SECTION 02546

Grouted Steel Reinforced PVC Profile Sewer Pipe Liner System

PART 1 - GENERAL

1.01 SCOPE

A. Work described in this Section includes furnishing all labor, materials, equipment, tools, subcontractors, and incidentals required for a complete and operable installation of grouted steel reinforced PVC profile liner. This conduit renewal system must fully conform to the Contract Documents. The intent of this process is to restore this trunk sewer to an additional fifty (50) year service life.

B. To expedite and facilitate the Work, the City has selected Sekisui's SPR792SU and SPR792SFU PVC profile sewer pipe lining system for this project and has negotiated a purchase price for these materials at the port of entry with Sekisui. All references to Manufacturer/Supplier contained within this specification section refer to Sekisui.

C. The Contractor shall be responsible for coordinating receipt of the lining system materials to their designated project facility/site in Atlanta, GA with the Manufacturer/Supplier. The Manufacturer/Supplier shall pay any and all customs duties and fees, transportation from the manufacturing facility to the nearest port and to the designated project facility/site. The Contractor shall pay the Manufacturer/Supplier for these materials during the course of the Work in accordance to the Manufacturers payment terms.

D. All materials shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Contract Documents. The general requirements herein, together with the detailed requirements of the specifications, establish the work necessary to furnish and install the liner system.

E. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the lining system being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price for the work shown and specified.

F. The grouted steel reinforced PVC profile lining renewal process utilizes an extruded polyvinyl chloride (PVC) profile strip that is installed into an existing conduit (host pipe). The extruded profile strip is shaped into a continuous cylindrical (or other) shape using a spiral winding machine, mechanically locked together on the grouting side (in the annular space between the host pipe and the new liner) by virtue of the profile design, and then the grouting process bonds the liner to the prepared surface of the host pipe. There shall be no internal adhesive or field-applied devices to secure the profile unless recommended by the Manufacturer/Supplier and approved by the Engineer. Welding of the seams, use of resin-based patching compound, parging and transition sections may be acceptable if

approved by the Engineer for defined and specific areas and in compliance with the Manufacturer/Supplier's fifty (50) year service life warranty.

G. The Work of this Section shall comply with the current versions, with revisions, of the following:

1. OSHA 29 CFR 1910.146 (permit-required confined-space regulations)
2. General and Special Conditions of this contract.

H. 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 Electrical Code.

I. Related Work Specified Elsewhere;

1. Section 01200 – Measurement and Payment
2. Section 02200 – Site Preparation
3. Section 02511 – Preconditioning and Cleaning Manholes and Sewers
4. Section 02730 - Sewers and Accessories
5. Section 02750 – Wastewater Flow Control
6. Section 02491 – Rehabilitation of Sanitary Sewer Manholes
7. Section 03200 – Concrete Reinforcing
8. Section 03300 – Concrete Work

J. The gravity sewer, rehabilitated with the grouted steel reinforced PVC profile conduit renewal system shall be structurally capable of withstanding a) an earthen overburden pressure depth of 30 feet dead load and b) an AASHTO HS-20 Truck traffic load in conjunction with a minimum 6 inch earthen overburden,. It must also be able to withstand an internal bursting pressure equivalent to 40 feet of vertical head of water. The manufacturer's documentation affirming that the product meets the project requirements based on the attached list of pipe segments detail scan can be found in Exhibit D – Spiral Wound Liner Design.

K. The rehabilitated sewer shall have an improved coefficient of friction sufficient to compensate for the reduced diameter of the rehabilitated pipe and shall at least have the same capacity as the existing sewer pipe. The Manufacturer's calculations to quantify the average end area reduction and the resultant flow impact calculations can be found in Exhibit D – Spiral Wound Liner Design.

L. The Manufacturer has provided a certificate certifying that the products for this project meet or exceed the requirements of ASTM F1697 and/or ASTM F1741 and the requirements of these Specifications. The manufacturer's certificate can be found in Exhibit D – Spiral Wound Liner Design.

M. Manufacturer's references meeting the requirements of 1.03 B Experience can be found in Exhibit D – Spiral Wound Liner Design.

N. The Manufacturer/Supplier has reviewed the project application and has certified via a notarized letter the fitness of its products for use in this application. The letter affirms that the grouted steel reinforced PVC lining system conforms to the requirements of this specification and all other applicable contract requirements. Certification that the material shall also provide the history of successful application of the product with Owner and Engineer contacts within the last five (5) years. The manufacturer's letter can be found in Exhibit D – Spiral Wound Liner Design.

1.02 SUBMITTALS

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

1. Product Data: Descriptive details and shop drawings covering full details of pipe lining material, fittings, special procedures, joints and assemblies, joint materials, termination and transition strips/splices or appliances and details, including any resin or cementitious parging, feathering or transition materials and full details for the lining layout and transition to and from manholes, vaults and access shafts. This includes catalogue cuts of all materials to be incorporated into the work with samples as requested by the Engineer and MSDS sheets on chemicals, grout or other components included. The Contractor shall submit this information no later than 90 days prior to the start of lining operations.

2. Manufacturer's Installation Instructions including: any special procedures required to install products specified and any safety equipment or processes; training and equipment; and QA/QC testing required to successfully install the 50-year service life certified product shall be submitted no later than 90 days prior to the start of lining operations.

3. Manufacturer's Warranty: A draft copy of the Manufacturer's warranty is to be submitted within 30 calendar days of NTP. Final copies of the Manufacturer's warranty shall be submitted within 30 days of completion of lining operations.

4. Installation Contractor's Qualifications: Documentation demonstrating that the installation contractor is approved and qualified by the Manufacturer to install the lining system shall be submitted with the Contractor's bid.

5. Installation Contractor's Experience References: The Contractor shall submit its history of successful applications of the specified product in similar size installations. In addition, the Contractor shall submit the Contractor's or subcontractor's installation references meeting the requirements of 1.03 B. Experience. This information shall be submitted with the Contractor's bid.

6. Contractor's Design Calculations: The Contractor shall submit final (after the Contractor's inspection) structural design calculations prepared and signed and sealed by a Professional Engineer licensed in the state of Georgia showing the required PVC liner system thickness, grout strength and thickness, and steel or other approved reinforcing requirements for the installation as required to fulfill the structural requirements. PVC profile lining strip design calculations shall be supported by field analysis, stated technical assumptions, requirements of this specification and ASTM F1697 /F1741. The calculations shall at a minimum demonstrate compliance with Section 1.01 J and K above for loads, pressures, and flow capacity. The submittals shall include calculations covering all conditions of host pipe shape and size, transition sections, pipeline configurations and all structures that are to be lined through. If the design can be achieved by fully utilizing the steel reinforced profile strip only and if the grout fill in the annulus is only necessary to address load transfer issues, the Contractor shall provide a fully standalone design in accordance to ASTM F 1741 for a fully deteriorated pipe. All designs are to be approved by the Engineer. The contract documents identify the requirements and limits of the rehabilitation. The Contractor shall submit the final calculations no later than 30 days following the Contractor's inspection.

7. All calculations shall be prepared, signed and sealed by a Professional Engineer licensed in the state of Georgia and shall demonstrate the ability of the internal lining system to conform to the installation requirements without buckling and/or deformation due to flotation and pressures experienced during the grouting operations.

8. Grouting Process: The Contractor shall prepare and submit a complete detailed description of the grouting process with the design calculations.

9. Safety Plan: The Contractor shall prepare and submit a site-specific safety plan. This plan shall address ventilation, lighting, ingress/egress, rescue procedures, and training certification of employees. It shall have sections that address specific parts of the installation operation and how the safety plan is tied to the Pumping and Grouting activities, procedures for inclement weather, or power failure; redundancy of equipment and manned monitoring items shall be included. The Contractor shall submit this plan no later than 90 days prior to the start of lining operations.

10. Host Pipe Cleaning Methods: The Contractor shall submit host pipe cleaning method(s) for all phases of the operation including debris removal and heavy pressure cleaning. The package should include the specifics on debris and detritus removal and hauling and disposal per Spec Sections 02511 and 02546. The Contractor shall submit the host pipe cleaning methods no later than 30 days prior to initiating cleaning operations.

11. Bypass Pumping Plan: The Contractor shall prepare and submit a bypass pumping and/or flow control pumping plan for approval of the Engineer. This plan must conform to the requirements of Spec Sections 02750 Wastewater Flow Control and

02546 (Refer to paragraph -2546-3.02 C. of this section.) It shall include safety features, alarms, manned observation locations and auto-dialer system to ensure continuous worker safety, flow monitoring, spill avoidance and operations. This plan shall include redundant equipment, processes and contingencies. The Contractor shall submit this plan no later than 30 days prior to mobilization of pumping equipment to the project site.

12. Pre-Installation Video and 360 Degree 3D Digital Laser Survey: The Contractor shall prepare and submit a pre-installation video and 360 degree 3D digital laser survey of host pipe in accordance with the requirements of Specification Sections 02752 and 02546. This activity is part of the pre-installation verification activities required for the Contractor and lining Supplier to certify the suitability of the existing conduit conditions, identify settlement, deterioration or areas requiring pre-installation repair. The Contractor shall submit these surveys following cleaning operations, and prior to initiating lining operations.

13. Work Plans (Lining): The Contractor shall prepare and submit work plans for the lining process. These plans detail the activities to be performed under the plan and shall include details of all materials and equipment to be used during the lining process. They shall include safety, flow control and other elements or considerations that are part of those project planned activities. They must be thorough, detailed, demonstrate redundancy to address potential failure scenarios such as pump or lighting failure, and include: assignment lists, checklists to be used to ensure all critical operations or activities are performed; contact lists; and contingency measures. The plans must address all coordination between the City's Public Information group and the Contractor's Customer Service team, and must describe potential community impacts resulting from changes to service necessitated by the work plan as well as provide for notice of community impacts. The Contractor shall submit these plans a minimum of 30 days prior to implementation.

14. Grout Mix Design: The Contractor shall submit a grout mix design from an industry-certified concrete supplier with certified laboratory test breaks data, which demonstrates that the grout mix will satisfy the structural requirements of this specification; the design calculations; and the Manufacturer's warranty. The grout mix design submittal must comply with the stated structural requirements and the submittal shall include the QA/QC plan that will be used to verify that the design meets those standards throughout the installation process. The Contractor shall submit the grout mix design a minimum of 60 days prior to the start of grouting activities.

15. Work Plans (Grouting): The Contractor shall prepare and submit work plans for annular grouting. These plans shall address the spacing and details of bulkheads, details of any bracing or restraint systems (including design calculations), grout injection/vent holes, the number and height of grout lifts required to fill the annular space, and methods for repairing holes in the lining are required. They must be coordinated with the structural design requirements and testing requirements in the

QA/QC plan, and addressed in the project schedule as the set-time and number of grouting lifts affect the production rate of the lining crews. The Contractor shall submit these work plans a minimum of 60 days prior to the start of grouting activities.

16. Documentation for the steel strip reinforcing, if applicable, confirming that the steel satisfies the requirements of this specification and the Contractor's design submittal shall be submitted as Product Data. If the design parameters require added reinforcing, submit the designer's detailed requirements; mesh, rebar or standees.

17. Documentation for the PVC profile strip material confirming that the material satisfies the requirements of this specification and the Contractor's design submittal shall be submitted as Product Data.

18. Quality Assurance and Quality Control Program: The Contractor shall prepare and submit a detailed Quality Assurance and Quality Control Program that fully describes and details the quality assurance and control measures to be implemented to ensure all lining activities conform to the Contract requirements. This program shall fully address the compressive strength testing and QA/QC measures for annular grouting, and shall describe the measures that will be taken in the event of compressive strength test failures. The Contractor shall submit this program description a minimum of 90 days prior to the start of lining operations.

19. As part of the Quality Assurance and Quality Control Program, the Contractor shall contract with an independent materials testing firm to oversee grout sampling and testing. The name of this firm and its qualifications for grout sampling and testing shall be included as part of the Program description.

20. Final Project Documentation: Within 2 weeks of final acceptance of the work the Contractor shall submit four (4) sets of the following to the Engineer in a comprehensive notebook format: DVDs of the original pre-construction videos; DVDs of all final submittal copies; DVDs of the pre-installation videos; DVDs of all rights of entry agreement copies; surveys; easements and the pre-construction videos of the areas affected; the restoration videos of each affected property and a copy of the property owner's signed acceptance of the restoration of the property; DVDs of all the project photos taken by the Contractor, Manufacturer/Supplier and others; digital and hard copy survey-stationed as-built drawings complying with the Owner's GIS system; DVDs of post-installation video survey of the renewed conduit; and DVD and hard copies of all warranty and bond documents.

B. The Contractor must submit a work plan for each portion of the work undertaken. This is to include all elements of the field work installation and all safety issues to be managed. A checklist detailing responsibility of each item is to be in the work plan. All emergency extraction equipment and gas detection devices are to be included on the checklists for each setup. The Engineer has the right to require adjustments to the plan but it remains the Contractor's plan and responsibility.

C. All activities associated with installation of the Grouted Steel Reinforced PVC Profile Sewer Pipe Liner System must be included in the P-6 project schedule. Refer to SC- 16. It shall include:

1. Reference IDs that coincide with the survey stations and Owner's GIS IDs
2. Identify work to be performed at manholes and vaults; points of access; and sewer segments; and location and duration of required equipment deployment along the Trunk sewer
3. Schedule updates require tracking of ROE and easement restraints; material deliveries; and other activities that the Engineer/Owner believes are necessary to maintain a functional and meaningful schedule of the Work.

1.03 QUALITY ASSURANCE

A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Plans or specified in these Specifications.

1. ASTM C109-05 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimen)
2. ASTM D256-06 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
3. ASTM D638-03 Standard Test Method for Tensile Properties of Plastics
4. ASTM D648-06 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
5. A653/A653M-06 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
6. ASTM C 939 Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
7. ASTM C940-98 Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Pre-placed Aggregate Concrete in the Laboratory.
8. ASTM C 942 Standard Test Method for Compressive Strength of Grout for Preplaced-Aggregate Concrete in the Laboratory
9. ASTM C1090-01 Standard Test method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic Cement Grout.
10. ASTM F1697-09 Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral Wound Liner Pipe Rehabilitation of Existing Sewers and Conduits.
11. ASTM F1741-08 Standard Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits.
12. ASTM D1784-03 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compound.

B. Experience: Due to the specialized nature of this work, the Contractor shall clearly demonstrate that he, his subcontractors, and his personnel are fully trained and experienced in the installation of the selected Grouted Steel Reinforced PVC Profile Sewer Pipe Liner System.

1. Contractor:
    a. The Contractor must be approved and qualified by the Manufacturer to install the lining system.
    b. The Contractor or the installation subcontractor shall have a minimum of ten (10) years' experience in sewer and confined space work and shall have installed a minimum of 2,000 linear feet (LF) of 66-inch sewer main or larger grouted steel reinforced PVC profile lining. . Experience on gunite, spray-on technologies, resin bag lining (CIPP), slip lining methods or others may not be used in this 2,000 linear feet (LF of 66-inch sewer main or larger requirement.
    c. A current Georgia Utility Contractor's License is required.
    d. Specific team experience requirements follow: Contractor shall supply a minimum of three (3) references from similar projects in a similar diameter range, with name of contact person, position and contact information. The information supplied shall include a project description, location and year started or completed.

2. Field Superintendent:
    a. The Contractor shall submit the name, qualifications and references for each proposed field superintendent for the project. The Contractor is required to have at least one (1) qualified and APPROVED superintendent on the job site at all times during all lining and grouting activities.
    b. The field superintendent must have field experience on a minimum of five (5) years of sewer construction including confined space training and one (1) successfully completed sewer lining project installing a grouted lining similar to the proposed grouted steel reinforced PVC profile system.
    c. Experience on gunite application or resin bag lining may not be substituted.

3. Installation Crew:
    a. At least one person other than the field superintendent from each lining installation crew shall have a minimum of five (5) years in sewer construction and confined space training and one (1) successfully completed sewer lining project installing a grouted lining similar to the proposed grouted steel reinforced PVC profile system
    b. Experience on gunite application or resin bag lining may not be substituted.

C. Warranty.

1. The Contractor shall warranty the lining installation to be free from defects in materials and workmanship for period of five (5) years from the date of completion

and final payment of this project. The Manufacturer/Supplier shall make periodic inspections of the lining process to ensure compliance with their recommended procedures and will provide timely documentation to the Engineer/Owner verifying that they have performed this field review. The Manufacturer/Supplier must provide a written (5) year product warranty for the grouted steel reinforced PVC liner system. A final certification from the manufacturer/supplier shall be provided certifying that the liner installation is acceptable for the benefit of the Owner and shall be submitted by the Contractor as a condition of final payment.

2. The Contractor shall, as a part of this warranty, agree without legal appeal, to repair or replace, at the Owner's discretion and within two (2) weeks of notification, any discovered defects or lining failures. This work will be performed at no cost to the Owner, and covers any work found to be defective within the five (5) year warranty period. Any such repairs or replacement shall include all costs of removal, repair and reinstallation; it shall carry no proration of cost.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Grouted Steel Reinforced PVC Profile Lining Strip:

1. Profile strip shall be made from compounds conforming to ASTM D1784-03 with a cell classification of 13334 or 12343.

2. Profile designation (geometry) shall be compatible with the design requirements for the renewed conduit and shall be suitable for installation in the host pipe.

3. Grouting port plugs, restraint appliances, patching and parging materials must be compatible with the PVC profile lining. Product Data for these materials must be submitted by the Contractor and certified by the Manufacturer/Supplier as a compatible part of the system covered by the warranty.

4. Provide all test results to the City prior to installation.

B. Annular Grout:

1. Grout to be used to fill the annular void space shall consist of Portland cement, water, and suitable admixtures for flowability and strength per approved manufacturer's specification. Any requests to utilize fly ash will require added QA/QC steps to affirm that any fly ash additives have a consistent pH of at least 7.

2. Flow characteristics, maximum drying shrinkage, and minimum compressive strength requirements for the grout shall be compatible with the design requirements for the renewed conduit and shall be compatible with the field conditions under which the

grout will be installed. The timing and strength of each grout lift shall be compatible with achieving the required strength and set without deforming the PCV liner

3. Grout shall be sampled and tested as follow:
   a. A minimum of six (6) cubes will be cast for each 50 cubic yards or each lift of grout placed per day, or fraction thereof. Grout shall be sampled and tested with a frequency of one cube at 24 hours, one at 3 days, one at 7 days, two at 28 days and one at 56 days or per the Engineer's instruction. Sample preparation, curing and testing shall conform to ASTM C109-05. The test report shall record date, time, location, identification of the lift where grout is placed, and identification of longitudinal location referenced to nearest manhole where grout is placed.
   b. In addition to the grout cubes a set of two (2) cylinders will be molded, at the same frequency as the cubes, and tested. The cylinders will be 4 inch diameter and 8 inches in length. The cylinders will be molded and initially cured in accordance with ASTM C31. After initial curing in the field, the cylinders will be transported to the laboratory for further curing and compressive strength testing in accordance with ASTM C39. Grout shall be tested for compressive strength at 28 days of age or per the Engineer's instruction.
   c. In the event of a grout test failure, the Contractor shall immediately notify the Owner and shall implement remedial measures as detailed in the Quality Assurance and Quality Control Program submittal.

C. Steel Reinforcing Strip and Reinforcing Options: (Dependent on design)

1. The steel reinforcing strip if part of the PVC liner profile strip shall be fabricated from sheet steel conforming to ASTM A653 or ASTM A1011.

2. The thickness, formed shape, and yield strength of the strip shall be compatible with the design requirements for the renewed conduit and the specified profile designation.

3. Alternate requirements for reinforcing steel may be required by the Engineer for added strength. All reinforcing bar shall be minimum 50 ksi rated, epoxy coating optional. Standees or chairs must be suitable for pre-assembly and underground utility application.

4. If dimpled 6" x 6" welded wire (WW) Fabric or polyester grid is used the submittal must detail laps and lengths and the restraining method. If carbon fiber or other reinforcing is used, it must support the 50-year utility service life requirements and be completely detailed in the structural calculations submittals.

5. All work shall conform to ASTM F1697F1741 "Standard Practice" for grouted steel reinforced PVC pipe installations.

2.02 PRODUCT HANDLING

A. The PVC lining profile material shall be packaged and shipped for ease of handling and product protection. The product shall be inspected for defects at the time of manufacture and again in the field prior to installation. Defects to the profiles include, but are not limited to, gouges, abrasion, flattening, cuts, punctures, and ultra-violet (UV) degradation. Defective product shall not be installed and shall be removed from the jobsite. Handling and storage of the profile reels shall be in accordance with the manufacturer's instructions.

B. All other products required to complete the grouted steel reinforced PVC profile lining renewal process shall be handled and stored in accordance with the manufacturer's instructions. Each product shall be accompanied by its relevant specification and MSDS information. Product may not be stored for more than a week at the access points and then only if they are physically secured from public access.

2.03 MATERIAL MARKING

A. The profile strip shall be distinctly marked on its inside surface at appropriate intervals with a code number identifying the manufacturer, plant, date of manufacture, and profile designation.

B. All other products required to complete the grouted steel reinforced PVC profile lining renewal process shall be distinctly marked with product type and manufacturer. All parts incorporated into the final lining system must be submitted and approved by the Manufacturer and Engineer.

2.04 ACCEPTABLE MANUFACTURERS

A. The grouted steel reinforced PVC profile lining system shall be as manufactured by Sekisui SPR Americas, LLC, or affiliate companies owned by Sekisui Chemical Co. Ltd.

PART 3 - EXECUTION

3.01 GENERAL

A. Perform all work in accordance with applicable OSHA standards.

B. All work shall conform to ASTM F 1697 " Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral Wound Liner Pipe Rehabilitation of Existing Sewers and Conduits.

3.02 PREPARATION

A. Host Pipe Access:

1. Unless otherwise specified by the Engineer, the Contractor may utilize any of the existing manholes in the project area as access points. The Contractor is required to obtain all permits, as well as notify the City regarding rights-of-entry and access necessary which are not expressly part of the City's proscribed maintenance easements. The Contractor is to copy the City on their agreements and/or negotiations with property owners and their permits packages. The Contractor is further to hold harmless the City and their agents from those agreements.

2. Should temporary excavations be needed to access the host pipe, such work shall be coordinated with the Engineer. Excavations shall be sloped or shored in accordance with all applicable safety regulations, detailed in both the work plan and safety plan and protected from public access. This activity is incidental to the work and is not paid separately.

3. Any permanent manholes or vaults that are added to the sewer system are to be numbered and mapped in accordance with the City's existing GIS designations and physically labeled in the field as well.

4. Any access requiring road closures or lane closures are to be properly permitted and coordinated with the Public Information staff and the Contractor's Customer Service staff. They are to be managed to have minimal impact on traffic and the surrounding community. They are to be safely managed at all times.

B. Cleaning:

1. All debris and obstructions shall be removed from the host pipe and disposed of in accordance with the requirements of the contract, and local codes and ordinances. The Contractor or his subcontractor is responsible for obtaining and paying for hauling and hauling permits. Chain of custody documentation may be required by the City on all debris and detritus disposal loads if deemed necessary. It will be incidental to the work and not paid for separately.

2. Cleaning shall be performed in accordance with Section 02511 and in accordance with the grouted steel reinforced PVC profile sewer pipe liner system manufacturer's requirements and paid for under the appropriate bid items.

3. Water jetting shall be used to clean and prepare the surface of the host pipe. All loose material, acids, grease and other deleterious substances shall be removed during cleaning, and the prepared surface shall be suitable for mechanical bonding with cementitious grout. The Contractor or his subcontractor is responsible for obtaining all temporary hydrant connections and paying for the water used. They are responsible for hauling off and properly disposing of the detritus. Chain of custody documentation may be required by the City on all debris and detritus disposal loads if deemed necessary. It will be incidental to the work and not paid for separately.

C. Flow bypassing and/or control:

1. Where required for safe and effective application of the lining technology, the Contractor shall determine whether diversion and/or full or partial bypass flows around the length of host pipe designated for renewal is required. These activities shall be detailed in both the work and safety plans. These activities shall be coordinated with the City's R.M. Clayton WRC, Sewer Operations Division and the Public Information staff. The Contractor's work plan shall not put the City's operations at risk. These activities may require weekend or low-flow evening operations and the Contractor shall build that flexibility into his contract schedule as incidental to that work.

2. The Contractor shall determine, in accordance with the Manufacturer's requirements, the conditions under which dry weather and/or wet weather flow shall be allowed through the relined sections of sewer during the period of construction/rehabilitation, and shall be responsible for all damage repairs, at no additional cost to the City.

3. The bypass shall be made by diverting flow or plugging the host pipe at an existing upstream manhole and pumping the full or partial flow into a downstream manhole; or by containing the existing flow in a manner which keeps the pipe clean after jetting. The Contractor shall submit a detailed work plan that fully describes each aspect of the diversion and/or pumping plan with redundancy, equipment specs and placement. The bypassing and flow control plan must contain specific safety elements and emergency criteria.

4. The Contractor is responsible for submitting a complete package of flow calculations covering the diversion pumping and containment of flow with their material submittals and work plan. This work plan must include redundancy and auto-dialers, alarms and/or manned support to ensure worker safety and the prevention of spills. The Contractor or his subcontractor must also have a defined contingency plan in the event that any portion of this work plan fails. This is a separate and distinct submittal which follows the work and safety plan submittals.

5. The pump and bypass lines at a minimum shall be of adequate capacity to handle peaking dry weather flows. They shall be set up with fail-safe floats and auto dialers that prevent safety incidents, overflows, failures and spills. The auto dialer shall be capable of calling at least 3 persons each for the Engineer/Owner and 2 for the Contractor.

6. Flow interruptions shall be coordinated with the Engineer at least 14 days in advance and with property owners and businesses at least 3 days in advance. The Contractor's Customer Service reps are to provide contact and coordination with stakeholders well in advance of the scheduled shutdowns and advise the Engineer of any issues to be managed during the activity. Contractor's Customer Service staff is required to be on-site and/or on-call during all diversion, pumping and service outages as determined necessary by the City or Engineer.

7. All motorized equipment shall have super-silencers to minimize the noise level and shall be surrounded by noise reduction panels when required by the Engineer or Owner. All critical point equipment will have redundancy including pre-fueled generators on standby.

8. Flow bypassing and/ or control shall be performed in accordance Section 02750.

D. Pre-Installation Inspection and Surveying:

1. After cleaning, and prior to installing the PVC profile material, the Contractor shall notify the Engineer and lining Manufacturer to inspect the host pipe. This is to ensure there are no excessive variations in the host pipe profile and no obstructions that would hinder the successful installation of grouted steel reinforced PVC profile lining. Contractor and the lining Manufacturer shall also verify that the sizing of the profile (wound geometry) will be suitable for the host pipe geometry. The Manufacturer shall provide to the Owner through the Contractor their notarized certification requirements per 1.02 Submittals: A.4. This task is a man entry observation where Contractor safety precautions must be followed.

2. The longitudinal and radial locations of all lateral connections to the host pipe shall be logged for subsequent reinstatement. These connections shall be located using the existing City GIS stationing and shall be entered into the as-built survey data. This task is a man entry observation where Contractor safety precautions must be followed.

3. The Contractor shall perform a pre-installation video survey of the host pipe as required by the Owner. It shall include survey stationing consistent with the City's GIS stationing, and show all manholes, vaults and lateral connections. The Contractor shall submit three (3) copies of this video on DVD. This work shall be performed in accordance with Section 02752 and paid for under the appropriate bid item.

4. The contractor shall perform a pre-installation high definition 3D laser scanning survey as required by the Owner. The surveyor shall have a minimum of 5-years of experience with such surveying technique. The accuracy of this surveying shall be +/- 3/8 inch. The Contractor will provide a copy of this survey and five (5) sets of alignment drawings generated from them and one (1) reproducible to the Owner and Engineer prior to commencement of any lining activity. This survey shall include survey stationing- consistent with the City's GIS stationing, and show all manholes, vaults and lateral connections. The Contractor shall submit three (3) copies of this video on DVD.

3.03 INSTALLATION

A. Grouted Steel Reinforced PVC Profile Lining:

1. Installation of grouted steel reinforced PVC profile shall conform to the Contract requirements, approved submittals and Manufacturer's requirements. The profile shall be wound/installed using the equipment recommended by the Manufacturer and certified to produce an acceptable and warrantable lining system. The winding machine traverses through the host pipe forming the spiral wound lining conduit as it goes.

2. The process shall be continuous until the lining is complete for the length of host pipe to be renewed. The material splicing method must be reviewed by the Engineer to assure quality and durability of the method of splicing. Any restraint appliances used as a permanent part of the work must be reviewed by the Engineer for compliance with the 50-year service life requirements. These appliances must be recommended by and installed in accordance with the Manufacturer's requirements. Exposed metal surfaces will not be accepted.

3. During lining operations the Contractor shall provide continuous uninterrupted service at all connecting laterals.

B. Annular Grouting of the PVC Lining System:

1. Annular grouting shall conform to the Contract requirements, Contractor's approved submittals, Manufacturer's requirements and the approved lining design.

2. After the PVC profile lining material has been installed, and before the annular space is grouted, the Contractor shall restore service at all lateral connections. Field conditions will dictate whether service restoration can be done from inside the conduit or whether restoration will require the exterior of the conduit and connecting pipes to be exposed.

3. Grouting shall be done between bulkheads installed at pre-determined distances along the conduit, in lift increments as per the approved submittals and the structural design.

4. Prior to grouting, bracing or restraint work shall be installed which shall be designed by the Contractor in coordination with the lining Manufacturer's engineer. This bracing shall serve the following functions during grouting; (a) preventing flotation of the PVC profile lining material, (b) aligning the PVC profile lining material within the host pipe so that the required annular space is maintained between the PVC profile strip and host pipe, (c) preventing excessive deflection, flotation or buckling of the PVC profile lining material.

5. The approved grout shall be pumped into the annular space between the PVC profile lining material and the host pipe through pre-drilled locations around the circumference of the PVC lining material. Vent holes shall be provided at suitable

locations to permit air to be expelled from the annular space and to monitor grout fill levels.

6. Grout shall be sampled and tested in accordance with the Contract requirements, Contractor's approved QA/QC plan, Manufacturer's recommendations, and ASTM C109-05.

    a. Grout strength shall be in accordance with the approved design submittal's strength requirements.
    b. The Contractor shall provide a 56-day curve of grout strength to the Engineer prior to the first grouting activity as part of the QA/QC plan monitoring baseline.

7. Grouting lifts shall not exceed the height of lifts as detailed in the approved lining design, and grouting work plan, nor shall the rate of pumping in CF exceed that recommended by the Manufacturer/Supplier and approved by the Engineer. Grouting must completely fill the annular space without causing deformation of the PVC profile material.

8. The volume of grout required to fill the annular space for each section between bulkheads is to be calculated prior to the grouting activity and reported to the Engineer. It shall be monitored to ensure that each segment is fully grouted per the approved design. The actual amount of grout injected/placed in each lift shall be reported and samples for QA/QC confirmation testing will be logged at predetermined points during injection/placement.

9. As part of the QA/QC Program, the Contractor shall subcontract with an independent testing firm to provide oversight of the grout sampling activity and the handling and testing of the grout samples so that the quality of the samples are not compromised.

3.04 COMPLETION OF WORK AND SITE RESTORATION

A. Ends of Renewed Conduit:

1. The ends of the PVC profile material shall be securely fastened and grouted in position per the Manufacturer/Supplier's recommendations. The PVC profile material shall be sealed to the host pipe with approved material capable of achieving a watertight seal and compatible with the lining materials and in compliance with the 50-year service life requirements.

2. The step in the flow line at the ends of the renewed conduit shall be tapered into the existing flow line using approved materials per the Manufacturer/Supplier's recommendations.

3. The areas where new PVC lining material abuts existing PVC lining material is to be leveled with the surrounding area with a compatible material that is approved by the Manufacturer/Supplier for that purpose. The resultant surfaces are to be a smooth and

to provide an even transition throughout the conduit. This transition must be inspected and certified by the Manufacturer/Supplier as warrantable and in keeping with the 50-year utility service life renewal program.

B. Any holes made in the PVC profile material during the grouting or installation operation shall be sealed with a material compatible with the lining material recommended by the Manufacturer/Supplier. Patching/sealing these holes must be approved by the Engineer and must not void the Manufacturer/Supplier warranty.

C. At points where temporary excavation was required for access to the host pipe or lateral connections, appropriate repairs and encasement shall be provided for the PVC profile material and/or connecting pipe connections. Encasement materials may consist of concrete, epoxy grout or other suitable materials as approved by the Engineer for the anticipated service.

D. Final Inspection and Acceptance:

1. After the installation of the liner and the completion of all grouting, lateral reinstatement and repair and manhole rehabilitation, the liner shall be visually inspected by the QA/QC manager, the Contractor's superintendent and the Engineer. This inspection will be video recorded. Where lateral connections have been damaged or where there are other deficiencies caused by the grouting operations, the damaged section of the liner, lateral connection or manhole shall be corrected at no additional cost to the Owner. All repairs will be in accordance with the Manufacturer/Supplier's recommendations and must be warrantable.

2. The grouted in-place, PVC profile lining in the renewed conduit shall be continuous over the entire length of an installation run and be free from defects such as foreign inclusions, holes, cuts, tears, bulges, restrictions and grout voids. The renewed conduit shall be impervious against leakage out of the conduit to the surrounding ground or into the conduit from the surrounding ground.

3. Any defect in the lining installation that will or potentially could affect the structural integrity or performance of the renewed conduit shall be repaired at the Contractor's expense using means and methods approved by the Engineer and the Manufacturer/Supplier providing the warranty.

****END OF SECTION 02546****