior to the anticipated inspection date.

C. Final acceptance prior to start of the guarantee period of the Contract will be on written approval by the Engineer, on the satisfactory completion of all Work, including maintenance, but exclusive of the replacement of plant material.

D. Any delay in the completion of any item of work in the planting operation that extends the planting into more than one season shall extend the correction period in accordance with the date of completion given above.

E. The Contractor shall replace, as soon as weather conditions permit, all dead plants and all plants not in a vigorous, thriving condition, which are noted at the end of the one-year correction period.

F. Plants used for replacement shall be of the same size and variety as existing plants. Replacement plants shall be furnished, planted, staked, and mulched as indicated for new plants.

G. All Work under this Section shall be left in good order to the satisfaction of the City and the Engineer, and the Contractor shall, without additional expense to the City, replace any trees, shrubs, etc., which develop defects or die during the one-year correction period.

1.09 MAINTENANCE FOLLOWING ACCEPTANCE OF PROJECT

A. Begin maintenance of plantings immediately after each area is planted and continue for the periods required to establish acceptable vegetation, but no less than the following:

1. Seeded lawns: at least 60 days, after date of substantial completion. If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance during following spring until acceptable lawn is established.

2. Sodded lawns: at least 30 days after date of substantial completion.

3. Trees and shrubs: at least 60 days after date of substantial completion.

B. Maintain lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling, re-grading, replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

C. Re-mulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.

D. Replant bare areas with same materials specified for lawns.

E. Watering: Provide and maintain temporary piping, hoses, and watering equipment to convey water from sources and to keep planted areas uniformly moist as required for proper growth.

F. Lay out temporary watering system and arrange watering schedule to prevent puddling, water erosion, and displacement of seed or mulch (if any). Lay out temporary watering system to avoid necessity of walking over muddy or newly seeded areas.

G. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height. Remove no more than 40 percent of grass leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Time initial and subsequent mowings to maintain following grass height:

Mow grass from 1-1/2 inches to 2 inches high. Do not mow to less than 1-1/2 inches.

H. Apply second fertilizer application after first mowing and when grass is dry. Use fertilizer that will provide at least 1.0 lb. of actual nitrogen per 1,000 sq. ft. of lawn area.

PART 2 – PRODUCTS

2.01 GENERAL

A. All landscaping materials for soil conditioning, weed abatement, or planting shall be first-grade, commercial quality and shall have certificates indicating the source of material, analysis, quantity, or weight attached to each sack or container or furnished with each delivery. Delivery certificates shall be given to the Engineer as each shipment of material is delivered. A list of the materials used, together with typical certificates of each material, shall be submitted to the Engineer prior to final acceptance.

2.02 TOPSOIL

A. Topsoil shall be obtained from naturally drained areas and shall be fertile, friable loam suitable for plant growth. Topsoil shall be subject to inspection and approval at the source of supply and upon delivery.

B. The topsoil shall be of uniform quality, free from subsoil, stiff or lumpy clay, hard clods, hardpan, rocks, disintegrated debris, plants, roots, seeds, and any other materials that would be toxic or harmful to plant growth. Topsoil shall contain no noxious weeds or noxious weed seeds.

C. The topsoil shall contain at least 6 percent organic matter as determined by loss of weight after ignition of moisture-free samples in accordance with current methods of the Association of Official Agricultural Chemists.

D. The acidity of the topsoil shall result in soil pH between 5.5 and 7.5. The salinity level shall be less than 3 millimhos/cm.

E. Clay, as determined by the Bouyoucous hydrometer or by the decantation method, shall not exceed 60 percent of the topsoil material.

F. Mechanical analysis shall be performed and shall conform to ASTM D 422.

G. Soil mix for interior plants shall be sphagnum moss or a soil mix furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. The soil mix shall be a mix designed specifically for interior container or potted planting.

2.03 FERTILIZER AND ADDITIVES

A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon.

B. Chemical fertilizers shall be a mixed commercial fertilizer conforming to FS O-F-241D, Type I, with percentages of nitrogen, phosphoric acid, and potash at 5-10-5 or 6-10-4. Fertilizers shall be uniform in composition, dry, and free flowing.

C. Animal fertilizer shall be well-rotted cattle manure, free from sawdust, shaving, or refuse of any kind, and shall contain not more than 25 percent straw by volume.

D. Tablets shall be 12 grams each 20-10-5 **"Agriform," "Lesslie,"** or equal.

E. Lime shall be dolomitic limestone containing not less than 85 percent of total carbonates. Limestone shall be ground to such fineness that 100 percent will pass a No. 200 sieve.

F. Agricultural gypsum shall be standard brand agricultural calcium sulfate intended for soil application and shall contain 19 percent combined sulfur.

2.04 PEAT MOSS

A. Peat shall be a domestic product conforming to FS Q-P-166E and may be reed peat, sedge peat, moss peat, reed muck, or sedge muck. Moss shall be of horticultural grade (fine shreds).

B. Sphagnum peat moss shall be good quality baled peatmoss free from injurious materials.

2.05 MULCH

A. Mulching material shall be well-rotted sawdust a minimum of 2 years old, pine bark or tan bark, all free of sticks, stones, clay, or other foreign materials. Bark mulch shall be medium chunk size, fortified with 1 percent nitrogen. [Mulch shall consist of 1/3 cattle manure and 2/3 coarse granular sawdust. Mulch shall be composted at least 90 days with added nitrogen and shall be free of weed seed and roots, sticks, lumps, and other foreign matter].

B. "Silva-fiber" mulch material shall be equal to "Silva-fiber" as manufactured by the Weyerhauser Company, Silva Products Department, Tacoma, Washington.

C. Wood chip mulch in planting beds shall be clean, inexpensive, pulverized shavings, 2-inch minimum to 4-inch maximum length as produced by chipping tree branches or similar means, placed to a depth of 4 inches.

D. Straw mulch or native hay for a soil/seed stabilizer shall be clean hay or straw applied at a rate of 3 tons per acre. Mulch is to be crimped into soil with a mulch crimper. Spacing on the blades of the mulch crimper shall be 6 inches minimum and 9 inches maximum. Blades shall be sufficiently weighted to penetrate the ground 3 inches.

2.06 PLANT MATERIALS

A. Plants shall meet requirements of the Contract Documents and shall be in accordance with the botanical names and applicable standards of quality, size, condition, and type. Plants shall be true to name, genera, species, and variety in accordance with reference publications.

B. Plant names are defined in "Standardized Plant Names" and "Bailey's Encyclopedia of Horticulture." When a name is not found in either reference, the accepted name used in the nursery trade shall apply.

C. Plants shall be marked for identification. Each bundle of plants and at least 25 percent of each species and variety of separate plants in any one shipment shall have legible labels securely attached before delivery to the Site.

D. Trees and shrubs shall be measured while their branches are in their normal position. Height and spread dimensions refer to the main body of the plant and not from branch or root tip to tip. No trees will be accepted with leaders cut or so damaged that cutting is necessary.

E. All plants shall be symmetrical and shall conform to the size, age, and condition on the Plant List. Exceptions are as follows:

1. Plants larger than indicated on the plant list may be used if approved by the Engineer, but approval of such plants shall not increase the Contract Price. If the use of larger plants is approved, the spread of roots or ball earth shall be increased in proportion to the size of the plant. Bare root plants furnished in size greater than indicated shall be balled and burlapped when required by the Engineer.

2. Where caliper or other dimensions of any plant materials are omitted from the Plant List, it shall be understood that such plant materials shall be normal stock for type listed.

F. Plants shall be of sound health, vigorous, and free from plant disease and shall be well-branched, shall have full foliage when in leaf, and shall have a healthy well-developed normal root system. Cold storage plants will not be accepted. Plants that are sensitive to shock from elevation change shall be grown for at least 2 years at elevations close enough to the Site to alleviate any plant damage due to such change.

G. Bare rooted (BR) plants shall have well-developed branch systems and vigorous root systems. They shall be dug to sufficient depth to insure full recovery and development of the plants. Roots of these plants shall be covered with a uniformly thick coating of mud puddled immediately after they are dug.

H. Balled and burlapped (BB) plants shall have firm, natural balls of earth of diameter not less than that indicated and be of sufficient depth to include all the fibrous and feeding roots. No plant moved with a ball will be

accepted if the ball is cracked or broken before or during plant operations, except on approval of the Engineer.

I. Roots or balls of all plants shall be adequately protected at all times from sun and drying winds.

J. Plants indicated to be in marked cans, pots, or other containers on the Plant List shall have been grown in the containers for a minimum of 6 months and a maximum of 2 years. Roots shall fill the containers but show no evidence of being or having been root bound.

K. Trees shall have straight trunks and all old abrasions and cuts shall be completely callused over. In no case shall trees be topped before delivery.

L. Plants shall have been transplanted or root-pruned at least once in the 2 years prior to delivery, but plants shall not be pruned immediately prior to delivery except as authorized by the Engineer.

2.07 SEED MIXTURES

A. Seed shall conform to applicable City, county, state, and federal regulations. Seed shall be mixed by dealer. The Contractor shall furnish dealer's guaranteed germination figure for each variety

B. Grass seed shall be fresh, clean, new-crop seed, composed of the following varieties mixed in the proportions by weight. Purity and germination percentage shall be the results of testing.

Common Names	Proportion by Weight (percent)	Purity (percent)	Germination (percent)
Type 1:			
Baron Kentucky Blue Grass	100	90	90
Type 2			
Buffalo Grass	33	90	90
Creeping Red Fescue	25	90	90
Fuccinellia	25	90	90
Penn Fine Rye Grass	17	90	90
Type 3:			
Western Wheat Grass	33	90	90
Fairway Crested Wheat Grass	33	90	90
Buffalo Grass	34	90	90

2.08 SOD GRASS

A. Sod shall contain at least 85 percent permanent grass suitable to the climate in which it is to be placed; shall not contain more than 25 percent nursing grass; shall not contain more than 10 percent weed and undesirable grasses, and shall be of good texture, free from obnoxious roots, stones, and foreign materials. The sod shall be cut in 16-inch squares, 16-inch wide strips, 4-ft wide strips, or 4-ft wide squares, uniformly 1-1/2 inches thick with clean cut edges.

B. The sod shall be nursery grown Kentucky Bluegrass sod. It shall be uniformly cut approximately 3/4-inch or more thick and shall be well rooted, 2-year old growth of permanent and desirable grasses indigenous to this general location. The sod shall be practically free from weeds and undesirable grasses.

2.09 WOOD EDGING

A. Wood edging shall be 2-inch x 4-inch redwood construction heart stock.

2.10 STAKING MATERIALS

A. Stakes for supporting trees shall be sound No. 2 redwood of uniform size not less than 2-inch x 2-inch or 2-1/2-inch min diameter wood posts of lengths on the staking details. All knots shall be solid. Alternatively,

stakes may be galvanized iron pipe, 1-inch (ID) diameter with 2 coats of olive green flat enamel paint

B. Hose for covering wire shall be new or used black or green 2-ply fiber-bearing garden hose, not less than 1/2-inch inside diameter.

C. Wire for tree bracing and guying shall be double strand pliable No. 10-gage galvanized steel wire or vinyl-coated steel wire.

D. Tree ties of other materials may be used with prior approval of Engineer.

2.11 MISCELLANEOUS MATERIALS

A. Wrapping material for trees, 2-inch diameter or larger, shall be 2 thicknesses of crinkled paper cemented together with bituminous material in strips 4-inch wide. Twine for tying shall be medium or coarse sisal yarn with a light impregnation of oil condensate from asphalt or tar.

B. Soil mix for interior plants shall be sphagnum moss or an approved soil mix furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. The soil mix shall be a mix designed specifically for interior container or potted planting.

PART 3 – EXECUTION

3.01 GENERAL

A. The landscape work shall not be performed at any time when it may be subject to damage by climatic conditions.

B. Dimensions and plant locations shall be coordinated with Engineer and final location shall be Site-oriented by the planter and Engineer. Any discrepancies or inconsistencies shall be brought to the attention of the Engineer.

C. Delivery of materials may begin only after samples and tests have been approved by the Engineer. Materials provided shall be not less quality than the approved sample.

D. The Contractor shall provide temporary fencing, barricades, covering, or other protections to preserve existing landscaping items indicated to remain and to protect the adjacent properties and other structures when they may be damaged by the landscape work.

E. The Contractor shall retain the services of a tree surgeon approved by the Engineer to repair damage to existing trees. Existing trees, which are to be saved, and which cannot be restored to full growth, as determined by tree surgeon, shall be removed and replaced with a new similar tree of 24-inch box size, unless otherwise approved by the Engineer.

F. The Contractor shall remove and/or relocate landscape items such as trees, shrubs, grass, other vegetation, improvements, and obstructions as indicated.

G. Waste materials shall be removed and disposed of off the Site, unless otherwise indicated.

H. It shall be the responsibility of the Contractor to obtain information regarding utilities in the area of work and to prevent damage to the same. The Contractor shall protect the utilities as necessary.

I. Burning of combustible materials on the Site shall not be permitted.

J. The Contractor shall protect structures, sidewalks, pavements, and other facilities that are subject to damage during landscape work. Open excavations shall be provided with barricades and warning lights which conform to the requirements of governing authorities and the state's OSHA safety requirements from dusk to dawn each day and when needed for safety.

K. Planting areas include all areas to be landscaped, unless indicated otherwise.

3.02 SOIL PREPARATION

A. The landscape work shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, re-compacted, and refinished to finish grades. The Engineer shall be notified of all areas that prevent the landscape work from being executed.

B. Areas requiring grading by the landscaper, including adjacent transition areas, shall be uniformly level or sloping between finish elevations to within 0.10-ft above or below required finish elevations.

C. The landscape work shall not proceed until after walks, curbs, pavings, edging, and irrigation systems are in place. Work under the Contract shall be completed to a point where the landscape areas will not be disturbed. The subgrade shall be free of waste materials of all kinds.

D. During grading, waste materials in the planting areas, such as weeds, rocks 2 inches and larger, building materials, rubble, wires, cans, glass, lumber, sticks, etc., shall be removed from the Site. Weeds shall be dug out by the roots.

E. Fertilizers, additives, seed, peat, etc., subject to moisture damage shall be kept dry in a weatherproof storage place.

F. After removal of waste materials, the planting area subgrade shall be scarified and pulverized to a depth of not less than 6 inches, and all surface irregularities below the cover of topsoil shall be removed.

G. Finish grading shall consist of:

1. Final contouring of the planting areas

2. Placing 4 inches of topsoil over all areas to be planted, unless indicated otherwise

3. Placing all soil additives and fertilizers

4. Tilling of planting areas

5. After tilling, bringing areas to uniform grades by floating and/or hand raking

6. Making minor adjustment of finish grades as directed by the Engineer

7. Removing waste materials such as stones, roots, or other undesirable foreign material and raking, disking, dragging, and smoothing soil ready for planting

H. Any unusual subsoil condition that will require special treatment shall be reported to the Engineer.

I. Topsoil shall be uniformly distributed over all areas where required. Subgrade and topsoil shall be damp and free from frost.

J. Surface drainage shall be provided as indicated by shaping the surfaces to facilitate the natural run-off of water. Low spots and pockets shall be filled with topsoil and graded to drain properly.

K. Finish grade of all planting areas shall be 1½ inches below finish grade of adjacent pavement of any kind.

L. In all shrub planting areas, 1½ inches of peat moss or soil-aid shall be raked into the top 3 inches of soil.

3.03 DELIVERY, STORAGE, AND HANDLING OF PLANT MATERIALS

A. No plants other than the required samples shall be dug or delivered to the Site until the required inspections have been made and the plant samples are approved.

B. Plants shall not be pruned prior to delivery except upon approval by the Engineer.

C. Plant material shall be planted on the day of delivery if possible. The Contractor shall protect the stock in a temporary nursery at the Site where it shall be protected from sun and drying winds and shall be shaded, kept moist, and protected with damp soil, moss, or other acceptable material. Plants shall be planted within 2 days after delivery.

D. All balled and burlapped plants which cannot be planted immediately after delivery shall be set on the ground and be well protected with soil, wet moss, or other acceptable material. Bare rooted plants, which cannot be planted immediately, shall be planted in heeled-in trenches immediately upon delivery. No material heeled-in for more than one week may be used. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent air pockets among the roots.

E. During planting operations, bare roots shall be covered with canvas, wet straw, or other suitable materials. No plants shall be bound with wire or rope at any time so as to damage the bark or break branches.

F. Plants shall not be picked up or moved by stem or branches, but shall be lifted and handled from the sides of the containers.

G. Plants shall be lifted and handled from the bottom of the ball or container. Plants with balls cracked or broken before or during planting operations will not be accepted and shall be immediately removed from the Site.

3.04 TREE AND PLANT LOCATIONS

A. The Contractor shall locate and stake all tree and shrub locations and have the locations approved by the Engineer before starting excavation for same. The plant locations shall be observed, and their locations shall be adjusted as directed by Engineer before final approval.

B. No trees shall be located closer than 72 inches to structures unless otherwise indicated. Ground covers and shrubs may be planted up to structures or curbs.

3.05 PLANT PITS

A. Plant pits, centered on location stakes, shall be excavated circular pits with vertical sides and flat or saucer shape bottom in accordance with the following sizes, unless indicated otherwise:

1. Tree pits shall be at least 2 feet greater in diameter than the specific diameter of ball or spread of roots, and at least 6 inches below depth of ball or roots. A 3-inch layer of manure shall be worked thoroughly to a depth of 6 inches below the pit bottom.

2. Shrubs shall be planted in pits or holes of soil 24 inches deep below finished grade, or deep enough to properly set the plant at finished grade with a minimum of 6 inches of planting soil under balls of all plants. Shrubs with balls shall be planted in pits that are at least 24 inches greater in diameter than the bottom of ball. Bare root shrubs shall be planted in pits at least 12 inches below the roots of the plant.

3.06 PREPARED BACKFILL

A. Tree and shrub pit backfilling soil shall consist of 3 parts topsoil, and 1 part peat or soil-aid by volume. Commercial fertilizer shall be sparingly mixed with the prepared topsoil, using 5 lb/cu yd or as required by manufacturer's printed recommendations.

B. Materials shall be thoroughly rotary-mixed on the Site before placement. Mixing of materials in pits, bins, trenches or beds will not be permitted.

C. Tree and shrub pits shall be provided with fertilizer tablets as follows:

1. 1 per one-gallon can plant

2. 3 per 5-gallon can plant

3. 5 per 15-gallon can plant

3.07 ROCKS OR UNDERGROUND OBSTRUCTIONS

A. In the event that rock or underground obstructions are encountered in the excavation of plant pits, alternative locations will be selected by the

Engineer. Moving of trees to alternative locations shall not entail additional costs to the City.

3.08 SETTING PLANT MATERIALS

A. The soil shall not be worked when the moisture content is so great that excessive compaction will occur, or when it is so dry that a dust will form in the air or clods will not break readily. Water shall be applied if necessary to provide ideal moisture for filling and for planting.

B. Plants shall be set plumb and straight in center of pits, and at such a level that after settlement that the crown of the plant will be 2 inches above the finished grade.

C. Balled and burlapped trees shall have planting soil placed and compacted around base of ball to fill all voids. All burlap ropes or wires shall be removed from the sides and tops of balls.

D. Roots of bare root plants shall be properly spread out and planting soil carefully worked in among them. All broken or frayed roots shall be cut off clean.

E. Vines shall be removed from stakes, untied, and securely fastened in an approved manner to wall or fence next to which they are planted.

F. Ground cover plants shall be evenly spaced, staggered in rows, and set at intervals indicated, so as to produce a uniform effect. Plants shall be watered immediately after planting operations have been completed.

G. Shrubs and vines shall be pruned to remove damaged branches. All bare root shrubs shall be pruned and shaped to compensate for transplant root loss.

H. Planting soil around roots or balls shall be thoroughly compacted and watered. After planting, the soil in the shrub beds shall be cultivated between shrubs, raked smooth, and neatly outlined. Muddy soil shall not be used for backfilling. All broken or frayed roots shall be properly cut off.

I. Trees and shrubs on slopes steeper than 6 to 1 shall be provided with watering dams or berms at least 6 inches high and 8 inches wider than planting pit unless indicated otherwise.

J. Trees shall be thoroughly watered immediately after planting.

K. Remove all tags and labels when directed by Engineer.

L. Trees shall have trunks wrapped in acceptable tree wrap material from base up to and above at least the second scaffold branch.

3.09 STAKING

A. Staking of trees shall be done immediately after planting. Plants shall stand plumb after staking. Staking shall be as indicated.

B. No balled and burlapped specimen "tree-like" shrubs shall be staked.

C. Trees of 2-inch caliper and larger shall be guyed at points of branching with 3 wires spaced equally around and outside the perimeter of the ball. Guy wires shall be covered with rubber hose at the bark, protected by approved material at points of contact. Each guy shall be positioned below crotches and fastened to a 4-inch diameter by 18-inch wood deadman, 12 inches below grade. One turnbuckle shall be provided for each guy.

D. Trees less than 2-inch caliper shall be supported by 2 stakes placed diametrically opposite at perimeter line of ball and to sufficient depth to hold tree rigid. Stakes shall be driven vertically and not twisted or pulled. Trees shall be wired to each stake as indicated on staking details. Trees shall be protected with rubber hose over wires at points of contact. Evergreen trees shall be guyed.

3.10 PRUNING AND MULCHING

A. Each tree and shrub shall be pruned in accordance with standard horticultural practice to preserve the natural character of the plant in the manner fitting its use in the landscape design, as approved by the Engineer.

B. All dead wood or suckers and all broken or badly bruised branches shall be removed by thinning out and shortening branches. Deciduous bare-rooted plants shall have not less than 1/3 of their respective leaf surfaces removed. All cuts shall be made just above a healthy bud. Pruning shall be done with clean, sharp tools.

C. Cuts over 3/4-inch diameter shall be painted with approved tree paint. Paint shall cover all exposed cambium as well as other living tissue. Paint shall be waterproof, adhesive, and elastic antiseptic; shall be free from kerosene, coal tar, creosote, or other materials injurious to the life of the tree; and shall be approved before it is used.

D. Plants shall be mulched after planting and cultivating have been completed. A layer of mulch materials shall be spread on finished

landscaping grade within all planting areas to a depth of 2 inches. The mulch around isolated plants shall be 6 inches greater in diameter than the planting hole. All shrub and ground cover beds shall be completely covered with the mulch.

E. All deciduous tree trunks shall be thoroughly sprayed with a methoxychlor or similar insecticide, and wrapped immediately after planting, with wrapping material overlapping 1-1/2 inches, wound from ground line to the second branch, and securely taped in at least 5 places, including the top, middle, and bottom.

3.11 SODDING

A. Grass sod shall be provided where indicated and shall be maintained.

B. The soil shall be prepared and fertilized before sodding. The Contractor shall prepare only enough ground that can be planted within 24 hours thereafter.

C. Soil preparation shall consist of the following:

1. Preparation of sub-grade grading shall be per the paragraphs titled "General" and "Soil Preparation" above.

2. Finish grading shall be per the paragraph entitled "Soil Preparation," above. Topsoil required at areas to be sodded shall be 1-1/2 inches. The soil additives and fertilizer for finish grading shall consist of mulch at 5 cu yd/1000 sq ft and commercial fertilizer at 20 lb/1000 sq ft.

D. Sod shall be cut and laid on Site the same day.

E. The sod shall be placed over leveled, compacted, and prepared finish graded soil. The topsoil and sub-base shall be moist enough to resist shifting.

F. Sod may be placed at any time when the ground is not frozen. The surface on which the sod is to be laid should be firm and free from footprints or other depressions. A string or line of boards may be used as a guide for setting the first line of sod across the area. Sods of the next course shall be matched against the edge of this first line in such a way the joints between the individual sod pieces in the 2 courses do not coincide. Successive courses shall be matched against the last line laid, in the same manner.

G. Sod joints shall be closely laid and filled with a mixture of grass seed and screened topsoil at the rate of 2 lbs of seed to each cu yd of topsoil. Sod fill soil shall be thoroughly tamped to a true and even surface at the required finished grade.

H. Sod on slopes should be staked down by driving a wooden peg through the sod. Wire stakes shall not be used for pegging sod.

I. Sod shall always be laid across slopes.

J. All new sod shall be rolled or firmly but lightly tamped with a suitable wooden or metal tamper, sufficiently to set or press sod into underlying soil.

K. After sodding has been completed, the sodded area shall be cleaned up and thoroughly moistened by sprinklers.

3.12 SEEDING-GENERAL

A. Grass seeds shall be provided where lawn is indicated and shall be maintained.

B. The soil shall be prepared and fertilized before seeding or shall be prepared per hydro-seeding instructions. The Contractor shall prepare only enough ground that can be planted within 24 hours thereafter.

C. Soil preparation shall consist of the following:

1. Preparation of sub-grade grading shall be per paragraphs titled "General" and "Soil Preparation," respectively, above.

2. Finish grading of soil per paragraph entitled "Soil Preparation," above. The soil additives and fertilizer for finish grading shall consist of mulch at 5 cu yd/1000 sq. ft. and commercial fertilizer at 20 lb/1000 sq. ft.

D. Sow seed at the rate of 2 lbs to 1000 sq ft of area. Equal quantities of seed shall be sown in the directions at right angles to each other to produce an even distribution of seed over the entire area.

E. No seeding shall be done when wind velocity exceeds 4 mph, within 24 hours after rain, or if the surface has been compacted without first loosening the ground.

F. The seed shall then be covered with a fine layer of soil to a depth not greater than 1/4-inch.

G. All lawn areas shall be covered with sphagnum peat moss or clean straw uniformly at a rate of 1-1/2 standard bales per 1000 sq ft.

H. After covering the seeds with soil and peat or straw, the planted area shall be rolled in 2 directions with a 200-lb roller or other roller designed for lawn seeding.

I. All lawn slopes greater than 5 percent or places where erosion is a problem shall be mulched with straw at a rate of 2 bales per 1000 sq ft.

J. Mechanical application (hydroseeding) is acceptable. The Contractor shall notify the Engineer of proposed method, mulch, and type of equipment to be used and shall receive approval before beginning this operation.

3.13 HYDRO-SEEDING

A. One-step hydro-seeding may be utilized. This method consists of preparing the seed bed; combining seed mixture at the rate of 6 lb per 1000 sq ft for Lawn Mix; fertilizer at the rate of 15 lb per 1000 sq ft; "Silva-fiber" or equal at the rate of 1400 lb per acre of area and water in tanks; agitating these compounds into a well-mixed slurry suspension; and spraying the mixture under pressure onto the prepared areas to be seeded.

B. Two-step hydro-seeding may be utilized. This method consists of preparing the seed bed; sowing seed mixture at the rate of 6 lb per 1000 sq ft for Lawn Mix in two directions with an approved mechanical seeder; incorporating fertilizers; and spraying under pressure a mixture of water and "Silva-fiber" or equal at the rate of 1400 lb per acre onto prepared, seeded, and fertilized areas. Fertilizer can be applied with the water and "Silva-fiber" or equal mixture if desired.

3.14 MISCELLANEOUS ITEMS

A. After all steel edging, plants, and sprinkler emitters are in place, and the existing sod in all wood mulch, cobble, and gravel areas has been removed to a depth of 4 inches, place filter fabric over the entire area to receive wood mulch, cobble, or gravel.

B. Wood chip mulch shall be placed in all shrub areas where indicated, spread carefully and evenly to a minimum depth of 4 inches, or to match existing, over planted areas.

C. Gravel shall be placed in the planting areas as indicated, spread carefully and evenly to a minimum depth of 4 inches, or to match existing, over the entire area.

D. Cobble shall be hand placed where indicated. Care shall be taken to fill all spaces, placing small cobble in the voids between the large cobble. When complete, Contractor shall fill all voids with sand and water thoroughly to ensure solid settlement of sand into all cracks and voids. Repeat as necessary to secure cobble from shifting.

E. Boulders shall be placed in field as directed by Engineer.

END OF SECTION

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SECTION 02910

TREES, PLANTS AND GROUND COVERS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and plant trees, plants and ground covers as shown on the Drawings and as specified herein.

B. Under this section, the Contractor shall also replace trees, plants and ground covers damaged by his operations. Existing trees, plants and ground covers damaged by the Contractor's operations shall be replaced as directed by the Engineer, to the satisfaction of the Engineer and at no additional cost to the Owner.

C. Work under this Section shall include, but not be limited to:

1. Soil preparation.
2. Planting mixes.
3. Mulch and planting accessories.
4. Furnishing and installing trees, plants and ground covers.
5. Existing tree care.
6. Filling around trees to remain.
7. Maintenance.

1.02 QUALITY ASSURANCE

A. Comply with requirements of Section 02000, Site Work

B. Plant names shall comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties shall conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.

C. Comply with sizing and grading standards of the latest edition of "American Standard for Nursery Stock". A plant shall be dimensioned as it stands in its

natural position.

D. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project.

E. Stock furnished shall be at least the minimum size as stock to be replaced. Larger stock is acceptable, at no additional cost, and providing that the larger plants will not be cut back to the existing plant size.

F. Provide "specimen" plants with height, shape and character of growth. Tag specimen trees or shrubs at the source of supply. The Engineer will inspect specimen selections at the source of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally, provide sufficient photographs of the proposed specimen plants for approval.

G. Plants may be inspected and approved at the place of growth, for compliance with specification requirements for quality, size, and variety. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work.

H. Contractor shall provide and pay for material testing. Testing agency shall be acceptable to the Engineer. Provide the following data:

1. Test representative material samples proposed for use.

2. Topsoil:

   a. pH factor.
   b. Mechanical analysis.
   c. Percentage of organic content.
   d. Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.

3. Peat Moss:

   a. Loss of weight by ignition.
   b. Moisture absorption capacity.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Mulch samples.

2. Planting accessories samples.

3. Certification for topsoil source and pH value; peat moss and plant fertilizer.

4. Material test reports.

5. Upon plant material acceptance, submit written instructions recommending procedures for maintenance of plant materials.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store materials in a manner to prevent wetting and deterioration.

B. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Spray deciduous plants in foliage with an approved "Anti-Desiccant" immediately after digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice or order to stock and on arrival, the certificate shall be submitted to the Engineer.

C. Protect all plants from drying out. If plants cannot be planted immediately upon delivery, properly protect them with soil, wet peat moss, or in a manner acceptable to the Engineer. Water heeled-in plantings daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches.

D. Cover plants transported on open vehicles with a protective covering to prevent wind burn.

E. Provide dry, loose topsoil for planting bed mixes. Frozen or muddy topsoil is not acceptable.

1.05 PROJECT CONDITIONS

A. Notify Engineer at least 7 working days prior to installation of plant material.

B. Protect existing utilities, paving, and other facilities from damage caused by landscaping operations.

C. Locate and protect existing irrigation system(s) during planting operations. Repair irrigation system components, damaged during planting operations, at Contractor's expense.

1.06 WARRANTY

A. Warrant plant material to remain alive and be in healthy condition for a period of 1 year after planting and acceptance. Inspection of plants will be made by the Engineer at completion of planting.

B. Replace, in accordance with these specifications, all plants that are dead or, as determined by the Engineer, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence. The cost of such replacement is at Contractor's expense. Warrant all replacement plants for 1 year after installation.

C. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of the Owner.

D. Remove and immediately replace all plants, as determined by the Engineer to be unsatisfactory during the initial planting installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Plants: Provide plants typical of their species or variety; with normal, densely-developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sunscald injuries, frost cracks, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation. All plants shall have a fully developed form without voids and open spaces. Plants held in storage will be rejected if they show signs of growth during storage.

1. Dig balled and burlapped plants with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the "American Standard for Nursery Stock". Cracked or mushroomed balls are not acceptable.

2. Container-grown stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.

    a. No plants shall be loose in the container.

b. Container stock shall not be pot bound.

3. Provide new tree species to match existing tree species. New species shall be provided with a single main trunk. Trees that have the main trunk forming a "Y" shape are not acceptable.

4. Plants planted in rows shall be matched in form.

5. Plants larger than those existing may be used when acceptable to the Engineer. If the use of larger plants is acceptable, increase the spread of roots or root ball in proportion to the size of the plant.

6. No pruning wounds shall be present with a diameter of more than 1-inch and such wounds must show vigorous bark on all edges.

7. Shrubs and small plants shall meet the requirements for spread as follows:

   a. The measurements for height shall be taken from the ground level to the height of the top of the plant and not the longest branch.
   b. Single stemmed or thin plants will not be accepted.
   c. Side branches shall be generous, well-twigged, and the plant as a whole well-bushed to the ground.
   d. Plants shall be in a moist, vigorous condition, free from dead wood, bruises, or other root or branch injuries.

2.02 ACCESSORIES

A. Topsoil for Planting Beds and Tree Pits: Fertile, friable, natural topsoil of loamy character, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks, and other foreign materials, with acidity range of between pH 6.0 and 6.8.

   1. Topsoil that has been stripped and stockpiled on site shall be the topsoil to be utilized on this project. Provide additional topsoil if necessary.

   2. Provide topsoil free of substances harmful to the plants which will be grown in the soil. Provide 12-inches of topsoil in all plant beds and tree pits.

   3. Planting mixture shall be composed of four (4) parts topsoil, two (2) parts peat moss, one (1) part sand and one (1) part well rotted manure, mixed together thoroughly, and worked into existing soil.

B. Peat Moss: Brown to black in color, weed and seed free granulated raw peat or baled peat, containing not more than 9% mineral on a dry basis. Provide ASTM D2607 sphagnum peat moss with a pH below 6.0 for ericaceous plants.

C. Fertilizer:

1. Plant Fertilizer Type "A": Commercial type approved by the Engineer, containing 5% nitrogen, 10% phosphoric acid, and 5% potash by weight. 1/4 of nitrogen in the form of nitrates, 1/4 in form of ammonia salt, and 1/2 in form of organic nitrogen.

2. Plant Fertilizer Type "B": Approved acid-base fertilizer.

D. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.

E. Premium grade shredded pine bark ¾-inch to 1-1/2-inch diameter. Furnish in 3 cubic. feet bags or bulk.

F. Water: Free of substances harmful to plant growth. Hoses or other methods of transportation shall be furnished by the Contractor.

G. Stakes for Staking: Hardwood, 2-inch x 2-inch x 8-feet long.

H. Stakes for Guying: Hardwood, 2-inch x 2-inch x 36-inches long.

I. Guying/Staking/Wire: No. 10 or 12, gage galvanized wire.

1. For large trees (4-inch caliper and greater) use turnbuckles and heavier gage wire as indicated below

a. Stakes for Staking: Hardwood, 4-inches x 4-inches x 8-feet long.
b. Guying/Staking/Wire: No. 6 or 8 gage galvanized wire.

2. Turnbuckles: Galvanized steel of size and gage required to provide tensile strength equal to that of the wire. Turnbuckle openings shall be at least 3-inches.

J. Staking and Guying Hose: Two ply, reinforced garden hose not less than ½-inch inside diameter.

K. Tree Wrap: Standard waterproofed tree wrapping paper, 2-1/2-inches wide, made of 2 layers of crepe kraft paper weighing not less than 30 lbs. per

ream, cemented together with asphalt. Tree wrap shall be removed at 12 months after installation of plant material.

L. Twine: Two-ply jute material.

M. Soil Separator: Rot resistant polypropylene filter fabric, water permeable, and unaffected by freezing and thawing.

N. Drainage Tile: ASTM F405 corrugated polyethylene drainage tubing, perforated.

O. Drainage Fill: AASHTO M43 #6 (3/8-inch to ¾-inch) clean uniformly graded stone or gravel.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine proposed planting areas and conditions of installation. Do not start planting work until unsatisfactory conditions are corrected.

3.02 CARE OF TREES TO REMAIN

A. Minor fills of 6-inches or less: Fill with topsoil; hand grade to required finish grade elevation.

B. Moderate fills of 12-inches or less: Place layer of ¾-inch to 1-1/2-inch stone or gravel on grade. Provide aggregate depth 1/2 of fill height, minimum of 3-inches. Cover drainage fill with polypropylene filter fabric or 1" thickness straw choke. Fill remaining depth with loose topsoil; hand grade to required finish grade elevations.

C. Deep fills over 12-inches: Place layer of ¾-inch to 1-1/2-inch stone or gravel on grade. Extend drainage fill to within 2-inch of required finish grade. Cover drainage fill with polypropylene filter fabric or 1-inch thickness straw choke. Fill remaining depth with loose topsoil; hand grade to required finish grade elevation. Provide tile drainage system and vents as indicated.

D. Deep fills over 18-inches: Place 4-inch depth of 1-inch to 2-inches stone or gravel fill on grade, extending three (3) feet beyond the outer branch drip line around tree branch perimeter. Cover drainage fill with polypropylene filter fabric or 1-inch thickness straw choke. Place 1-inch to 2-inches stone or gravel fill around tree trunk, extending to within 2-inches of required finish grade elevation. Fill remaining depth with loose topsoil; hand grade to required finish grade elevation. Do not place earth fill in contact with tree trunk, maintain 18-inches diameter of drainage fill exposed at finish grade.

3.03 PREPARATION

A. Time of Planting:

1. Evergreen material: Plant evergreen materials between September 1 and November 1 or in spring before new growth begins. If project requirements require planting at other times, plants shall be sprayed with anti-desiccant prior to planting operations.

2. Deciduous material: Plant deciduous materials in a dormant condition. If deciduous trees are planted in-leaf, they shall be sprayed with an anti-desiccant prior to planting operation.

3. Planting times other than those indicated shall be acceptable to the Engineer.

B. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor.

C. Locate plants as indicated or as approved in the field after staking by the Contractor. If obstructions are encountered that are not shown on the drawings, do not proceed with planting operations until alternate plant locations have been selected.

D. Excavate circular plant pits with vertical sides, except for plants specifically indicated to be planted in beds. Provide shrub pits at least 12-inches greater than the diameter of the root system and 24-inches greater for trees. Depth of pit shall accommodate the root system. Provide undisturbed tamped down topsoil to hold root ball at nursery grade as shown on the drawings. Remove excavated materials from the site.

E. Provide pre-mixed planting mixture for use around the balls and roots of the plants consisting of planting topsoil and 1/2 lb. plant fertilizer Type "A" for each cu. yd. of mixture.

F. Provide pre-mixed ground cover bed planting mixture consisting of 3 parts planting topsoil to 1 part peat moss and 1/2 lb. plant fertilizer Type "A" per cu. yd. Provide beds a minimum of 12-inches deep. If slopes are greater than 4 to 1 increase depth to 18-inches.

G. Provide pre-mixed planting mixture for use around the balls and roots of ericaceous plants consisting of 2 part planting topsoil to 1 part sphagnum peat moss and 1/2 lb. plant fertilizer Type "B" per cu. yd. of mixture.

3.04 INSTALLATION

A. Set plant material in the planting pit to proper grade and alignment. Set plants upright, plumb, and faced to give the best appearance or relationship to each other or adjacent structure. Set plant material 2-inches to 3-inches above the finish grade. No filling will be permitted around trunks or stems. Backfill the pit with planting mixture. Do not use frozen or muddy mixtures for backfilling. Form a ring of soil around the edge of each planting pit to retain water.

B. After balled and burlapped plants are set, muddle planting soil mixture around bases of balls and fill all voids. Remove all burlap, ropes, and wires from the tops of balls of trees and remove entirely from all other plant material.

C. Space ground cover plants in accordance with indicated dimensions. Adjust spacing as necessary to evenly fill planting bed with indicated quantity of plants. Plant to within 12-inches of the trunks of trees and shrubs within planting bed and to within 6-inches of edge of bed.

D. Drain tile: The Contractor shall provide drainage tiles if he encounters standing water in planting pits or conditions warrant. Install drainage tile with perforations down and closed joints, firmly bedded in minimum 4-inch layer of granular fill material. Provide full bearing for each pipe section. Provide continuous slope in the direction of flow.

1. Provide collars and couplings for all in-line joints and elbows for all corners and changes in direction.

2. Provide unperforated run out pipe. Extend drainage tile to out fall indicated and make connection.

3. Obtain required inspections and perform testing before backfilling. Remove obstructions, replace damaged components, and retest system as required. Provide a satisfactory free flowing drainage tile system.

4. Place drainage fill over drain piping after satisfactory testing and acceptance. Compact drainage fill layers not exceeding 6" in loose depth. Exercise care to avoid damage or displacement of installed piping.

    a. Completely cover drain lines to width of at least 6-inches each side of pipe and above top of pipe to within 18-inches of finish grade.
    b. Provide soil separator over drainage fill prior to topsoil fill. Overlap a minimum of 6-inches.

5. Install topsoil fill over compacted drainage fill. Compact topsoil fill in

layers not exceeding 6-inches in loose depth. Extend topsoil fill to indicated finish or existing grade elevations.

E. Mulching:

1. Mulch tree and shrub planting pits and shrub beds with required mulching material 3-inches deep immediately after planting. Thoroughly water mulched areas. After watering, rake mulch to provide a uniform finished surface.

2. Mulch ground cover beds with mulch 2-inches deep immediately after planting.

F. Wrapping, Guying and Staking:

1. Inspect trees for injury to trunks, evidence of insect infestation, and improper pruning before wrapping.

2. Wrap trunks of all trees spirally from bottom to top with specified tree wrap and secure in place.

   a. Overlap 1/2 the width of the tree wrap strip and cover the trunk from the ground to the height of the second branch.

   b. Secure tree wrap in place with twine wound spirally downward in opposite direction, tied around the tree in at least 3 places in addition to the top and bottom. Wrapping and twine to be removed 12 months after installation of plant material.

3. Staking/Guying:

   a. Stake/guy all trees immediately after lawn seeding or sodding operations and prior to acceptance. When high winds or other conditions which may affect tree survival or appearance occur, the Engineer may require immediate staking/guying.
   b. Stake deciduous trees under 3-inches in caliper. Stake evergreen trees under 8-feet tall.
   c. Guy deciduous trees over 3-inches in caliper. Guy evergreen trees over 8-feet tall.

4. All work shall be acceptable to the Engineer.

G. Pruning:

1. Prune branches of deciduous stock, after planting, to balance the loss of roots and preserve the natural character appropriate to the particular

plant requirements. In general, remove 1/4 to 1/3 of the leaf bearing buds, proportion shall in all cases be acceptable to the Engineer. Remove or cut back broken, damaged, and unsymmetrical growth of new wood.

2. Multiple leader plants: Preserve the leader which will best promote the symmetry of the plant. Cut branches flush with the trunk or main branch, at a point beyond a lateral shoot or bud at a distance of not less than 1/2 the diameter of the supporting branch. Make cut on an angle.

3. Prune evergreens only to remove broken or damaged branches.

H. Care of Existing Trees:

1. Selectively prune existing trees in designated areas, under Engineer's direction. Remove sucker shoots, dead, rubbing, and damaged branching.

2. Fertilize designated existing trees with 2 to 3 lbs. of Type "A" plant fertilizer per inch of trunk diameter, for trees less than 6-inches in diameter and 3 to 5 lbs. for trees greater than 6-inches in diameter.

   a. Fertilize in early spring before growth begins or in late October.
   b. Fertilize at 2-feet to 3-feet on center in a triangular pattern to a depth of 18-inches within the dripline.
   c. Injection or drilling fertilization methods, when used, shall be acceptable subject to Engineer's approval.

3. Water existing trees every 2 weeks until acceptance. Water thoroughly with a fine mist sprinkler head soaker hose or hose at a low flow rate over the entire drip line area as required to allow water to penetrate to a depth of 12-inches to 18-inches.

I. Tree Relocation:

1. Transplant trees designated for relocation to locations shown on the drawings. Prune, dig, ball and burlap, move and plant in accordance with specified tree planting requirements.

3.05 MAINTENANCE

A. Maintain plantings until completion and acceptance of the entire project.

B. Maintenance shall include pruning, cultivating, weeding, watering, and application of appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.

1. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.

2. Tighten and repair guy wires and stakes as required.

3. Remove tree wrapping and twine 12 months after installation of plant material.

4. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.

5. Water trees, plants, and ground cover beds within the first 24 hours of initial planting, and not less than twice per week until final acceptance.

3.06 ACCEPTANCE

A. Inspection to determine acceptance of planted areas will be made by the Engineer, upon Contractor's request. Provide notification at least 10 working days before requested inspection date. Planted areas will be accepted provided all requirements, including maintenance, have been complied with and plant materials are alive and in a healthy, vigorous condition.

B. Upon acceptance, the Owner will assume plant maintenance.

3.07 CLEANING

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soils, debris, and equipment. Repair damage resulting from planting operations.

+ + + END OF SECTION 02910 + + +

SECTION 02920

Site Restoration

PART 1 GENERAL

1. 1.01 SCOPE

A. The Contractor shall provide all, labor, materials, equipment and incidentals required for all site restoration and related operations necessary shown on the Drawings or specified in these Specifications.

B. This section includes disposition of materials and structures encountered in the Work, all cleanup and any other similar, incidental, or appurtenant operations which may be necessary to properly complete the Work.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. The Contractor shall submit certificates of inspection as required by government authorities. The Contractor shall submit other data substantiating that materials comply with specified requirements.

2. The Contractor shall submit instructions recommending procedures to be established by the City for maintenance of site restoration work for one (1) full year.

1.03 QUALITY ASSURANCE

A. The Contractor shall ship site restoration materials with certificates of inspection required by authorities having jurisdiction. The Contractor shall comply with regulations applicable to site restoration materials.

B. If specified site restoration materials are not obtainable, the Contractor shall submit proof of non-availability to the Engineer together with proposal for use of equivalent material.

1.04 SAFETY REQUIREMENTS

A. Hazards Control:

1. The Contractor shall store volatile wastes in covered metal containers, and

remove from the site of the Work daily.

2. The Contractor shall prevent accumulation of wastes that create hazardous conditions.

3. The Contractor shall provide adequate ventilation during use of volatile or noxious substances.

B. The Contractor shall conduct cleaning and disposal operations in compliance with local ordinances and environmental laws and regulations.

1. The Contractor shall not burn or bury rubbish and waste materials on the site of the Work without prior written permission from the Engineer.

2. The Contractor shall not dispose of volatile wastes such as mineral spirits, oil, or fuel in open drainage ditches or storm or sanitary drains.

1.05 DELIVERY

A. The Contractor shall deliver packaged materials in containers showing weight, analysis, and name of manufacturer. The Contractor shall protect materials from deterioration during delivery and while stored at the site of the Work.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.01 DISPOSITION OF MATERIALS AND STRUCTURES ENCOUNTERED IN THE WORK

A. Existing materials or structures that may be encountered (within the lines, grades, or trenching sections established for completion of the Work), if unsuitable or unacceptable to the Engineer for use in the Work, and for which the disposition is not otherwise specified, shall either be disposed of by the Contractor or shall remain the property of the City as further provided in this section.

B. At the option of the City, any existing materials or structures of "value" encountered in the Work shall remain the property of the City. The term "value" shall be defined by the City.

C. Any existing materials or structures encountered in the Work, and determined not to be of "value" by the City, shall be disposed of by the Contractor, in an approved manner.

3.02 JOB CONDITIONS

A. The Contractor shall determine the locations of underground utilities and perform Work in a manner which will avoid possible damage. The Contractor shall hand excavate, as required. The Contractor shall maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

B. All bare earth areas within the limit of work shall be grassed, mulched, or covered with other plant material as shown on the Drawings.

C. On a continuous basis, the Contractor shall maintain the site of the Work free from accumulations of waste, debris, and rubbish caused by his operations.

D. At completion of the Work, the Contractor shall remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all sight-exposed surfaces. The Contractor shall leave the site of the Work clean and ready for occupancy or use.

E. The Contractor shall proceed with the complete site restoration work as rapidly as portions of the site of the Work become available, working within seasonal limitations for each kind of site restoration work required. The Contractor will not be allowed to postpone cleanup and seeding or sodding until the end of the Work.

F. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, the Contractor shall notify the Engineer before planting.

G. The Contractor shall install materials during normal planting seasons for each type of site restoration work.

H. The Contractor shall plant or replace trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to the Engineer. If planting of trees and shrubs occurs after lawn work, the Contractor shall protect lawn areas and promptly repair damage to lawns resulting from planting operations. Refer to Section 02900, Trees, Plants and Ground Covers.

I. The Contractor may, at his option, employ additional measures (other than those specified) to prevent loss of, or damage to the Work resulting from the effects of wind and/or water. No additional compensation will be made for the employment of such additional measures.

3.03 CLEANUP

A. During site restoration work, the Contractor shall keep pavements clean and the site of the Work in an orderly condition.

B. The Contractor shall protect site restoration work and materials from damage due to site restoration operations, operations by other contractors, and trades and trespassers. The Contractor shall maintain protection during installation and maintenance periods. The Contractor shall treat, repair, or replace damaged site restoration work as directed by the Engineer.

C. Immediately upon completion of any section of the Work and before payment therefore has been made, the Contractor shall remove from the site of the Work all construction equipment, temporary structures, and debris, and shall restore the site of the Work to a condition equal to or better than that which existed prior to construction. Waste materials shall be disposed of at locations satisfactory to the City or affected regulatory agencies.

D. The Contractor shall not remove barricades and warning and direction signs until directed by the Engineer.

E. After completion of all Work required by the Contract and before final payment has been made, the Contractor shall make a final cleanup of each separate part of the Work; shall restore all surfaces to a neat and orderly condition; and shall remove all construction equipment, tools, and supplies.

3.04 INSPECTION AND ACCEPTANCE

A. When site restoration work is completed, including maintenance, the Engineer will, upon request, make an inspection to determine acceptability.

B. Where inspected site restoration work does not comply with the requirements of the Engineer, the Contractor shall replace rejected work and continue specified maintenance until reinspected by the Engineer and found to be acceptable. The Contractor shall remove rejected plants and materials promptly from the site of the Work.

+ + + END OF SECTION 02920 + + +

SECTION 03300

Concrete Work

PART 1 – GENERAL

1.01 SCOPE

A. The extent of concrete work is shown on the Drawings and indicated in the Specifications.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings"

2. ACI 311.4R "Guide for Concrete Inspection"

3. ACI 318 "Building Code Requirements for Reinforced Concrete"

4. ACI 347 "Recommended Practice for Concrete Formwork"

5. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"

6. Concrete Reinforcing Steel Institute, "Manual of Standard Practice"

7. Where local building code requirements exist, comply with provisions of such codes that are more stringent than the preceding codes and standards.

B. Workmanship: The Contractor is responsible for correction of concrete work that does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as approved by the Engineer.

C. Construction Tolerances:

1. Variation from Plumb: For lines and surfaces of columns, piers, walls, and arises, do not exceed l/4 inch in l0 feet nor more than one inch total; except for exposed corners, control joints and other conspicuous lines, do not exceed l/4 inch in any story or 20 foot maximum, nor l/2 inch in 40 feet or more.

2. Variation from Grade: For grades shown for slab soffits, ceilings, beam soffits, and in arises, do not exceed l/4 inch in l0 feet, 3/8 inch in any bay or 20 foot maximum, nor 3/4 inch in 40 feet or more. For exposed lintels, sills, parapets, joints and other conspicuous lines, do not exceed 1/4 inch in any bay or 20 foot maximum, or ½ inch in 40 feet or more from horizontal or grade indicated.

3. Variation from Linear Building Line: For position shown in plan and related position of columns, walls, and partitions, do not exceed ½ inch in any bay or 20 foot maximum, nor one inch in 40 feet or more.

4. Variation in Cross-Sectional Dimensions: For columns and beams and thickness of slabs and walls, do not exceed minus l/4 inch nor plus 1/2 inch.

1.03 CLASSES OF CONCRETE

A. Class “A” concrete 4,000 psi compressive strength at 28 days shall be steel reinforced and includes the following:

1. Foundations
2. Walls
3. Slab on grade
4. Beams
5. Elevated concrete floors
6. Columns

B. Class “B” concrete 3,000 psi compressive strength at 28 days shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following:

1. Sidewalks
2. Curbs
3. Pavement patch
4. Thrust blocking
5. Fence post footing
6. Mud slabs
7. Fill concrete
8. Concrete encasement of pipe

1.04 FACTORY TESTING AND MIX DESIGN

A. Testing Before Construction: Employ concrete testing laboratory, acceptable to Engineer, at Contractor's expense to perform material evaluation tests and to design concrete mixes.

D. Tests for Concrete Materials:

1. Test aggregates by the methods of sampling and testing of ASTM C 33.

2. For Portland cement, sample the cement and determine the properties by the methods of test of ASTM C 150.

3. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing, when acceptable to the Engineer.

C. Proportioning and Design of Mixes:

1. Submit written mix design to the Engineer for review and approval at least 15 days prior to start of work. Do not begin concrete work until the mix design has been approved by the Engineer.

2. Prepare design mixes for each type of concrete. Use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs.

3. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1.

4. Submit written reports to the Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Engineer.

D. Laboratory Trial Batches:

1. When laboratory trial batches are used to select concrete proportions, prepare test specimens in accordance with ASTM C 192 and conduct strength tests in accordance with ASTM C 39, as specified in ACI 301.

2. Establish a curve showing relationship between water-cement ratio (or cement content) and compressive strength with at least three

points representing batches that produce strengths above and below that required. Use not less than three specimens tested at 28-days, or an earlier age when acceptable to the Engineer, to establish each point on the curve.

E. Field Experience Method:

1. When field experience methods are used to select concrete proportions, establish proportions as specified in ACI 301.

2. Strength data for establishing standard deviation will be considered suitable if the concrete production facility has certified records consisting of at least thirty consecutive tests in one group or the statistical average for two groups totaling thirty or more tests, representing similar materials and projects conditions.

F. Standard Deviation:

1. If standard deviation exceeds 600 psi or if no suitable records are available, select proportions to produce an average strength of at least 1200-psi greater than the required compressive strength of concrete.

2. After sufficient experience and test data become available from the job, using ACI 214 methods of evaluation, the standard deviation may be reduced when the probable frequency of an average of three consecutive tests below required compressive strength will not exceed one in one hundred.

G. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the City and as accepted by the Engineer. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by the Engineer before using in the work.

H. Compressive Strength:

1. Design mixes for a specified strength of 3,500 psi at 28 days using a minimum of 5 1/4 bags of cement (94 pounds), and a maximum of 6 gallons of water per bag of cement, unless otherwise indicated.

2. Design mixes to provide concrete with the properties shown on the Drawings.

I. Admixtures:

1. Use air-entraining admixture in all concrete, unless otherwise shown or specified. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content by volume within the following limits:

a. 6% to 9% for maximum aggregate 1/2 inch and under.

b. 4% to 6% for maximum aggregate over 1/2 inch through 1 1/2 inch.

c. 2.5% to 4.5% for maximum aggregate over 1 1/2 inch.

J. Slump Limits:

1. Proportion and design mixes to result in concrete slump at the point of placement as follows:

a. Ramps and Sloping Surfaces: Not more than 3 inches.

b. Reinforced Foundation Systems: Not less than 1 inch and not more than 3 inches.

c. All Other Concrete: Not less than 1 inch and not more than 4 inches.

1.05 TESTING DURING CONSTRUCTION

A. All testing of samples will be done by a testing laboratory selected by the City in accordance with Section 01410. Testing shall be paid for separately by the City directly to the testing laboratory.

B. Testing During Construction:

1. Perform one slump test (ASTM C 143) for each concrete load at point of discharge, and prepare one set of three standard compressive strength cylinders (ASTM C 31) for each 50 cubic yards or fraction thereof of concrete placed in any one day. Store compressive strength cylinders in dampened protective material.

C. The following quality control testing is required during construction:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C94.

2. Slump: ASTM C 143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens; additional tests when concrete consistency seems to have changed.

D. Compressive Strength:

1. ASTM C 39, one set of 6 standard cylinders (ASTM C 31) for each 50 cubic yards or fraction thereof, of each concrete class placed in any one day or for each 5,000 square feet of surface area placed; 2 specimens tested at 7 days, 3 specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

2. When the total quantity of a given class of concrete is less than 50 cubic yards, or the quantity of concrete or any single structure is less than 10 cubic yards, the Engineer may waive compressive strength testing, but such action shall not relieve the Contractor from responsibility for furnishing concrete of the required strength.

3. The strength level of concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the specified strength by more than 500 psi.

E. Air Content: ASTM C 231, pressure method or ASTM C 173; one for each set of compressive strength test specimens.

F. Additional Tests: When test results indicate specified concrete strengths and other characteristics have not been attained, perform additional testing to determine the extent to which deficiencies exist. Where cored cylinders are utilized to determine adequacy of concrete, comply with ASTM C42.

1.06 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's specifications with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds and others as requested by the Engineer.

B. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI Special Publication No. 66 (SP-66) "ACI Detailing Manual" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangements of concrete

reinforcement. Include special reinforcement required at openings through concrete structures.

C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.

PART 2 – PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Finish Concrete:

1. Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

2. Where plywood is used in formwork, provide material complying with U.S. Product Standard PS-I "A-C or B-B High Density Overlaid Concrete Form", Class I, unless otherwise acceptable to Engineer.

B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Textured Finished Concrete: Form textured finish concrete surfaces with units of face design, size arrangement and configuration as shown on the Drawings. Provide solid backing and form supports to ensure stability of textured form liners.

D. Cylindrical Columns and Supports: Form all round-section members with metal, fiberglass reinforced plastic, or paper or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant type adhesive and wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.

E. Curved Structures: Form round or curved surfaces to true arcs without flat planes unless otherwise indicated on the Drawings.

F. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60 unless otherwise shown.

B. Epoxy-Coated Reinforcing Bars: ASTM A 775.

C. Steel Wire: ASTM A 82, plain, cold-drawn steel.

D. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

E. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise specified. Solid precast concrete block may be used for supporting footing and foundation mats against earth material. Wood, clay, brick and other non-standard devices will not be acceptable.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base materials will not support chair legs.

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected or stainless steel protected.

2.03 CONCRETE MATERIALS

A. Portland Cement:

1. ASTM C 150, Type I, unless otherwise acceptable to Engineer.

2. Use only one brand of cement throughout the project, unless otherwise acceptable to Engineer.

B. Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for all exposed concrete.

1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.

2. Coarse Aggregate: Clean, uncoated, crushed granite or similar hard stone processed from natural rock or stone, and containing no clay, mud, loam or foreign matter.

3. Maximum Aggregate Size: Not larger than one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, nor three-fourths of the minimum clear spacing between individual reinforcing bars or bundles of bars. Size limitations may be waived if, in the judgment of the Engineer, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids.

4. Water: Clean, fresh, and safely drinkable by humans.

5. Air-Entraining Admixture: ASTM C 260.

2.04 RELATED MATERIALS

A. Grout: Ready mixed Portland cement, sand and water mixture conforming with materials and mix design of highest strength project-required concrete except for deletion of coarse aggregate.

B. Nonshrink Grout: Factory-premixed cementitious material containing no corrosive material, which is nonshrink from time of placement and shows no expansion after final set when tested under ASTM C 827, has an initial setting time of not less than 45 minutes, has a 24 hour compressive strength of not less than 3,000 psi under ASTM C 109 for a trowelable mix, and is selected and applied in conformance with manufacturer's recommendations.

C. Compaction Grout:

1. Compaction grouting of voids surrounding the exterior of sewers or manholes is accomplished with the constant placement of a stiff, mortar-type Portland cement based grout material at pressures not to exceed 100 psi at the pump, unless otherwise approved by the Engineer. Cement (if used) shall be Type I or Type II Portland Cement conforming to ASTM C150. Admixtures (if used) shall conform to ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete. Grout shall either be ready-mix transported to the site, or mixed on-site. For each batch of ready-mix delivered to the site, the ready-mix plant shall issue a ticket recording the mix components, time mixed, water added, etc. The slump of the grout mix shall not exceed 3 inches.

2. The injected grout mass shall occupy the void space. The grout mass shall be injected at pressures which are requisite for the conditions encountered and shall not exceed 10 psi at the point of injection, unless otherwise approved by the Engineer. The grout volume shall expand and densify targeted soils in-place. The grout pressure produces soil compaction by displacing soil at depth until resisted by the weight of overlying soils. The grouting treatment is applied on a grid pattern, to accomplish improved compaction of displaced soils and greater uniformity of the treated soil mass.

3. Provide positive displacement pumping units with variable speed capabilities. The pumping system shall be capable of pumping the grout at pressures up to 100 psi at the pump.

4. Use steel injection pipes of sufficient diameter and wall thickness to allow grout injection to the pressure specified. Injection pipes may be installed from the interior of manholes. Otherwise, injection pipes shall be installed from the ground surface. The end of each injection pipe shall be sealed to prevent soil strata from entering the pipe during installation.

D. Waterstops (Plastic): Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as indicated. Size to suit joints. Use polyvinyl chloride (PVC) waterstops complying with Corps of Engineers Spec. CRD-C572.

E. Waterstops (Copper): Provide formed-sheet, annealed copper waterstops as shown.

F. Joint Sealing Compound: One component, non-sag, low modulus polyurethane or polysulfide sealant conforming to Federal Specification TT-S230C, Class A, Type II and ASTM C920, Type S, Class 25, Grade NS.

G. Moisture Barrier: Polyethylene sheet not less than 8 mils thick.

H. Liquid Chemical Floor Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than two pounds of fluosilicates per gallon.

I. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately nine ounces per square yard, complying with AASHTO M182, Class 2.

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

1. Waterproof Paper.

2. Polyethylene Film.

3. Polyethylene-coated burlap.

K. Membrane-Forming Curing Compound: ASTM C 309, Type I unless other type acceptable to Engineer.

2.05 CONCRETE MIXING

A. Job-Site Mixing:

1. Mix materials for concrete in an acceptable drum type batch machine mixer. For mixers of one cubic yard, or smaller capacity, continue mixing at least 1 1/2 minutes, but not more than 5 minutes after all ingredients are in the mixer, before any part of the batch is released. For mixers of capacity larger than one cubic yard, increase the minimum 1 1/2 minutes of mixing time by 15 seconds for each additional cubic yard, or fraction thereof.

2. Provide a batch ticket for each batch discharged and used in the work, indicating the project identification name and number, date, mix time, quantity, and amount of water introduced.

B. Ready-Mix Concrete:

1. Comply with the requirements of ASTM C 94, and as herein specified.

2. Delete the references for allowing additional water to be added to the batch for material with insufficient slump. Addition of water to the batch will not be permitted.

3. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

4. When the air temperature is between 85F and 90F, reduce the mixing and delivery time from 1 1/2 hours to 75 minutes, and when the air temperature is above 90F, reduce the mixing and delivery time to 60 minutes.

2.06 FLOWABLE FILL

A. Furnish and place flowable fill as directed by the Engineer. Applications include bedding, encasement and closures for pipe, and general backfill for trenches.

B. All materials shall conform to the requirements of the Georgia Department of Transportation Specifications, current edition, Section 600 for controlled low strength flowable fill.

C. The Contractor shall submit mix designs for flowable fill to the Engineer for approval.

PART 3 – EXECUTION

3.01 FORMS

A. Design, erect, support, brace and maintain:

1. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formwork so concrete members and structures are of correct size, shapes, alignment, elevation and position.

2. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

3. Construct forms complying with ACI 347, to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

4. Fabricate forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

5. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

6. Chamfer exposed corners and edges as shown, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

B. Form Ties:

1. Factory-fabricated, adjustable-length, metal form ties, designed to prevent form deflection, to prevent spalling concrete surfaces upon removal, and to prevent passage of water along tie surface through concrete.

2. Provide ties so portion remaining within concrete is at least l inch inside concrete, and do not leave holes larger than one-inch diameter in concrete surface.

C. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

D. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement if required to eliminate mortar leaks and maintain proper alignment.

3.02 PLACING REINFORCEMENT

A. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

D. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Do not place reinforcing bars more than 2 inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

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

3.03 JOINTS

A. Construction Joints:

1. Locate and install necessary construction joints, which are not shown on the Drawings, so as not to impair the strength and appearance of the structure, as acceptable to the Engineer.

2. Provide keyways in all construction joints in walls, slabs and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs. Construct keyways l l/2 inches deep unless otherwise detailed.

3. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints.

B. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form a continuous diaphragm in each joint. Make provisions to support and protect waterstops during the progress of the work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any point.

C. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs on ground at all points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.

D. Control Joints in Slabs-on-Ground:

1. Construct control joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/8 to 1/4 inch wide x 1/4 of the slab depth, unless otherwise shown.

2. Form control joints by inserting a premolded plastic, hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with the slab surface. Tool slab edges round on each side of insert. After the concrete has cured, remove inserts and clean groove of loose debris.

3.04 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screeds required. Align the concrete surface to the elevation of the screed strips by the use of strike-off templates or accepted compacting type screeds.

3.05 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue, repair, and patch as required to return forms to acceptable surface condition. Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed.

B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of the form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

C. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.06 CONCRETE PLACEMENT

A. Pre-Placement Inspection:

1. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit the installation of their work; cooperate with other trades in setting such work, as required. Moisten wood forms immediately before placing concrete, where form coatings are not used.

2. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

B. Construction Sequence: Before placing any concrete, complete blasting, heavy earthwork and other construction operations that might cause damage to concrete structures.

1. General:

a. Comply with ACI 304, and as herein specified.

b. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.

c. At all horizontal waterstops, place 1/2 inch of grout for each foot of wall pour height in bottom of forms immediately before pouring concrete walls.

2. Placing Concrete in Forms:

a. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

b. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation

of concrete in accordance with ACI 309 recommended practices.

c. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the placed layer of concrete and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

3. Placing Concrete Slabs:

a. Deposit and consolidate concrete in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

b. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

c. Bring slab surfaces to the correct level with a straightedge and strikeoff. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not disturb the slab surfaces prior to beginning finishing operations.

d. Maintain reinforcing in the proper position during concrete placement operations.

4. Cold Weather Placing:

a. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as herein specified.

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

c. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

d. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in writing by the Engineer.

5. Hot Weather Placing:

a. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305R and as herein specified.

b. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature, provided the water equivalent of the ice is calculated to the total amount of mixing water.

c. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

d. Fog spray forms, reinforcing steel and subgrade just before concrete is placed.

e. Do not use retarding admixtures without the written acceptance of the Engineer.

3.07 FINISH OF FORMED SURFACES

A. Concealed Surfaces: For formed concrete surfaces not exposed-to-view in the finished work, leave surface finish imparted by the form facing material used, with defective areas and form tie voids repaired and patched as specified, and fins and other projections exceeding l/4 inch in height rubbed flush.

B. Visible Surfaces: For formed concrete surfaces exposed-to-view, including those surfaces of water or other material holding structures visible when the structure is empty, or surfaces that are to be covered with a thin or flexible finish material bonded to the concrete, perform finish operations as specified above under "Concealed Surfaces," and in addition wet and rub entire surfaces with a carborundum stone of medium fineness until all form marks and other surface irregularities have been removed and a uniform

surface appearance achieved. Do not create a plaster coating on concrete.

C. Unformed Visible Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces.

3.08 MONOLITHIC SLAB FINISHES

A. Scratch Finish:

1. Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

2. After placing slabs, plane surface so that depressions between high spots do not exceed 1/2 inch under a 10-foot straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.

B. Float Finish:

1. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

2. After screeding, consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of floats. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane so that depressions between high spots do not exceed 6/16 inch under a 10 foot straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish:

1. Apply trowel finish to monolithic slab surfaces that are to be exposed-to-view, unless otherwise shown, and slab surfaces that are to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thinfilm finish coating system.

2. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface plane so that depressions between high spots do not exceed 1/8 inch under a l0 foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.

D. Chemical-Hardener Finish:

1. Apply chemical-hardener finish to interior concrete floors where indicated. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water, and apply in three coats; first coat, 1/3 strength; second coat, 1/2 strength; third coat, 2/3 strength. Evenly apply each coat, and allow 24 hours for drying between coats.

2. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.

3. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

E. Non-Slip Broom Finish:

1. Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.

2. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with the Engineer before application.

F. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

3.09 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying, and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of cement and proper hardening.

2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

3. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least seven days and in accordance with ACI 30l procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by one or more of the following methods as selected by the Contractor:

1. Provide moist curing: by covering concrete surfaces with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive cover.

2. Provide moisture-cover curing: by covering concrete surfaces with moisture-retaining cover, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Provide membrane curing: by applying compound to damp concrete surfaces as soon as film has disappeared. Apply uniformly in continuous operation by power-spray or roller equipment in accordance with manufacturer's directions. Recoat areas that are subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Do not use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing,

membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to the Engineer.

C. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

D. Curing Unformed Surfaces: Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing. Final cure unformed surfaces, unless otherwise specified, by methods specified above, as applicable.

3.10 FORM REMOVAL

A. In all cases, time and sequence of concrete form removal is at Contractor discretion. Formwork supporting weight of concrete, such as beams and slabs, must remain in place at least 14 days and until concrete has attained minimum design 28 day compressive strength. Formwork not supporting weight of concrete, such as sides of beams, walls and columns, may be removed no sooner than 48 hours after placement of concrete or when concrete is sufficiently hard as not to be damaged by form removal operations.

3.11 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment. Grout base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on Drawings. Screed, tamp, and finish concrete surfaces as scheduled.

E. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on Drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

F. Compaction Grouting: The Contractor shall confirm the Engineer's approximate location of void areas around the suspect sewer or manhole prior to installation of the injection pipes. All costs associated with the void investigation shall be incidental to the compaction grouting work. If necessary, the grouting operation shall be delayed until the Contractor can perform point repairs or other rehabilitative measures to restore structural stability to the sewer. The grout injection rate shall not exceed 4.0 cubic feet per minute, unless authorized by the Engineer. Progress the grouting process in stages using the "bottom up" method. The "bottom up" method stages start at the bottom of the grouting pipe, at least 1 foot into the underlying dense soil strata, progressing upward at maximum intervals of 2 feet. The Contractor shall carefully control grout pumping rates and injection pressures. Injection holes lost during grouting operations shall be replaced by the Contractor at no additional cost to the Owner. For injection pipes installed from the interior of manholes, remove the injectors and patch the holes with quick setting hydraulic cement.

3.13 FLOWABLE FILL

A. Furnish and place flowable fill concrete as directed by the Engineer. Typical applications include bedding, encasement and closures for pipe and general backfill of trenches.

B. Contractor shall flood the pipeline, sequence Flowable Fill placement, provide straps, soil anchors or other approved means of restraint to

prevent flotation or misalignment that may occur at no additional cost to the City.

C. Flowable fill shall be protected from freezing for a period of 36 hours after placement.

D. All flowable fill shall be furnished and installed in accordance with Georgia Department of Transportation Standard Specification Section 600 – Controlled Low Strength Flowable Fill and/or City of Atlanta Department of Public Works flowable fill requirements whichever is deemed appropriate by the Engineer.

3.14 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:

1. Repair and patch defective areas with cement mortar immediately after removal of forms, but only when acceptable to Engineer.

2. Cut out honeycomb, rock pockets, voids over l/8 inch in any dimension and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than one inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to Engineer.

3. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color of surrounding surface. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces:

1. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets and holes left by tie rods and bolts; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement core plugs secured in place with bonding agent.

2. Repair concealed formed surfaces, where possible, that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.

2. Repair finished unformed surfaces that contain defects that adversely affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01 inch wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

3. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

4. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.

5. Repair defective areas, except random cracks and single holes not exceeding one-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete, and brush with a neat cement grout coating or concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of same materials to provide concrete of the same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

6. Repair isolated random cracks and single holes not over one inch in diameter by dry-pack method. Groove top of cracks and cutout holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and brush with neat cement grout coating or concrete bonding agent. Place dry-pack before cement grout takes its initial set. Mix dry-pack, consisting of one

part Portland cement to 2 1/2 parts fine aggregate passing a No. l6 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

7. Repair methods not specified above may be used, subject to acceptance of Engineer.

8. Agreement by the Engineer to permit repair or patching of concrete does not waive the Engineer's authority to require complete removal and replacement of defective concrete pours should the patch not prove satisfactory to the Engineer, due either to deficiency in strength, function or appearance.

END OF SECTION