

**APPENDIX I
TOWN OF NEEDHAM
REFERENCE SPECIFICATIONS**

SECTION 6 WATER CONTRACT SPECIFICATIONS

6.1 CEMENT LINED DUCTILE IRON (CLDI) PIPE

6.1.1 General

The Contractor shall make all earth excavations, provide all materials, lay, joint and connect all ductile-iron water pipe and fittings and cast-iron fittings at the locations and elevations shown on the contract plans, construct concrete thrust blocks, backfill, compact, maintain the backfilled trench, dispose of all excess materials and do all appurtenant work in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

6.1.2 Inspection and Acceptance of Pipe

The Contractor shall submit to the Engineer for approval within ten (10) days after execution of the Contract, a list of materials to be furnished, the names of suppliers and the date of delivery of materials to the sites. Where American National Standards Institute (ANSI) Standards are referenced, it shall be understood that reference to American Water Works Association (AWWA) Standards are both inferred and implied where joint ANSI/AWWA Standards exist.

Ductile-iron pipe shall be fabricated in accordance with the requirements of ANSI Standard A21.51 for “Ductile-Iron Pipe, Centrifugally Cast in metal molds or Sandlined Molds, for Water or Other Liquids”, approved as standard, with the following qualifications:

1. Joints shall be push-on.
2. Pipe thickness shall be Class 52.
3. Certification shall be provided by the manufacturer as described in Section 51-5.2.
4. The outside coating shall be asphaltic as described in Section 51-9.1.
5. The inside lining shall be cement-mortar as described in Section 51-9.2.

Ductile-iron pipe shall have push-on type joints except where pipe is to be joined with specials, fittings, or valves, in which case ductile-iron pipe shall be furnished with mechanical joint ends. Both types of joints as required, shall be furnished as specified under this section.

The gasketed and bolted joint, or mechanical joint, shall be as detailed in the American Standard A21.11, except the nominal thickness of the bells shall not be less than the nominal wall thickness of the pipe. Pipe restraint shall be Megalug mechanical joint restraint as manufactured by EBAA Iron Sales, Inc. or equivalent.

Each ductile-iron pipe shall have conspicuously painted on the outside, the pressure class and weight of the pipe.

Manufacturer's Affidavit of Factory Inspection and Testing: Adequate quality control and manufacturing inspection shall be provided by the Contractor's manufacturer to assure that all push-on type, ductile iron pipe is fabricated in strict accordance with the applicable provisions of the ANSI Standards. The Contractor shall furnish a sworn affidavit of compliance that all hydrostatic and physical properties tests have been made and that the results of same comply with ANSI requirements.

6.1.3 Installing CLDI Pipe

Care shall be taken in loading, transporting and unloading to prevent injury to the pipes or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Engineer.

If any pipe is damaged after it has been laid, it shall be removed and replaced with a sound pipe in accordance with these specifications by the Contractor at their expense. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until used in the completed work, and when laid shall conform to the lines and grades required.

Ductile-iron pipe and fittings shall be installed in accordance with the requirements of AWWA Standard Specification C600 except as otherwise provided herein. A firm, even bearing throughout the length of the pipe shall be constructed by tamping selected material at the sides of the pipe up to the springline. A minimum of five (5) feet of cover shall be maintained and blocking will not be permitted. Pipe shall not have more than six (6) feet of cover unless approved by the Engineer.

All pipe shall be sound and clean before laying. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer. Fittings, in addition to those shown on the drawings, shall be provided, if required, in crossing utilities, which may be encountered upon opening the trench. Solid sleeves shall be used only where approved by the Engineer.

When cutting of pipe is required, the cutting shall be done by saw leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a push-on bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.

Excavations and backfill for the pipe shall be made in accordance with Section 5.5 and 5.6, *Earthwork Specifications*.

6.1.4 Pipe Jointing Requirements (Push-on Type)

Push-on joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated with an approved lubricant. The plain pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be joined, and pushed home with a jack or by other means. After jointing the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located.

6.1.5 Pipe Fittings

Fittings shall conform to the requirements of ANSI Standard A21.10, for “Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches, for Water and Other Liquids”, for fittings with bell and spigot joints, mechanical joints and flange joints and the dimensions and weights shown on the tables contained in ANSI Standard A21.10. As an alternative, mechanical joint fittings may conform to ANSI Standard A21.53 for “Ductile-Iron Compact Fittings, 3 Inches through 16 Inches for Water and Other Liquids”. The mechanical joint shall also conform in all respects to ANSI Standard A21.11 for “Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings”. Flanged fittings shall conform to Table 10.14 of ANSI Standard A21.10.

Fittings shall be ductile iron. All fittings shall be Class 350 and shall have mechanical joint ends.

The inside surfaces of all fittings shall receive a cement-mortar lining and asphaltic seal coat as described in ANSI A21.10.

Adequate quality control and manufacturing inspection shall be provided by the Contractor's manufacturer to assure that all pipe fittings are fabricated in strict accordance with the applicable provisions of ANSI Standards. The Contractor shall furnish a sworn affidavit of compliance that inspection and all specified acceptance tests have been made and that the results of same comply with the ANSI requirements.

6.1.6 Jointing Mechanical Joint Fittings

Mechanical joints at valves, fittings and where designated shall be in accordance with the Appendix A of ANSI Specification A21.11 and the instructions of the manufacturer. To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tight to the specified torques. Under no condition shall extension wrenches or pipe over handle or ordinary ratchet wrench be used to secure greater leverage.

6.1.7 Furnishing and Placing Plain Concrete

The Contractor shall furnish, deliver and place plain concrete for anchorage at fittings and at other locations where directed by the Engineer.

Concrete shall be of a mix not leaner than one (1) part cement, 2 parts sand and 4 parts stone, and having a compressive strength of not less than 3,000 pounds per square inch at 28 days. Unless otherwise permitted by the Engineer, concrete shall be provided from an approved plant and any such concrete shall be subject to cylinder tests at the expense of the Contractor, if requested by the Engineer.

All plugs, caps, tees and bends, deflecting 11¼ degrees or more shall be provided with a reaction backing of plain concrete.

Concrete shall be placed between solid ground and the fitting to be anchored, and the area of bearing on the pipe and on the ground shall be as shown or directed by the Engineer. The backing shall, unless otherwise directed by the Engineer, be so placed that the pipe and fitting joints will be accessible for repair.

6.1.8 Insulation

Where the ductile iron pipe is constructed with less than five feet of cover, the Contractor shall insulate the pipe and install insulation board above the pipe as shown on the plans. The insulation around the ductile iron pipe shall be 2-inch thick polysocyanurate with vapor barrier.

Trymer 2000XP as manufactured by Johns Manville or an approved equal shall be used for insulating ductile iron pipes where required. The thickness shall be 2 inches as shown on the drawings. Vapor barrier to be Saranex 560 CX as manufactured by Johns Manville or approved equal.

Approved equal products from other manufacturers shall be Extruded-Polystyrene Board Insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C578, Type IV, with 1.60 pounds per cubic foot minimum density and a compressive strength of 25 pounds per inch as specified in ASTM D1622 and ASTM D1621 respectively. The maximum thermal conductivity of the insulation shall conform to ASTM C518, C177, and C578. The maximum water absorption percentage by volume shall be one percent in accordance with ASTM D2842. The range of water vapor permeance shall be 0.4 to 1.0 perm in accordance with ASTM E96.

6.1.9 Measurement and Payment

Measurement and payment for providing water pipe and fittings shall be based on the unit bid price per linear foot and shall be measured along the top center line of the pipe including valves and fittings. Payment shall include all materials, labor, tools and equipment to remove the pavement (where necessary), sawcutting, excavate the trench, provide trench drainage (pumping), install bedding materials, lay and joint the pipe and fittings, cut the pipe to meet required lengths, connect new water mains with existing mains, cutting existing mains as required by the Engineer, plug and/or cap new or existing mains, disconnect the old main to be abandoned, disconnect and reconnect lateral mains, safeguard and protect other utilities, backfill, compact, dispose of excess materials and maintain the backfilled area in accordance with these

specifications and as shown on the contract plans or as directed by the Engineer. Payment shall include the testing of fire services before and after installation.

Furnish and Install Cement-Lined Ductile-Iron Pipe and Cast-Iron Fittings as follows:

Payment Items:		Unit
6.1.9a	20" CLDI Pipe	Linear Foot
6.1.9b	16" CLDI Pipe	Linear Foot
6.1.9c	12" CLDI Pipe	Linear Foot
6.1.9d	8" CLDI Pipe	Linear Foot
6.1.9e	6" CLDI Pipe	Linear Foot
6.1.9f	4" CLDI Pipe	Linear Foot
6.1.9g	Pipe Insulation, All Sizes	Linear Foot
6.1.9h	Cap Main, All Sizes	Each

6.2 TAPPING SLEEVES AND VALVES

6.2.1 General

The Contractor shall make all earth excavations, provide all materials, labor, tools and equipment required to provide tapping sleeves and valves complete and in place, backfill, compact, dispose of all excess materials and do all appurtenant work in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

6.2.2 Tapping Sleeves and Gate Valves

Valves shall conform to the requirements for gate valves as specified in Section 6.3, except as modified for passage of tapping machine cutters. The hub ends shall be designed for mechanical joints. Valves shall be set in accordance with the provisions of this Section.

Sleeves shall be of cast-iron, designed for working pressures not less than 200 psi and have gaskets that fully encircle the pipe.

Each tapping sleeve and valve shall be accompanied by a heavy duty cast iron valve box as specified in Section 6.3.4.

6.2.3 Installing Tapping Sleeves and Valves

Prior to ordering tapping sleeves and valves, the Contractor shall determine the exact location, elevation and dimensions of the existing main(s) to be tapped.

Installation shall be made under pressure, maintaining the flow of water in the existing mains at all times. The existing main shall be thoroughly cleaned around the entire

circumference of the main to the full length of the sleeve plus eight (8) inches. All scaling and debris shall be removed using a metal file. The Contractor shall be responsible to ensure a tight seal exists between the existing pipe and the sleeve. Before backfilling, all exposed portions of any bolts used to hold the two halves of the sleeve together shall be heavily coated with two coats of bituminous paint comparable to Inertol No. 66 Special Heavy. The entire operation shall be conducted by workmen thoroughly experienced in the installation of tapping sleeves and valves.

No visible leakage will be permitted after the valve and sleeve are installed and prior to backfill.

6.2.4 Measurement and Payment

Furnishing and payment for providing tapping sleeves with gate valves and boxes should be based on the unit bid price per unit stated in the proposal.

Payment shall include all materials, labor, tools and equipment to remove the pavement (where necessary), excavate the trench, provide trench drainage (pumping), install bedding materials, provide tapping sleeves with gate valves and boxes complete and in place, make all taps and cuts, make all assemblies of sleeves and gate valves, construct thrust blocks as directed by the Engineer, maintain uninterrupted flow in the existing water main(s) without loss of water, backfill, compact, dispose of excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Payment Items:		Unit
6.2.4a	8"x8" Tapping Sleeve With 8" Gate Valve and Box	Each
6.2.4b	X"xX" Tapping Sleeve With X" Gate Valve and Box	Each

6.3 VALVES

6.3.1 General

The Contractor shall make all earth excavations, furnish and install valves, valve boxes and appurtenant work, backfill, compact, dispose of all excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

6.3.2 Gate Valves

Gate valves shall be as manufactured by the Mueller Company, American Darling Valve and Manufacturing Company or approved equal and shall conform to Standard Specification AWWA C515, with the following additional requirements:

- 1. Non-rising stems.
- 2. Mechanical joint ends.
- 3. O-ring stem seal.

4. Open in a clockwise direction.

6.3.3 Wedge Valves

Wedge valves shall conform to AWWA C509, Standard for Resilient Seated Gate Valves. Wedges shall be constructed of ductile iron, fully encapsulated in synthetic rubber except for guide and wedge nut areas. Wedge rubber shall be molded in place and bonded to the ductile iron portion, and shall not be mechanically attached with screws, rivets, or similar fasteners. Wedges shall seat against seating surfaces arranged symmetrically about the centerline of the operating stem, so that seating is equally effective regardless of direction of pressure unbalance across the wedge. Stems shall be sealed by at least two O-Rings; all stem seals shall be replaceable with valve wide open and while subjected to full rated pressure. Waterways shall be smooth and shall have no depressions or cavities in seat area when foreign material can lodge and prevent closure or sealing. Valve bodies and bonnets shall be coated, inside and out, with fusion-bonded epoxy. Coatings shall conform to AWWA C550, Standard for Protective Interior Coatings for Valves and Hydrants.

6.3.4 Valve Boxes

Each valve shall be furnished with a heavy duty valve box of the two piece, adjustable, Buffalo type with 5½ inch diameter shaft, top section at least 26 inches long and bottom section 36 inches long, making a minimum overall extended length of 66 inches. If deeper main burial requires a longer upper section for the top to be at finished grade, it shall be supplied as necessary. Cast-iron covers with the word “WATER” cast on the upper surface shall be included with each top section. The cover as installed shall be flush with the finished grade. The valve box shall be set perpendicular to the plane of the roadway surface over the length of the box and shall be centered over the operating nut so that the centerline of the lower part of the valve box is not more than ½ inch off the centerline of the valve stem.

Replacement of valve boxes shall included the removal of existing valve boxes, and the furnishing and installing of new valve boxes. The new boxes shall be installed in the same location as the existing boxes, and they shall be set to the proposed roadway grade.

6.3.5 Measurement and Payment

Measurement and payment for providing valves and valve boxes, as well as removing valve boxes, shall be based on the unit bid price per unit stated in the proposal. Payment shall include all materials, labor, tools and equipment to remove the pavement (where necessary), excavate the trench, provide trench drainage (pumping), provide valves and valve boxes complete and in place including all appurtenant work, backfill, compact, dispose of excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

Payment Items:		Unit
6.3.5a	16-inch Valves and Boxes	Each
6.3.5b	12-inch Valves and Boxes	Each
6.3.5c	8-inch Valves and Boxes	Each
6.3.5d	6-inch Valves and Boxes	Each
6.3.5e	4-inch Valves and Boxes	Each
6.3.5f	Replace Valve Boxes	Each
6.3.5g	Abandon Valve In Place	Each
6.3.5h	8-inch Insertion Valve	Each

6.4 FIRE HYDRANTS

6.4.1 General

The Contractor shall make all earth excavations, provide new fire hydrants including the 6 inch pipe hydrant connection, hydrant tee, and all appurtenant work, construct concrete thrust blocks, backfill, compact, dispose of excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

6.4.2 Installing Hydrants

Hydrants shall be as manufactured by Mueller Company, Super Centurian 250 Model A-423 or approved equal and equipped with a National Standard operating nut and a National Standard nozzle thread. Hydrants shall be equipped 5¼ main valve opening three way, with two 2½ hose nozzles and one 4½ pumper nozzle and shall be designed for 78-inch burial, unless otherwise approved by the Engineer.

Hydrants shall be of the compression type for 250 pound service having a minimum valve opening of 5 inches and shall have a break-away flange and 6-inch mechanical joint inlet. Hydrants will be painted Yellow with a white bonnet and shall open clockwise. Hydrants will be outfitted with 5' fiberglass Red/White Reflective Hydrant marker with Red mini Flag attached by bolt on a flat Bracket with spring.

Before ordering the hydrants, the Contractor shall submit the name of manufacturer and type of hydrants to the Engineer for approval. The hydrant shall be installed at least 24 inches and no more than 30 inches from the edge of the traveled way (gutter) and shall not obstruct any part of a sidewalk. The bottom of the hydrant shall be placed on a minimum 8-inch-thick layer of compacted ¾-inch to 1½ inch crushed stone. The hydrant shall be set within ¼-inch in 2 feet of plumb, and thrust blocks shall be provided for both the hydrant tee and hydrant base. The 6-inch valve shall be at least 24 inches from the edge of the traveled way.

6.4.3 Installing Thrust Blocks

The Contractor shall furnish and install plain concrete for anchorage of hydrants.

Concrete shall be of a mix not leaner than one part cement, 2 parts sand and 4 parts stone, and having a compressive strength of not less than 3,000 pounds per square inch at 28 days. Unless otherwise permitted by the Engineer, concrete shall be provided from an approved plant and any such concrete shall be subject to cylinder tests at the expense of the Contractor, if requested by the Engineer.

The bowl of each hydrant shall be well braced with concrete backing against unexcavated earth at the end of the trench. The backing shall, unless otherwise directed by the Engineer, be so placed that the pipe and fitting joints will be accessible for repair.

6.4.4 Measurement and Payment

Measurement and payment for providing fire hydrants shall be based on the unit bid price per unit stated in the proposal.

Payment shall include all materials, labor, tools and equipment to remove the pavement (where necessary), excavate the trench, provide trench drainage (pumping), provide bedding materials, provide the crushed stone base, provide the fire hydrant complete and in place, including the six (6) inch connecting CLDI water pipe and all appurtenant work, provide the 6” gate valve and valve box, provide the hydrant tee, provide thrust blocks and restraining glands, hydrant extensions to bring to grade, backfill, compact, dispose of excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

Payment Items:		Unit
6.4.4a	New fire hydrant and appurtenant work	Each

6.5 REMOVAL OF EXISTING HYDRANTS

6.5.1 General

The Contractor shall make all earth excavations, remove the existing fire hydrant(s) indicated on the contract plans, remove the existing six (6) inch connecting pipe, remove the valve and valve box, cap the existing tee on the abandoned main, cut and remove sections of the abandoned main, cap and/or plug all openings in the abandoned main, deliver the existing hydrant, valve and valve box to the Needham Department of Public Works stock yard, backfill, compact, dispose of excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

6.5.2 Hydrant Removal

Hydrants shall only be removed after the proposed hydrant(s) have been put into service and the existing water main has been disconnected from the Town's water distribution system, or as directed by the Engineer. Pavement removal and trench excavation shall be conducted in accordance with Section 5.5 of these specifications. Backfill, compaction and grading shall be conducted in accordance with Sections 5.6 and 5.7.

The Contractor shall remove the hydrant and its appurtenances, including the riser pipe and hydrant base, the six (6) inch connecting pipe, the six (6) inch valve and the valve box with its cover. If a six (6) inch connecting pipe exists between the water main tee and the valve, it shall also be removed by the Contractor. The Contractor shall cap the existing tee and cap or plug all openings in the abandoned main, as specified in Section 6.6.2, prior to backfilling.

The Contractor shall replace the pavement system, as specified in Section 5.8, after the trench excavation has been backfilled. The Contractor shall reset all granite or reinforced concrete curbing disturbed during the hydrant removal process in accordance with these specifications, and bituminous curb or berm shall be replaced as directed by the Engineer.

The shoulder and/or sidewalk area shall be returned to their original condition as determined by the Engineer. The Contractor shall strip the existing topsoil (the top 4-inch soil layer) from the shoulder area prior to excavating the trench and stockpile it for reuse, or shall replace the topsoil layer with new material meeting Sections 5.9.1 & 5.9.2 at their expense. The Contractor shall seed the surface of the disturbed area in accordance with Section 5.9.3 after the existing or replaced topsoil layer has been installed and compacted.

6.5.3 Measurement and Payment

Measurement and payment for removing existing hydrants, including all appurtenant work and delivery, shall be based on the unit bid price per hydrant removed. Payment shall include all labor, materials, tools and equipment, remove the pavement (where

necessary), excavate the trench, provide trench drainage (pumping), remove the existing hydrant(s), remove the existing six (6) inch connecting pipe, remove the valve and valve box, cap the existing tee on the abandoned main, cut and remove sections of the abandoned main, cap and/or plug all openings in the abandoned main, deliver the existing hydrant, valve and valve box to the Needham Department of Public Works stock yard, backfill, compact, dispose of excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

Payment Items:		Unit
6.5.3a	Remove existing hydrant and appurtenant work	Each

6.6 **TRANSFER HOUSE CONNECTIONS**

6.6.1 **General**

The Contractor shall make all earth excavations, provide all labor, materials, tools and equipment to disconnect existing water service laterals from the existing water main to be abandoned and reconnect them to new corporation stops provided in the new main, backfill, compact, dispose of all excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

6.6.2 **Transfer House Connections**

Where water service laterals are to be connected to the proposed main by shortening their existing length, the water service lateral shall be transferred. After the proposed water main has been installed and put into service, the Contractor shall transfer existing one (1) inch or greater copper water service laterals from the existing main to new corporation stops provided on the proposed main. All new corporations, except as noted below, shall be wet-tapped into the proposed main after the water main has been tested, disinfected, and activated for service and their locations marked with paint on the edge of the trench prior to backfilling the main. Taps shall be made at the ten o'clock or two o'clock positions on the pipe cross-section and shall be made perpendicular to the tangent surface plane on the pipe barrel. Water service laterals which are greater than one (1) inch in diameter shall be made using a saddle connection as manufactured by the Mueller Company, or approved equal. Corporation stops shall be Mueller Model H-15008 and shall have on one end compression, and the other, Mueller thread. Corporation stops shall comply with AWWA C-800. All components that come into contact with potable water shall comply with the latest requirements of the Federal Safe Drinking Water Act and shall be designated Lead-Free. Corporation stops shall be stamped or embossed with a mark or name indicating that the product is manufactured from lead-free alloy, as defined in the latest requirements of the Federal Safe Drinking Water Act. The Contractor shall cut the existing service to allow for an eight (8) inch gooseneck to be formed prior to the corporation connection. All scaling or tuberculation shall be removed from the service lateral pipe surface prior to making the pipe cut. The cut shall be made using a C-clamp pipe cutter of appropriate

size and shall be made perpendicular to the longitudinal axis of the service. The Contractor shall de-burr the end of the lateral with a metal file and shall clean its surface with an emery cloth for a distance of one and one-half (1½) inches from the end prior to connecting the lateral to the corporation stop.

6.6.3 Measurement and Payment

Measurement and payment for transferring existing house connections shall be based on the unit bid price per water service transferred. Payment shall include all labor, materials, tools and equipment, to remove the pavement (where necessary), excavate the trench, provide trench drainage (pumping), transfer the existing lateral to the proposed main, provide a corporation stop on the proposed main during construction of the main, provide all location marks, fittings, incidentals and all appurtenant work, backfill, compact, dispose of all excess materials and maintain the backfilled trench in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

Payment Items:		Unit
6.6.3a	Transfer water service lateral	Each

6.7 RENEW HOUSE CONNECTIONS

6.7.1 General

The Contractor shall make all earth excavations, provide all labor, materials, tools and equipment to disconnect existing water service laterals from the existing water main to be abandoned, remove the laterals from the existing curb stops to the existing corporation stops, remove the existing curb stops and boxes, provide new curb stops and boxes, provide new laterals from the curb stops to new corporations provided in the proposed main, backfill, compact, dispose of all excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

6.7.2 Renew House Connections

Where water service laterals are to be connected to the proposed main by extending their existing length, where laterals are smaller than 1-inch diameter, or where laterals are made of a material other than Type K copper tubing, the water service lateral shall be renewed.

After the proposed water main has been installed and put into service, the Contractor shall renew existing:

1. Water service laterals smaller than one inch diameter by replacing the existing service with a minimum size 1-inch Type K lateral from the existing curb stop to new corporation stops provided during construction of the proposed main. Unions are not permitted. Existing laterals found to have existing unions in their length shall be renewed.
2. Water service laterals where laterals are made of a lead material by replacing the existing lead service with a minimum size 1-inch Type K lateral from the existing water meter inside the house (or building) to new corporation stops provided during construction of the proposed main. Unions are not permitted. Existing laterals found to have existing unions in their length shall be renewed.

All new corporations, except as noted below, shall be wet-tapped into the proposed main after the water main has been tested, disinfected, and activated for service and their locations marked with paint on the edge of the trench prior to backfilling the main. Taps shall be made at the ten o'clock or two o'clock positions on the pipe cross-section and shall be made perpendicular to the tangent surface plane on the pipe barrel. Water service laterals which are greater than one (1) inch diameter shall be made using a saddle connection. The renewed water service lateral shall be made of Type K copper tubing and shall have a two (2) foot gooseneck prior to the corporation stop. All excavation, backfill and compaction shall be conducted in accordance with Section 5.5 & 5.6 of these specifications.

6.7.3 Tubing

Tubing furnished for the connections shall be Type K Copper Tubing.

6.7.4 Fittings

Line fittings, if required shall be three (3) pieces with compression ends. Corporation stops shall be Mueller Model H-15008 as manufactured by the Mueller Company and shall have one end compression and the other Mueller thread. Curb stops shall be Mueller Model H-15209 and shall be one (1) inch or greater and shall have compression ends. All curb stops shall be without drains. Saddles shall be single banded and as manufactured by the Mueller Company, Model No. DR1A (water mains 12" diameter or less) or Model No. DR2A (water mains greater than 12" diameter), or approved equal. Male IPS by compression adaptors, unions, corporation stops, and curb stops shall comply with AWWA C-800. All brass components that come into contact with potable water shall comply with the latest requirements of the Federal Safe Drinking Water Act and shall be designated Lead-Free. All brass fittings shall be stamped or embossed with a mark or name indicating that the product is manufactured from lead-free alloy, as defined in the latest requirements of the Federal Safe Drinking Water Act.

Compression-type pipe adaptors shall be Style 90, as manufactured by the Dresser Manufacturing Division of Dresser Industries. All other joints, including IPS by compression adaptors, shall be of two-piece type, which when they are screwed together bottom out on a shoulder. A stainless steel gripper band overlapping itself

shall be squeezed into the tubing as the two pieces are assembled. An integral conductor spring shall be built in to ensure electrical continuity between the fitting and the tubing.

6.7.5 Curb Boxes

Curb boxes for one (1) inch services shall be made of cast-iron of the two piece, sliding type with cast-iron covers. The base piece shall have a saddle-shaped bottom to fit over the service connection with ample clearance. The cover shall be extra heavy duty and secured with a 1-inch pentagonal plug. Curb boxes shall have a minimum inside diameter of 1¼ inches and have a sufficient length to fit finished grade with a minimum six (6) inch overlap of the telescoping pieces. Curb boxes shall be equipped with an inside stationary rod which is 36 inches long and pinned to the curb stop. The rod top shall be formed so that it fits Needham DPW Water Division's curb wrenches.

Curb boxes for services 1½ inches and larger shall be Mueller No. H-1300-1, complete with lid and screw and the top shall be flush with the finished grade.

All curb stops and valves shall be operable at the time of paving and at the time of the acceptance of the work.

All curb boxes shall be covered by a “buffalo style” box for all services, as detailed in the Drawings.

6.7.6 Measurement and Payment

Measurement and payment for renewing house connections smaller than (1) inch shall be based on the unit bid price per water service renewed. Payment shall include all labor, materials, tools and equipment to remove the pavement (where necessary), excavate the trench, provide trench drainage (pumping), remove the existing water service lateral, provide a new water service lateral from the curb stop to the corporation stop on the main, provide a new curb stop and Erie style box, and an additional “buffalo style” box for all curb stops, provide a new corporation stop on the main, provide all location marks, fittings, incidentals and all appurtenant work, backfill, compact, dispose of all excess materials and maintain the backfilled area in accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

Measurement and payment for renewing lead house connections shall be based on the unit bid price per water service renewed. Payment shall include all labor, materials, tools and equipment to remove the pavement (where necessary), excavate the trench, provide trench drainage (pumping), remove the existing water service lateral, provide a new water service lateral from the existing water meter inside the house (or building) to the corporation stop on the main, provide a new curb stop and erie style box, and an additional “buffalo style” box for all curb stops, provide a new corporation stop on the main, provide all location marks, fittings, incidentals and all appurtenant work, backfill, compact, dispose of all excess materials and maintain the backfilled area in

accordance with these specifications and as shown on the contract plans, or as directed by the Engineer.

The service connections to be paid for under this item for all sizes and classes shall be per each service of the completed connection; the lengths of valves or fittings shall not be deducted.

The unit price for furnishing and installing copper tubing shall include excavation, installing service pipe (up to 2½ inch diameter) at a depth of five (5) feet from the corporation stop to the curb stop with fittings and adapters, as necessary and shown on the drawings; including connection to the existing service. Installation of “buffalo style” boxes for all services. Excavation, including saw cutting, removal and disposal of bituminous concrete, dewatering, bedding, backfill and restoration of property to include loaming, seeding, curbing (granite or bituminous reset in concrete), all types of sidewalk reconstruction, and dust control measures.

Payment Items:		Unit
6.7.6a	Renew water service lateral <i>water main to curb stop at property line</i>	Each
6.7.6b	Renew water service lateral <i>water main to water meter inside house</i>	Each
6.7.6c	Renew water service lateral special	Each

6.8 PRESSURE TEST, LEAKAGE TEST, AND CHLORINATION

6.8.1 Pressure and Leakage Test

All newly installed fresh water mains shall be hydrostatically pressure tested for strength and for leakage. Testing shall be conducted by an independent water testing company approved by the Engineer other than the Contractor who installed the water main. The testing shall conform to Section 4 of ANSI Standard C600 for “Installation of Ductile-Iron Water Mains and their Appurtenances”.

6.8.2 Chlorination

Before being placed in service, all new pipelines shall be chlorinated in accordance with AWWA Standard C651for “Disinfecting Water Mains”. Chlorination shall be performed by an independent third-party contractor, hired by the Contractor and approved by the Engineer. Chlorination shall be by the-Continuous Feed Method unless otherwise approved by the Engineer.

Disinfecting of water mains shall only be conducted by workmen who have had experience and are well acquainted with the use of chlorine or other disinfecting agents. A disinfection and neutralization plan shall be submitted to and approved by the Engineer before doing the work. The disinfection and neutralization plan shall include (at a minimum):

- a. Map or plan identifying main segments by valve or station locations.
 - b. Identification of the pipe diameter and lengths to be tested.
 - c. Confirmation that the continuous feed method will be used in disinfecting the mains and a full description of how that method will be used.
 - d. Chlorine feed location(s).
 - e. Chlorine agent to be utilized, including free chlorine concentration.
 - f. Material Safety Data Sheets (MSDS) for all chemicals to be used.
 - g. Chlorine batching calculations to show required level of chlorine being added to the mains.
 - h. Flushing methods listing pipe diameter, length, flushing time calculations and locations of flushing feed and outlets.
 - i. Methods of measuring chlorine solution being added to the pipe and after it has been added.
 - j. Sample collection techniques.
 - k. Identification of independent third-party contractor performing the disinfection activities.
 - l. Name of MassDEP certified laboratory proposed to perform the tests.
 - m. Dechlorination methods, including dechlorination agent and locations.
- 1. To ensure that the chlorine solution is distributed throughout the main, taps should be made at the beginning of the line to inject the chlorine and also at all extremities in order to ensure the flow of chlorine solution through the entire length of main.
- 2. Before chlorination, the line shall be flushed thoroughly to clear out all solid matter, mud, silt, leaves, etc., that may have accumulated in the line during installation.
- 3. Samples shall be collected by the Contractor, in the presence of the Engineer and the Water Department, and delivered to the MassDEP-approved laboratory identified in the approved disinfection and neutralization plan. Samples shall be tested for Total Coliform, Heterotrophic Plate Count (HPC), and free chlorine. The following results are required to activate the water main for service:
 - a. Total Coliform = 0 (absent)
 - b. HPC < 500 CFU/mL
 - c. Free chlorine <= system residual chlorine concentration

6.8.3 Measurement and Payment

Furnishing all labor, materials, tools, and equipment required to perform the pressure tests, leakage tests, disinfection, flushing and leaving the new water mains ready for service, will be paid at the lump sum price stated in the Proposal.

This price shall be full compensation for all work required to complete testing to demonstrate satisfactory compliance with pressure and leakage specifications and disinfection to demonstrate that the main is acceptable for domestic water service.

The payments may be apportioned among the various sections of pipe to be installed and payment included in progress estimates after the satisfactory completion of each section, as agreed upon by the Engineer.

Payment Items:		Unit
6.8.3a	Pressure Tests, Leakage Tests & Chlorination	Lump Sum

6.9 TEMPORARY WATER SERVICE

6.9.1 General

The Contractor shall furnish and install temporary water service to all water users whose regular water service is interrupted for more than 8 hours because of the Contractor’s operations; and when there is no longer need for the temporary water service, they shall disconnect and remove the temporary water service and all materials installed in connection therewith.

6.9.2 Temporary Water Service

Unless otherwise approved by the Engineer, temporary water service shall be supplied from 2-inch, 4-inch or 6-inch diameter temporary pipelines, as specified on the plans, at ground surface with hose connections connected to the existing water service at or near the existing curb stop of the service. Temporary water service connections to outside faucets on buildings or any other location whereby the supplied water service is not conveyed through the property’s water meter will not be allowed unless otherwise approved in writing by the Engineer. The temporary pipelines shall be fed from hydrants with sufficient valves and in such a manner that the hydrants can be readily used, for firefighting without disconnecting the temporary water service.) Temporary water service pipes are subject to the same testing and disinfection standards as new water pipes. See Section 6.8 for requirements.

Temporary service pipes/hoses connected to existing services shall be at least the same inside diameter as the existing services unless otherwise authorized by the Engineer. Temporary pipelines shall be laid within street lines in locations satisfactory to the Engineer where they will cause the least obstruction and will be less likely to be damaged. At driveways, provision shall be made to permit property owners to drive over the temporary pipe and where temporary pipe or hose crosses sidewalks or other

pedestrians, by the use of bituminous concrete hot mix to form a ramp on each side of the pipe. Cold patch shall not be used without Engineer approval. At driveway crossings involving 6 inch nominal diameter pipe and at street crossings involving any diameter, a narrow trench shall be cut in the paving and the temporary pipe placed just below the surface with temporary surfacing above it, or other satisfactory arrangements shall be made.

All piping materials used and assembled joints shall be of adequate quality to withstand the pressures that develop and all conditions of use. Joints shall not leak. Temporary water pipeline material shall be HDPE.

Once put into use, the temporary service pipe shall be maintained until the water main is restored to service. Any interruptions, whether caused by frost, physical damage or otherwise, shall be immediately corrected and the service restored or replaced without additional payment.

In all cases, the location, method of placing, materials employed and the sanitary precautions shall be fully satisfactory to the Engineer.

6.9.3 Measurement and Payment

Payment for installing, maintaining and removing temporary water service shall be made at the lump sum price, as stated in the Proposal. This price and payment shall be full compensation for furnishing all material, labor, equipment and incidentals including excavation and backfill required to provide temporary connections, as shown on the drawings or as directed by the Engineer.

Payment Items:		Unit
6.9.3a	Temporary Water Service—Incl. Excavations & All Incidental Work	Lump Sum

6.10 RESTORATION OF LAWN SPRINKLER SYSTEM

6.10.1 General

The Contractor shall make any required adjustments to lawn sprinkler systems, horizontally or vertically, where during the course of constructing walks, driveways, and/or regarding lawns it becomes necessary.

6.10.2 Construction Methods

If the adjustment of sprinkler heads is to grade only, they shall remain in their original horizontal location, and operate in their original orientation. If the adjustment requires a horizontal relocation of the sprinkler heads, the contractor shall coordinate the work with the individual homeowner, and orient the sprinklers so as to function in their original fashion. The system shall be tested to verify proper function and, if required, additional adjustments shall be made. All lawns shall be restored to their original condition. Damage to lawns shall be kept to a minimum.

The contractor shall reuse all existing sprinkler heads. Damaged sprinkler heads shall be replaced with an equivalent unit and the cost shall be born by the contractor, with no additional charge to the Town. Cost of tubing, fitting, and other materials required to complete the restoration shall be considered incidental and no separate payment made.

6.10.3 Measurement and Payment

Measurement and payment for restoring sprinkler systems shall based on each system restored. Payment shall include all materials (except new sprinkler heads), labor tools and equipment required to completely restore lawn sprinkler systems. Cost for the restoration of lawns shall be paid for under the unit prices for the individual items, including loam borrow, lawn seeding, and lawn sodding.

Payment Items:		Unit
6.10.1a	Restoration of Lawn Sprinkler System	Lump Sum

SECTION 7 DRAINAGE CONTRACT SPECIFICATIONS

7.1 REINFORCED CONCRETE PIPE (RCP)

7.1.1 General

The Contractor shall make all earth excavations, furnish all materials, lay, joint and connect all drainage pipe at the locations and elevations shown on the contract plans, make drainage structure connections, backfill, compact, dispose of all excess materials, and do all appurtenant work in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

7.1.2 Inspection and Acceptance of Pipe

All pipe will be inspected before being laid. Drainage pipe that fails to meet any of the specifications listed herein or is found to be damaged, as determined by the Engineer, shall be rejected. The Contractor shall provide all labor and equipment necessary to assist the Engineer in inspecting the pipe.

Reinforced concrete pipe shall meet ASTM Specification C76 and be Class III Wall B RCP minimum. Each unit of pipe shall have an interior surface that is free from roughness, projections, indentations, offsets or irregularities of any kind. Pipe units shall have a minimum laying length of 8 feet except as otherwise indicated or approved by the Engineer. Any pipe that is to be cut to meet length requirements shall be cut using an abrasive saw, blade-type cutters or other approved equipment adapted for that purpose. Sledgehammers and chisels are not considered suitable as cutters and shall not be permitted. All cuts shall be clean, smooth and at right angles to the longitudinal axis of the pipe except as otherwise permitted in these specifications or as shown on the contract plans. Certified copies of tests on materials and the pipe units will be required and shall be submitted by the Contractor to the Engineer when the pipe is delivered to the site. All tests shall be made in accordance with the latest applicable ASTM Specifications.

Acceptance of the pipe shall be on the basis of plant load-bearing tests, material tests and inspection of the complete product. The quality of all materials used in the pipe, the process of manufacture and any required cuts made in the pipe shall also be considered during the acceptance process. Inspection may be made at the place of manufacture, after delivery to the site or at both places. Any pipe unit shall be subject to rejection at any time because of failure to meet any of the specification requirements, damage to the pipe caused by storage, improper handling or dropping materials or equipment on the pipe. All pipe which is rejected by the Engineer shall be immediately removed from the project site by the Contractor.

7.1.3 Installing RCP Pipe

The pipe shall be laid true to the lines and grades indicated on the contract plans. Should a utility conflict, or other obstruction as determined by the Engineer, occur

and a field change be necessary, the Engineer shall make the required decisions regarding final placement of the pipe. The pipe shall be set in a bedding of Gravel Borrow — Type c, meeting Section 5.6.1, unless the existing spoil is determined to be suitable by the Engineer. The bedding shall be placed to a minimum depth of six (6) inches below the bottom of the pipe and shall extend around and over the pipe for a minimum distance of six (6) inches. The pipe shall be installed from the low end to the high end with the bell of the pipe at the high end. Each pipe unit shall be handled into its position in the trench by using equipment adapted for that purpose. The Contractor shall furnish approved devices to properly support the pipe when it is lifted. Excavations and backfill for the pipe shall be made in accordance with Sections 5.5 & 5.6, *Earthwork Specifications*.

7.1.4 Pipe Jointing Requirements

Each pipe unit shall be so laid as to form a tight joint with the next adjoining pipe and bring the inverts continuously to the required grade. Suitable bell holes shall be provided so that after placement only the barrel of the pipe receives bearing pressure from the supporting material. When each pipe unit has been properly bedded, sufficient bedding and backfill material shall be placed and compacted between the pipe and the sides of the trench to hold the pipe in correct alignment. Care shall be taken to distribute the fill evenly on both sides of the pipe in order to prevent misalignment. After the pipe units are aligned in the trench and are ready to be sealed, the entire circumference of the pipe at the joint shall be cleaned. Each joint shall be cemented with Portland Type II cement mortar around the entire circumference of the pipe joint meeting MassDOT Specification M4.02.15. Mortar shall be placed in the bell holes in order to seal the bottom portion of the joint. The mortar shall be troweled in place by hand and shall completely conform to the shape of the joint. The mortar shall extend from the top of the bell on the preceding pipe to the barrel of the succeeding pipe forming a straight line which creates a 30 degree angle with the longitudinal axis of the barrel of the pipe. The joint shall be completely mortared and shall have a smooth surface finish.

7.1.5 Connections to Existing Structures

Connections to existing structures shall be made by coring, drilling, pneumatic chisel, or other means as approved by the Engineer. Connections to precast or poured in place manholes or catch basins shall be made by coring. The Contractor shall be responsible to ensure that the invert of the connecting pipe is built to the design invert elevation shown on the plans. The pipe shall extend into the structure sufficiently so that all portions of the end of the pipe match the inside wall of the structure or protrude into the structure. The end of the pipe closest to the inside wall of the structure shall not protrude more than 2 inches beyond the inside wall of the structure. All connections to existing structures shall be mortared with Portland Type II cement meeting MassDOT Specification M4.02.15. Each connection shall be mortared completely around the circumference of the pipe inside and outside the structure. The mortar shall be troweled by hand and shall fill completely the voids between the pipe wall and the structure. The inside and outside mortar surfaces shall be made smooth, neat, and in a good workmanlike condition.

7.1.6 Measurement and Payment

Measurement and Payment for drainage pipe shall be based on the unit bid price per linear foot of the completed pipeline lengths taken along their centerlines. Payment shall include all materials, labor, tools, and equipment to remove the pavement (where necessary) excavate the trench, provide trench drainage (pumping), install bedding materials, lay and joint the pipe, cut the pipe to meet required lengths, safeguard and protect other utilities, backfill and compact the backfill, dispose of surplus or unacceptable spoil and maintain the backfilled trench in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Payment Items:		Unit
7.1.6a	RCP pipe – 8 inch	Linear Foot
7.1.6b	RCP pipe – 12 inch	Linear Foot
7.1.6c	RCP pipe – 15 inch	Linear Foot
7.1.6d	RCP pipe – 18 inch	Linear Foot
7.1.6e	RCP pipe – 24 inch	Linear Foot
7.1.6f	RCP pipe – 36 inch	Linear Foot
7.1.6g	Connection to Existing Structures, Coring	Each
7.1.6h	Connection to Existing Structures, Other	Each

7.2 POLYVINYLCHLORIDE (PVC) PIPE

7.2.1 General

The Contractor shall make all earth excavations, furnish all materials, labor, tools and equipment, install bedding materials, lay, joint and connect all drainage or sub-drain pipe at the locations and elevations shown on the contract plans, make drainage or sub-drain structure connections, backfill, compact, dispose of all excess materials and do all appurtenant work in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

7.2.2 Inspection and Acceptance of Pipe

All pipe will be inspected before being laid. Drainage pipe that fails to meet any of the specifications listed herein or is found to be damaged as determined by the Engineer shall be rejected. The Contractor shall provide all labor and equipment necessary to assist the Engineer in inspecting the pipe. Polyvinylchloride (PVC) pipe shall meet ASTM Specification D-3034 SDR35 or as specified by the Engineer. Sub-drains shall meet the provisions of M5.03.9 of the MassDOT specifications for slot-perforated corrugated plastic pipe. Any pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed from the project site. Any pipe showing visible damage and for which it is believed there is no incipient fracture beyond the limits of the damaged section, may have the damaged section, as identified by the Engineer, cut off before

the pipe is laid. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the damage. All pipe cuts shall be filed smooth and beveled to match the manufacturer's spigot end of the pipe. All cutting shall be done with blade-type cutters, abrasive discs or other equipment approved by the Engineer. Care shall be taken to avoid exposure to direct sunlight or prolonged high temperature for extended periods of time immediately preceding installation.

7.2.3 Installing PVC Pipe

The pipe shall be laid true to the lines and grades indicated on the contract plans. Should a utility conflict occur and a field change be necessary, the Engineer shall make the required decisions regarding final placement of the pipe. The pipe shall be set in a bedding of gravel borrow, type c meeting Section 5.6.1 unless the existing spoil is determined to be suitable by the Engineer. The bedding shall be placed to a minimum depth of six (6) inches below the bottom of the pipe and shall extend around and over the pipe for a minimum distance of six (6) inches. Sub-drain trench shall be lined with filter fabric, and backfilled with $\frac{3}{4}$ " to $1\frac{1}{2}$ " screened gravel, as shown on the plans. The pipe shall be installed from the low end to the high end with the bell of the pipe at the high end. Each pipe unit shall be handled into its position in the trench by using equipment adapted for that purpose. The Contractor shall furnish approved devices to permit satisfactory support of all parts of the pipe unit when it is lifted. Excavations and backfill for the pipe shall be made in accordance with Section 5.5 and 5.6, *Earthwork Specifications*.

7.2.4 Pipe Jointing Requirements

Pipe joints shall meet ASTM Specification D-3212 for pipes using flexible elastomeric seals and shall not allow infiltration to exceed 50 gallons/inch/diameter/mile/day. Each pipe unit shall be laid and connected so as to form a tight joint with the adjoining pipe and bring the inverts continuously to the required grade. Pipe ends shall be kept clean of all debris, dirt, grease, or other material which may prevent a tight seal from forming. Care shall be taken to preserve the alignment of pipes already laid during the jointing process. After the pipe units are aligned in the trench and are ready to be joined, all joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damaging the pipe or gasket and create a tight seal. Joints where the gasket is damaged or not properly positioned as determined by the Engineer shall be pulled apart and remade using a new gasket.

7.2.5 Connections to Existing Structures

Connections to existing structures shall be made by pneumatic chisellers, drilling, coring or other means as approved by the Engineer. Connections to precast, or poured-in-place manholes or catchbasins shall be made by coring. The Contractor shall be responsible to ensure that the invert of the connecting pipe is built to the design invert elevation shown on the plans. The pipe shall extend into the structure sufficiently so that all portions of the end of the pipe match the inside wall of the

structure or protrude into the structure. The end of the pipe closest the inside wall of the structure shall not protrude more than 1 inch beyond the inside wall of the structure. All connections to existing structures shall be mortared with Portland Type II cement meeting MassDOT Specification M4.02.15. Each connection shall be mortared completely around the circumference of the pipe inside and outside the structure. The mortar shall be troweled by hand and shall fill completely the voids between the pipe wall and the structure. The inside and outside mortar surfaces shall be made smooth, neat and in a good workmanship condition.

7.2.6 Measurement and Payment

Measurement and Payment for drainage pipe shall be based on the unit bid price per linear foot of the completed pipeline lengths taken along their centerlines. Payment shall include all materials, labor, tools and equipment to remove the pavement (where necessary), excavate the trench, provide trench drainage (pumping), install bedding materials, lay and joint the pipe, cut the pipe to meet required lengths, safeguard and protect other utilities, backfill and compact the backfill, dispose of surplus or unacceptable spoil and maintain the backfilled trench in accordance with these specifications and as shown on the contract plans or as directed by the Engineer. Measurement and payment for sub-drains shall also include the cost of providing and placing filter fabric and washed gravel.

Payment Items:		Unit
7.2.6a	SDR26 pipe – 6 inch	Linear Foot
7.2.6b	SDR26 pipe – 18 inch	Linear Foot
7.2.6c	SDR26 pipe – 24 inch	Linear Foot
7.2.6d	8-inch Subdrain	Linear Foot

7.3 DRAINAGE MANHOLES

7.3.1 General

The Contractor shall furnish all materials, labor, tools and equipment, make all earth excavations, install base materials, drainage structures, brick leveling courses, tables and channels, frames and covers at the locations and elevations shown on the contract plans, make drainage structure to pipe connections, backfill, compact, dispose of all excess materials and do all appurtenant work in accordance with these specifications as shown on the contract plans or as directed by the Engineer.

7.3.2 Foundation Requirements

All drainage manhole structures shall be placed on a minimum 8-inch thick layer of Compacted Gravel, Type c, meeting Section 5.6.1. The gravel base shall be compacted in one 8-inch lift and shall be level. The gravel base shall extend for a distance of at least 1 foot beyond the limits of the concrete base of the manhole structure. The

Contractor shall be responsible to ensure that the base is set at the correct elevation to meet these specifications and the invert requirements on the contract plans.

7.3.3 Precast Reinforced Concrete Manhole Sections

The drainage manhole sections shall conform to the ASTM Standard Specification for Precast Reinforced Concrete Manhole Sections C478 Eccentric Cone or Flat Slab Top and Base Riser Section with Integral Floor.

7.3.4 Manhole Joints

Manhole joints shall conform to ASTM C478 and shall be sealed using Butyl Rubber or Neoprene Rings and Portland Type II Cement Mortar.

7.3.5 Drainage Manhole Steps

Drainage manhole steps shall be installed and shall conform to ASTM C478.

7.3.6 Brick Leveling Courses

At least two layers and not more than five layers of a brick leveling course shall be constructed on top of the drainage structure. All brick shall be sound, hard and uniformly burned brick, regular and uniform in shape and size, of compact texture and satisfactory to the Engineer. Rejected brick shall be immediately removed from the work site. The bricks shall be clean and thoroughly wetted shortly before use and each brick shall be laid in a full bed and joint of mortar meeting MassDOTM4.02.15 and bonded. The brick shall be laid radially along its longitudinal axis around the manhole opening and shaped to adjust the pitch of the manhole frame and cover to match the cross-section and grade of the road as shown on the contract plans exactly.

7.3.7 Table and Channel Construction

A channel shall be formed of 4000 psi type II Portland cement concrete meeting MassDOT Specification M4.02.00 et seq. in the bottom of the manhole base section in order to eliminate the possibility of standing water in the base of the manhole.

7.3.8 Pipe to Manhole Connections

Pipe to manhole connections shall be made at pre-formed knock-outs at the locations and inverts shown on the contract plans. Pipe connections shall meet the same specifications previously stated in Section 7.1.5. It is the Contractor's responsibility to coordinate with the manufacturer to obtain the correct manhole structures with the correct knock-out sizes, locations and elevations.

7.3.9 Drainage Manhole Frames and Covers

Manhole frames and covers shall be heavy duty, 24-inch diameter Marblehead Pattern, as manufactured by E. L. LeBaron Foundry Company; or approved equal. Each frame

and cover shall have a minimum weight of 450 pounds and the cover shall be marked with the letter “D”.

7.3.10 Measurement and Payment

Measurement for furnishing and installing drainage manholes shall be based on a standard unit having a depth of 6½ feet or less as indicated on the contract plans measured vertically at the center of the structure from the top of the cover to the invert of the finished channel. Drainage manholes greater than the 6½ ft. depth and less than or equal to 8½ ft. as measured above shall be based on the unit bid price for Drainage Manhole – 8½ ft.

Drainage manholes greater than the 8½ ft. depth and less than or equal to 10½ ft. as measured above shall be paid based on the unit price for Drainage Manhole - 10½ ft.

Drainage manholes greater than the 10½ ft. depth as measured above shall be considered Special Drainage Manholes and shall be measured as complete units regardless of depth.

Payment shall be on a per unit basis and shall include all labor, materials, tools and equipment to excavate, provide drainage (pumping), install base materials, drainage manhole sections, flat slab tops (if the manhole depth is less than 6½ feet), joints, brick leveling courses, channels (tables), pipe connections, manhole frames and covers at the locations and elevations shown on the contract plans, backfill, compact, dispose of excess materials and maintain the backfill around the structure in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Payment Items:		Unit
7.3.10a	Drainage Manhole – 6½ ft.	Each
7.3.10b	Drainage Manhole – 8½ ft.	Each
7.3.10c	Drainage Manhole – 10½ ft.	Each
7.3.10d	Special Drainage Manhole	Each

7.4 CATCH BASINS

7.4.1 General

The Contractor shall furnish all materials, tools and equipment, make all excavation, install base materials, structures, brick leveling courses, frames and grates at the locations and elevations shown on the contract plans, make drainage structure to pipe connections, backfill, compact, dispose of all excess materials, maintain the backfilled area around the structure and do all appurtenant work in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

7.4.2 Foundation Requirements

All catch basin structures shall be placed on a minimum 8-inch thick base layer of Compacted Gravel, Type C, meeting Section 5.6.1. The gravel base shall be compacted in one 8-inch lift and shall be level. The gravel base shall extend for a distance of at least 1 foot beyond the limits of the concrete base of the catch basin structure. The Contractor shall be responsible to ensure that the base is set at the correct elevation to meet these specifications and the invert requirements on the contract plans.

7.4.3 Precast Reinforced Concrete Catch Basins

The catch basin structures shall conform to the ASTM Standard Specification for Precast Reinforced Concrete Manhole Sections (ASTM C478) Flat Slab Top and Base Riser Section with Integral Floor. No steps or ladders shall be installed in the catch basin structure.

Sluiceway catch basins shall be constructed from concrete block placed on a cement concrete base, as shown on the plans.

7.4.4 Catch Basin Joints

Catch basin joints shall conform to ASTM C478.

7.4.5 Catch Basin Sump Requirements

A 30-inch sump shall be provided below the lowest pipe invert connected to the catchbasin structure. Sluiceway catchbasins shall be constructed as shown on the plans and shall not contain a sump.

7.4.6 Brick Leveling Courses

Brick leveling courses shall conform to the specifications previously stated in Section 7.3.6.

7.4.7 Pipe-to-Catch Basin Connections

Pipe to catch basin connections shall be made at pre-formed knock-outs at the locations and inverts shown on the contract plans. Pipe connections shall meet the same specifications stated in Section 7.1.5.

It is the Contractor's responsibility to coordinate with the manufacturer to obtain the correct catch basin structures with the correct knock-out sizes, locations, and elevations.

7.4.8 Catch Basin Frames and Grates

Catch basin frames and grates shall be heavy duty, cast iron 24-inch square standard except as otherwise specified on the contract plans. The frame shall be 4-flange unless a curb inlet is required in which case it shall be 3-flange. The grate shall be a standard

square pattern and be rated bicycle safe. Double grates, when required, shall be set in a double frame manufactured for that purpose. Catch basin frames and grates shall be as manufactured by East Jordan Iron Works or approved equal.

7.4.9 Curb Inlets

Curb inlets, when required, shall conform to MassDOT Specification M9.04.5. The curb inlet shall be installed immediately behind the grate and the centerline of the inlet shall match the centerline of the grate. The curb inlet shall have a 6-inch reveal at the gutter and shall be parallel with the grade of the gutter at the inlet location. Granite transition stones shall be installed at both ends of the curb inlet in order to provide a smooth transition from the roadway curb to the curb inlet and back to the roadway curb except as otherwise specified in the contract plans. Granite transition stones shall be at least 3 feet and no more than 4 feet in length. The transition stones and curb inlet shall be set in a bed of mortar meeting MassDOT Specification M4.02.15. Adjustments to the curb inlet to align the inlet with the gutter grade shall be made with shaped brick. The foundation for the transition stones shall consist of a 6-inch compacted gravel base on which the mortar shall be placed. The joints between the curb inlets and transition stones shall be no greater than 1/4-inch wide and shall be mortared.

All existing curb inlets located within the Project Limits at the edge of pavement shall be remove and stacked by the contractor at a designation to be determined by the Engineer.

7.4.10 Measurement and Payment

Measurement for furnishing and installing catch basins shall be based on a standard 5½ ft. or 6½ ft. unit measured vertically on the catch basin centerline from the INSIDE bottom of the sump to the top of the catch basin grate. Catch basins greater than the 6½ ft. depth as measured above shall be considered Special Catch Basins and shall be measured as complete units regardless of depth. Catch basins for double grates shall be 5-foot diameter (inside measure), include the flat top section, and also be considered Special Catch Basins, regardless of depth. Payment shall be on a unit price basis and shall include compensation for providing all material, labor, tools and equipment to excavate, provide drainage (pumping), install base materials, catch basin sections, brick leveling courses, pipe connections, catch basin frames and grates at the locations and elevations shown on the contract plans, backfill, compact, dispose of all excess materials and maintain the backfilled area around the structure in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement for furnishing and installing curb inlets shall be based on a per unit basis. Payment shall include compensation for providing all material, labor, tools and equipment to excavate, install foundation materials (including gravel, mortar and shaped brick), curb inlets and associated transition stones, mortared joints at the locations and elevations described in these specifications and as shown on the contract plans, backfill, compact, dispose of all excess materials and maintain the backfilled area

around the curb inlet and transition stones in accordance with these specifications and as shown on the contract plans or as directed by the Engineer. Removal and stacking of existing granite curb inlets shall be based on a per unit basis payment shall include. All compensation for excavating, removal, loading, and transporting existing curb inlets to a location designated by the engineer. All existing curb inlets will become the property of the owner.

Sluiceway Catch basin shall be based on lump sum to include all labor and materials described in these specifications and as shown on the contract plans, to connect the scupper installed in the curbing to the manhole including coring, PVC piping excavation, backfill, asphalt removal, compaction and dispose of all excess materials.

Payment Items:		Unit
7.4.10a	Catch Basin – 5½ ft.	Each
7.4.10b	Catch Basin – 6½ ft.	Each
7.4.10c	Special Catch Basin	Each
7.4.10d	Curb Inlet	Each
7.4.10e	Curb Inlet Removed & Stacked	Each
7.4.10f	Sluiceway Catch Basin	Each
7.4.10g	Double Straight Granite Curb Inlet	Each

7.5 MISCELLANEOUS DRAINAGE WORK

7.5.1 Rebuilding Existing Structures

The Contractor shall provide all materials, labor, tools and equipment, make all earth excavations, remove and store castings, plate or cover underground structures as required, rebuild the existing structure to the limits indicated on the plans or as directed by the Engineer, install brick leveling courses, reset the existing casting, backfill, compact, dispose of all excess material and maintain the backfilled area in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

When the line or grade or both the line and grade of the structure changes by six (6) inches or less, the structure shall be adjusted to the proposed line and grade. (See Section 9.1.6, *Casting Adjustments*)

When the line or grade, or both the line and grade, of the structure changes by more than six (6) inches, the structure shall be remodeled. The sloped and/or vertical masonry shall be removed to such depths as shown on the contract plans or directed by the Engineer and new masonry shall be constructed to conform to the proposed design and in conformity with the requirements of the applicable parts of Section 201 of the MassDOT Specifications.

When, in the judgment of the Engineer, the existing structure shows deterioration or is otherwise unsuitable for remodeling, the structure shall be rebuilt. The casting and deteriorated masonry shall be removed in a neat manner until a clean sound base is obtained upon which concrete blocks may be set to rebuild the structure. The casting shall be set to the proposed line and grade on brick leveling courses as shown on the contract plans or as indicated by the Engineer.

Drainage structures to be abandoned are indicated in the design plans. The contractor will remove the upper portions of the masonry to a depth of 3 feet below the finish grade. Inlets and outlets of structures shall be plugged with brick masonry not less than 8 inches in thickness. Structures shall be completely filled with selected excavated material placed in 12-inch layers and thoroughly compacted. The present castings shall be carefully removed. They shall be satisfactorily stored and protected until they are required for reuse or removed from the project by the owner.

Drainage structures to be removed entirely are indicated on the contract plans. The contractor shall first remove the frame and grate or cover and if approved by the Engineer, will safely store the casting for reuse. All material associated with the existing structure deemed unsuitable for reuse by the Engineer will be removed from the site and disposed of by the Contractor. The removal of the drainage vault refers to a large concrete structure with a granite top slab. This structure shall be removed in its entirety to allow proper installation of a new 6-foot diameter drainage manhole.

New castings shall be provided where required by the contract drawings or as indicated by the Engineer. New castings shall be installed in accordance with these specifications and as directed by the Engineer.

When a change in type of structure is required, as converting a catch basin to a manhole, the masonry shall be removed to such a depth as directed by the Engineer and new masonry, including a brick invert, shall be constructed to conform to the proposed design.

The contractor will be held responsible for the protection of the castings. Any frames, grates, or covers damaged in any manner during the process of construction shall be replaced by new castings by the contractor, at their expense.

Prior to the actual removal of the present castings, a count will be made and recorded of all castings in satisfactory condition for reuse. Castings to be salvaged and reused will be reset at existing or proposed structures as directed by the Engineer.

7.5.2 Flared End Sections (FES)

Reinforced concrete flared end sections shall be provided where indicated on the contract plans and shall be appropriate for the pipe diameter to which they are attached. The flared end sections shall be situated on an 8-inch minimum compacted gravel base. The flared end sections shall be as manufactured by Scituate Concrete Pipe Corporation or approved equal. A rip-rap apron, 5 feet long and 4 feet wide, shall be constructed at the outfall to the flared end section using 50 pound stone. The stone

shall be set in an 8-inch gravel base and smaller stones shall be set in between the larger stones to form a stable structure.

7.5.3 Backflow/Flapper Valves

Backflow/flapper valves shall be provided where indicated on the contract plans and shall be appropriate for the pipe diameter to which they are attached. Any backflow/flapper valve shall be a SERIES 6000 MODEL 10C FLAP GATE or equivalent, as approved by the Engineer.

7.5.4 Brook and Culvert Maintenance

This work involves the maintenance and cleaning of brook channels and culverts. This work, which shall be performed by hand, shall include the clearing of debris (silt, vegetation, rocks, felled trees, etc.) from the channel bottoms and culverts as generally shown on the Contract Plans. This work may also include the repair of the walls of the channel (mortaring joints, replacing rocks in the wall, replacing wall sections, etc.) and repair of erosion damage behind the channel walls, including restoration of any impacted areas.

7.5.5 Measurement and Payment

Measurement and payment for casting adjustments shall be as specified in Section 9.1.19.

Measurement and payment for remodeling structures shall be on a per unit basis and shall include all materials, labor, tools and equipment and all work necessary to provide the remodeled structure in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for rebuilding structures shall be on a per vertical foot basis from the elevation of the clean sound base to the elevation of the bottom of the casting and shall include all materials, labors, tools and equipment and all work necessary to provide the rebuilt structure in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for new castings shall be on a per unit basis and shall include all work necessary to provide new castings complete and in-place in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for flared-end sections shall be on a per unit basis and shall include all materials, labor, tools and equipment and all work necessary to provide flared-end sections and their associated rip-rap aprons in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for a change in type of structure shall be on a per unit basis and shall include all labor, materials, tools, equipment, and all work necessary to

provide the change in type structure in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for all castings removed and reset either for manhole frames and covers or catch basin frames and grates, when rebuilding a structure or salvaging an existing casting from an abandoned or removed structure, where such casting has been inspected and approved for reuse by the Engineer, will be paid for on a per unit basis. Resetting of castings will include removal temporary storage and resetting casting, and shall include all labor, materials, tools, equipment, and all work necessary to provide the change in type structure in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for drainage structures either abandoned or removed will be paid for on a per unit basis and shall include all labor, materials, tools, equipment, and all work necessary to provide the change in type structure in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for drainage structures reset will be paid for on a per unit basis and shall include all labor, materials, tools, equipment, and all work necessary to reset the existing drainage structure in place in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for backflow/flapper valves, installed or replaced, shall be paid for on a per unit basis and shall include all labor, materials, tools, equipment, and all work necessary to install in accordance with manufacturer’s instruction, as shown on the contract plans, or as directed by the Engineer.

Measurement and payment for culvert flushing shall be on a per unit basis and shall include all materials, labor, tools, and disposal to provide culvert flushing, and complete debris removal and disposal in accordance with these specifications and as shown on the Contract Plans or as directed by the Engineer. Any materials, labor, tools, and disposal costs shall be considered incidental to the work and included in the bid price under this Section unless specifically included in the Unit Price Bid Sheet.

Measurement and payment for brook maintenance shall be on a lump sum basis and shall include all equipment, materials, labor, tools, and disposal to provide brook maintenance in accordance with these specifications and as shown on the Contract Plans or as directed by the Engineer. Any materials, labor, tools, and disposal costs shall be considered incidental to the work and included in the bid price under this Section unless specifically included in the Unit Price Bid Sheet.

Payment Items:		Unit
7.5.	Drainage Structure Remodeled	Each
7.5.5b	Drainage Structure Rebuilt	Vert. Foot
7.5.5c	Frame and Grate	Each

7.5.5d	Frame and Cover	Each
7.5.5e	Flared-End Section with Rip-Rap	Each
7.5.5f	Drainage Structure Change in Type	Each
7.5.5g	Drainage Structure Abandoned	Each
7.5.5h	Drainage Structure Removed	Each
7.5.5i	Drainage Structure Reset	Each
7.5.5j	Frame & Grate Removed & Reset	Each
7.5.5k	Frame & Cover Removed & Reset	Each
7.5.5l	Double Frame and Grate	Each
7.5.5m	Drainage Vault Removed	Each
7.5.5n	Backflow/Flapper Valve	Each
7.5.5o-w	Culvert Flushing	Linear Foot
7.5.5x-z	Brook Maintenance	Lump Sum

SECTION 8 SEWER CONTRACT SPECIFICATIONS

8.1 POLYVINYLCHLORIDE (PVC) PIPE

8.1.1 General

The Contractor shall make all earth excavations, furnish all materials, labor, tools and equipment, install bedding materials, lay, joint and connect all sewer pipe at the locations and elevations shown on the contract plans, make sewer structure connections, backfill, compact, dispose of all excess materials and do all appurtenant work in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

8.1.2 Inspection and Acceptance-of Pipe

All pipe will be inspected before being laid. Sewer pipe that fails to meet any of the specifications listed herein or is found to be damaged as determined by the Engineer shall be rejected. The Contractor shall provide all labor and equipment necessary to assist the Engineer in inspecting the pipe. Polyvinylchloride (PVC) pipe shall meet ASTM Specification D-3034 SDR35 or as specified by the Engineer. Any pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed from the project site. Any pipe showing visible damage and for which it is believed there is no incipient fracture beyond the limits of the damaged section, may have the damaged section, as identified by the Engineer, cut off before the pipe is laid. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the damage. All pipe cuts shall be filed smooth and beveled to match the manufacturer's spigot end of the pipe. All cutting shall be done with blade-type cutters, abrasive discs or other equipment approved by the Engineer. Care shall be taken to avoid exposure to direct sunlight or prolonged high temperature for extended periods of time immediately preceding installation.

8.1.3 Installing PVC Pipe

The pipe shall be laid true to the lines and grades indicated on the contract plans. Should a utility conflict, or other obstruction as determined by the Engineer, occur and a field change be necessary, the Engineer shall make the required decisions regarding final placement of the pipe. The pipe shall be set in a bedding of $\frac{3}{4}$ -inch crushed stone meeting MassDOT Specification. The bedding shall be placed to a minimum depth of six (6) inches below the bottom of the pipe and shall extend around the pipe up to the spring line. The pipe shall be laid accurately to the required lines and grades using a pipe-laying laser in accordance with the manufacturer's recommendations. Care shall be taken to maintain an accurate alignment and to give the pipe a firm bearing along its entire length. Walking or stepping directly on the pipes shall not be permitted after they have been laid.

Adjustments to the line and grade in order to comply with the contract plans shall be made by re-grading the bedding material. The bedding shall then continue over the pipe using Gravel Borrow, Type C, as specified in Section 5.6.1, unless the existing spoil is determined to be suitable by the Engineer. Should the existing spoil be used, all stones greater than four (4) inches shall be removed prior to placement of the spoil. The gravel bedding shall be thoroughly compacted using a vibratory compactor. Any length of pipe that becomes damaged or misaligned shall be removed and replaced by a sound and satisfactory length to the correct alignment by the Contractor at their expense. The pipe shall be installed from the low end to the high end with the bell of the pipe at the high end. Each pipe unit shall be handled into its position in the trench by using equipment adapted for that purpose. The Contractor shall furnish approved devices to properly support the pipe when it is lifted. Excavations and backfill for the pipe shall be made in accordance with Section 5.5 and 5.6, Earthwork Specifications.

8.1.4 Pipe Jointing Requirements

Pipe joints shall meet ASTM Specification D-3212 for pipes using flexible elastomeric seals and shall not allow infiltration to exceed 50 gallons/inch/diameter/mile/day. Each pipe unit shall be laid and connected so as to form a tight joint with the adjoining pipe and bring the inverts continuously to the required grade. Pipe ends shall be kept clean of all debris, dirt, grease, or other material, which may prevent a tight seal from forming. Care shall be taken to preserve the alignment of pipes already laid during the jointing process. After the pipe units are aligned in the trench and are ready to be joined, all joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendations. Each pipe unit shall then be carefully pushed into place without damaging the pipe or gasket and create a tight seal. Joints where the gasket is damaged or not properly positioned as determined by the Engineer shall be pulled apart and remade using a new gasket.

8.1.5 Pipe Fittings

Couplings

Couplings shall be non-shear elastomeric with a pipe stiffness factor two times greater than SDR-35 PVC pipe as manufactured by DFW/HPI or approved equal. Both pipe ends and the coupling shall be cleaned of all dust, dirt or debris prior to making the connection. Cut pipe ends shall be filed smooth using a hand file around the inside and outside diameter of the pipe prior to application of the coupling. Stainless steel clamps shall be used to secure the coupling to the pipe.

Saddles

Saddles shall be flexible elastomeric wye configuration as manufactured by DFW/HPI or approved equal. Saddle tees shall not be used unless specifically approved in writing by the Engineer. The saddle wye shall be set at the two o'clock or ten o'clock position on the pipe barrel and angled in the direction of flow.' Saddle connections shall be at least 2 feet away from all existing sewer main pipe joints.

Prior to the application of the saddle, the surface of the pipe shall be cleaned of all dust, dirt or debris. In the case of PVC or transit (asbestos-cement) pipe, the barrel shall be cored using a hole saw and the inside and outside edges filed smooth. Holes in clay pipe shall be accomplished by drilling several drill holes around the circumference of the connection, and then chiseling the remainder to produce as neat and uniform a hole as possible. Holes that introduce fractures into the pipe barrel, or which are non-uniform or jagged in appearance, as determined by the Engineer, shall result in replacement of the pipe section by the Contractor at their expense.

The saddle shall be secured to the barrel of the pipe with two stainless steel clamps.

Saddle connections to the sewer main shall be supported by a concrete cradle at least two (2) feet in length.

Wyes, Tees and Bends

Wye, tee and bend fittings shall be SDR-35 PVC meeting ASTM specification D3034 and D3212. Fittings shall be as manufactured by Plastic Trends, Inc., Vassallo or approved equal.

Temporary Caps and Plugs

Temporary caps and plugs shall be SDR-35 PVC meeting ASTM specification D3034 and D3212. Caps and plugs shall be as manufactured by Plastic Trends, Inc., Vassallo or approved equal.

8.1.6 Concrete Cradles and Envelopes

The Contractor shall provide concrete cradles and/or envelopes in accordance with these specifications and as indicated on the contract plans or as directed by the Engineer. Concrete shall be 3000 psi Type II Portland cement concrete with $\frac{3}{4}$ inch aggregate and shall be placed to a minimum thickness of six (6) inches from the barrel of the pipe along its length. Concrete cradles shall be installed up to the spring line of the pipe (120 arc centered on the vertical axis of the pipe cross-section). Concrete envelopes shall completely surround the pipe. Concrete (including aggregates) shall conform to MassDOT Specification M4.02.00 et. seq. Precast concrete blocks shall be used to support the pipe at the correct line and grade while placing the concrete. No wood blocks are permitted.

8.1.7 Chimneys

The Contractor shall provide chimneys in accordance with these specifications and as indicated on the contract plans or as directed by the Engineer. The chimney pipe shall be eight inch (8") SDR 35 PVC. The bottom of the chimney pipe shall be connected to the sewer main using the appropriately sized tee as specified in Section 8.1.5. The top of the chimney pipe shall be fitted with an 8 inch by four inch wye fitting and temporary plugs. The top of the chimney pipe shall be at least five (5) feet below the finished grade. An eight-foot-long concrete cradle, as specified in Section 8.1.6, centered on the chimney shall be provided under the sewer main. The chimney pipe and fittings shall be located within an 18-inch corrugated polyethylene pipe.

The polyethylene pipe shall be provided in two sections. The bottom section shall be 24 inches in length and the top section shall vary according to design requirements. The bottom end of the polyethylene pipe shall be cut to allow passage of the sewer main through the end of the pipe with a minimum 2-inch clearance between the edge of the cut and the sewer main. The bottom end shall be anchored in the concrete cradle under the sewer main. The top end shall be cut to allow access to the wye fitting through the sidewall of the polyethylene pipe. The two sections shall be joined by a "spin-on" coupling as manufactured by Advanced Drainage Systems, Inc. (ADS) or approved equal. The annular space between the riser pipe and the surrounding polyethylene chimney shall be completely filled with fine to medium mason's sand.

8.1.8 Connections to Existing Structures

Connections to existing sewer manholes shall be made by coring. Expandable rubberized boots shall be used at each connection. The Contractor shall be responsible for ensuring that the invert of the connecting pipe is built to the design invert elevation shown on the plans. The pipe shall extend into the structure sufficiently so that all portions of the end of the pipe match the inside wall of the structure. The cavity between the outside wall of the pipe and the cored surface shall be completely filled with quick drying non-shrink hydraulic cement. The cement surfaces shall be made smooth, neat and in a good workmanlike condition.

The existing brick table shall be rebuilt to meet the new invert. The Contractor may elect to core a new channel-in the existing brick table if conditions permit. However, any failure or leakage that develops shall be repaired by the Contractor, at their expense.

8.1.9 Leakage Testing

All newly installed sewers and appurtenant structures shall be made as nearly watertight as possible. Sewer mains and partial sewer service laterals shall be tested for leakage by an independent testing company approved by the Engineer other than the Contractor who installed the sewer main. Leakage testing procedures and allowances shall conform to ASTM Specification C924. Sewer mains or portions thereof which exceed the maximum allowable leakage shall be repaired and retested at the Contractor's expense until they comply with the ASTM specification. I Sewer manholes shall not

show any evidence of leakage as determined by the Engineer. Manholes which are found to be leaking shall be repaired at the Contractor's expense.

8.1.10 Measurement and Payment

Measurement and payment for sewer pipe shall be based on the unit bid price per linear foot. Payment shall include all materials, labor, tools and equipment to remove the pavement (where necessary), excavate the trench, provide trench drainage (pumping), install bedding materials, lay and joint the pipe, cut the pipe to meet required lengths, install pipe fittings, safeguard and protect other utilities, backfill and compact the trench, dispose of surplus or unacceptable spoil and maintain the backfilled trench in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for concrete cradles or envelopes shall be based on the unit bid price per cubic yard. Payment shall include all form work, materials, labor, tools and equipment in order to provide the cradle or envelope complete and in place in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for chimneys shall be based on the unit bid price for each chimney installed. Payment shall include all materials, labor, tools and equipment required to provide the chimney complete and in place in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for connections of sewer mains to existing sewer stubs shall be based on the unit bid price for each connection made. Payment shall include all materials, labor, tools, and equipment required to locate the sewer, verify the invert elevation, excavate, and backfill to make the connection complete and in place in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for building connections shall be based on the unit bid price per linear foot. Payment shall include all materials, labor, tools and equipment to remove pavement (where necessary), excavate the trench, provide trench drainage (pumping), install bedding materials, lay and joint the pipe, cut the pipe to meet required lengths, install pipe fittings, safeguard and protect other utilities, backfill and compact the trench, dispose of surplus or unacceptable spoil and maintain the backfilled trench in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for leakage testing shall be based on a lump sum basis. Payment shall include all leakage testing required under the contract including all phases thereof and any retesting which is required by the specifications.

Payment Items:		Unit
8.1.10a	PVC sewer pipe – 8 inch	Linear Foot
8.1.10b	PVC sewer pipe – 12 inch	Linear Foot
8.1.10c	Concrete Cradle or Envelope	Cubic Yard
8.1.10d	Chimney	Each
8.1.10e	Connection to Existing Sewer Structures-Coring	Each
8.1.10f	Leakage Testing	Lump Sum

8.2 SEWER MANHOLES

8.2.1 General

The Contractor shall furnish all materials, labor, tools and equipment, make all earth excavations, install base materials, sewer structures, brick leveling courses, tables, frames and covers at the locations and elevations shown on the contract plans, make sewer structure to pipe connections, backfill, compact, dispose of all excess materials and do all appurtenant work in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

8.2.2 Foundation Requirements.

All sewer manhole structures shall be placed on a minimum 8-inch thick base layer of compacted gravel, Type C, as specified in Section 5.6.1. The gravel base shall be compacted in one 8-inch lift and shall be level. The gravel base shall extend for a distance of at least one foot beyond the limits of the concrete base of the manhole structure. The Contractor shall be responsible to ensure that the base is set at the correct elevation to meet these specifications and the invert requirements on the contract plans.

8.2.3 Precast Reinforced Concrete Manhole Sections

The sewer manhole sections shall conform to the ASTM Standard Specification for Precast Reinforced Concrete Manhole Sections C478 Eccentric Cone or Flat Slab, Top and Base Riser Section with Integral Floor.

8.2.4 Manhole Joints

Manhole joints shall conform to ASTM C478 and shall be sealed using Butyl Rubber or Neoprene Rings and Portland Type II Cement Mortar.

8.2.5 Sewer Manhole Steps

Sewer manhole steps shall be installed in accordance with ASTM Specification C478.

8.2.6 Brick Leveling Courses

At least two layers and no more than five layers of a brick leveling course shall be constructed on top of the sewer manhole. All brick shall be sound, hard and uniformly burned brick, regular and uniform in shape and size, of compact texture and satisfactory to the Engineer. Rejected brick shall be immediately removed from the work site.

The bricks shall be clean and thoroughly wetted shortly before use and each brick shall be laid in a full bed and joint of mortar meeting MassDOT 4.02.15 and bonded. The brick shall be laid radially along its longitudinal axis around the manhole opening and shaped to adjust the pitch of the manhole frame and cover to match the cross-section and grade of the road as shown on the contract plans exactly.

8.2.7 Table and Channel Construction

A table and channel shall be formed of red sewer brick complying with ASTM Specification C32 and 4000 psi Type II Portland cement concrete meeting Massachusetts Department of Transportation (MassDOT) Specification M4.02.00 et seq. All brick shall be sound hard and uniformly burned brick, regular and uniform in shape and size, of compact texture and satisfactory to the Engineer. Rejected brick shall be immediately removed from the work and substituted with brick satisfactory to the Engineer.

Mortar for the brickwork shall be composed of Type II Portland cement, sand, and water in accordance with MassDOT Specification M4.02.15.

Bricks shall be clean and thoroughly wetted before being laid in a full bed and joint of mortar and bonded. Brick shall be protected against weather, water, sewage, and/or frost until the mortar has set.

8.2.8 Pipe to Manhole Connections

Pipe to manhole connections shall be made at manufacturer- installed openings with rubberized boots and stainless steel clamps. It is the Contractor's responsibility to coordinate with the manufacturer to obtain sewer manhole structures with the correct diameter openings, locations and elevations as shown on the contract plans. Sewer manholes which do not have the correct size, location or elevation opening(s) shall be recorded or replaced as determined by the Engineer at the Contractor's expense. All recording allowed by the Engineer shall conform to Section 8.1.8 of these specifications.

8.2.9 Sewer Manhole Frames and Covers

Manhole frames and covers shall be heavy duty, 24-inch diameter Marblehead Pattern, as manufactured by E. L. LeBaron Foundry Company or approved equal. Each frame and cover shall have a minimum weight of 450 pounds and the cover shall be marked with the letter "S".

8.2.10 Drop Manhole Requirements

All drop manholes shall be constructed with an outside drop in accordance with these specifications and as shown on the contract plans or as directed by the Engineer. In rare or unusual circumstances, the Contractor may install an inside drop if approved in writing by the Engineer.

The drop shall be made using a wye fitting and a two (2) foot radius sweep. All fittings shall be the same diameter as the sewer main to which they are connected. The pipe wall of the drop shall be at least two feet away from the wall of the structure and shall be encased in 3000 psi Type II Portland cement concrete meeting MassDOT Specification M4.02.00 et seq.

8.2.11 Rebuilding Existing Structures

When the line or grade or both the line and grade of the structure changes by six (6) inches or less, the structure shall be adjusted to the proposed line and grade. (See Section 9.1.6, *Casting Adjustments*)

When the line or grade, or both the line and grade, of the structure change by more than six (6) inches, the structure shall be remodeled. The sloped and/or vertical masonry shall be removed and new masonry constructed to conform to the proposed design as shown on the contract plans or as directed by the Engineer.

When, in the judgment of the Engineer, the existing structure shows deterioration or is otherwise unsuitable for remodeling, the structure shall be replaced with a new structure meeting Section 8.2, *Sewer Manholes*, of these specifications. Doghouse style manholes are not permitted.

Where a sewer manhole is indicated on the contract plans to be relocated, the contractor shall excavate the surrounding material outside the manhole and will excavate the new hole for relocation of the existing structure simultaneously. Sewer main replaced to meet the new location shall be constructed prior to the actual relocation of the existing structures and all private services connecting to that particular link in the main will be reconnected. The casting of the existing structure will be carefully removed to prevent damage and stored on-site until such time that resetting is needed. The contractor shall remove each section of the precast manhole separately and rebuild the sewer manhole in its new location from the bottom section up. Joints between precast sections will be made watertight with new butyl rubber sealing rings. The contractor shall reconnect the new main to the relocated manhole

in accordance with the procedures as defined in applicable subsection of these specifications.

Prior to resetting any portions of the existing sewer manhole, the suitability of each section must be inspected and approved by the Engineer. If any precast portions of the existing sewer manhole are deemed to be unsuitable for reuse, the contractor will abandon the rehabilitation/relocation efforts and will furnish and install a new manhole that meets the specification requirements of Section 8.2 for new manholes.

Upon completion of reconnecting to the relocated manhole and backfilling of the excavation, the contractor will reset the salvage frame and cover.

8.2.12 Drop Manhole Rehabilitation

The Contractor shall furnish all materials, labor, tools and equipment, to rehabilitate the drop manholes at the locations and elevations shown on the contract plans. The rehabilitation shall consist of:

1. Clearing of obstructions in all inverts, including the outside drop;
2. Heavy cleaning of the manhole and outside drop;
3. Installation of a “top hat” liner into the outside drop from the main line sewer to drop’s invert within the manhole;
4. All CCTV, inspection and cleaning required;
5. All other work required to provide a functional sewer, drop, and manhole.

Measurement and payment include rehabilitation of drop manhole as indicated on the plan and shall also include disposal of all debris, sewer bypass and furnishing, and installing all items listed in Section 8.2.12 above.

8.2.13 Measurement and Payment

Measurement for furnishing and installing sewer manholes shall be based on a standard unit having a depth of 6 feet or less as indicated on the contract plans measured vertically at the center of the structure from the top of the cover to the invert of the finished channel.

Sewer manholes greater than the 12 ft. depth, as measured above, shall be considered special sewer manholes and shall be measured as complete units regardless of depth.

Payment shall be on a per unit basis and shall include all labor, materials, tools and equipment to excavate, provide drainage (pumping), install base materials, sewer manhole sections, flat slab tops (if required to meet design plan requirements), joints, brick leveling courses, channels (tables), pipe connections, and manhole frames & covers at the locations and elevations shown on the contract plans, backfill, compact, dispose of excess materials and maintain the backfill around the structure in

accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for remodeling/rebuilding existing sewer manholes will be on a per unit basis and will include all labor, materials, tools, equipment and work necessary for the completion of the item. Excavation of the existing structure and for the relocated position of the existing structure are incidental to this item. Reconnection of the new main to the relocated sewer manhole and existing manhole to remain will be paid in accordance with Section 8.1.10 of these specifications. Resetting the frame and cover, as well as removal and temporary storage are considered incidental to the remodeling/rebuilding item.

Measurement and payment for relocating existing sewer manholes will be on a per unit basis and will include all labor, materials, tools, equipment and work necessary for the completion of the item. Excavation of the existing structure and for the relocated position of the existing structure are incidental to this item. Reconnection of the new main to the relocated sewer manhole and existing manhole to remain will be paid in accordance with Section 8.1.10 of these specifications. Resetting the frame and cover, as well as removal and temporary storage are considered incidental to the relocation item.

Measurement and payment for Item 8.2.13j shall include rehabilitation of drop manhole as indicated on the plan and shall also include disposal of all debris, sewer bypass and furnishing and installing all items listed in Section 8.2.12 above.

Payment Items:		Unit
8.2.13a	Sewer Manhole – 6 ft.	Each
8.2.13b	Sewer Manhole – 8 ft.	Each
8.2.13c	Sewer Manhole – 10 ft.	Each
8.2.13d	Sewer Manhole – 12 ft.	Each
8.2.13e	Special Sewer Manhole	Each
8.2.13f	Frame and Cover – Sewer	Each
8.2.13g	Drop Manhole – Sewer	Each
8.2.13h	Sewer Structure Remodeled/Rebuilt	Each
8.2.13i	Sewer Structure Relocated	Each
8.2.13j	Drop Manhole Rehabilitation	Each

8.3 BUILDING CONNECTIONS

8.3.1 General

The Contractor shall provide all materials, labor, tools and equipment, make all earth excavations, install bedding materials, lay, joint and connect all sewer service laterals at the locations and elevations shown on the contract plans, including connections to

existing sewer laterals, backfill, compact, dispose of all excess materials and do all appurtenant work in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Renewal of sewer service laterals shall consist of connecting to the existing main as specified in Section 8.1.5, laying of new PVC sewer lateral as specified above and connection to the existing sewer lateral as shown on the construction plans as specified in Section 8.1.5.

8.3.2 Connection at Sewer Main

Sewer service laterals shall be connected to the sewer main at a wye or a saddle wye. The wye shall be located at either the two o'clock or ten o'clock positions and angled in the direction of the flow (see Section 8.1.5). A bend fitting shall be used to adjust the alignment and grade of the service lateral to meet design requirements. The service lateral shall be four (4) inch SDR 35 PVC or other diameters approved by the Engineer. Schedule 20 or Schedule 40 PVC is not permitted. Joints shall be "ring-tite" and shall meet the same requirements specified in Section 8.1.4. The lateral's pipe slope shall be at least two (2) percent and shall have no angles or changes in direction except at the sewer main connection. The service lateral shall be bedded in Gravel Borrow, Type C, and compacted to the satisfaction of the Engineer.

8.3.3 Connection at Building

Sewer service lateral connections to the building sewer shall comply with the Massachusetts Building Code. All sewer service laterals within ten (10) feet of the building wall (foundation) shall be cast iron or Schedule 40 PVC. Couplings as specified in Section 8.1.5 shall be used to connect pipes of different types.

8.3.4 Measurement and Payment

Measurement and payment for sewer service laterals shall be based on the unit price per linear foot. Measurement and payment for renewal/reestablishment of sewer service laterals shall be based on the contract unit price per each. Payment shall include all materials, labor, tools and equipment to provide sewer service laterals complete and in place in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Payment Items:		Unit
8.3.4a	Sewer Service Lateral	Linear Foot
8.3.4b	Renew Sewer Service Lateral	Each

8.4 DEMOLITION AND ALTERATIONS

8.4.1 General

The contractor shall provide all materials, labor, tools and equipment to demolish, alter, remove, and dispose of existing facilities as indicated on drawings, as specified, and as directed by Engineer. Demolish and remove existing construction, utilities, equipment, and appurtenances without damaging integrity of existing structures, equipment, and appurtenances that are to remain.

Repair or remove items that are damaged. Repair and install damaged items at no additional compensation and to condition at least equal to that which existed prior to start of work. Exercise all necessary precautions for fire prevention. Make acceptable fire extinguishers available at all times in areas where demolition work by burning torches is throughout progress of work. Proceed in such manner as to minimize spread of dust and flying particles and to provide safe working conditions for personnel.

Maintain circulation of traffic within area at all times during demolition operations.

Obtain permission from Engineer before abandoning or removing any existing structures, materials, equipment, and appurtenances.

Make necessary arrangements with and perform work required by utility companies and municipal departments for discontinuations or interruptions in services due to demolition work.

8.4.2 Demolition of Existing Pump Station

Two weeks prior to demolition the Contractor shall submit to Engineer for review, a demolition plan describing the proposed sequence, methods, and equipment for demolition and disposal of each structure. The Contractor shall coordinate with the Owner any equipment to be salvaged. Store equipment to be salvaged from relocation where directed by the Engineer and if necessary, protect from damage during work.

Confine apparatus, storage of materials, demolition work, new construction, and operations of workmen to areas that will not interfere with continued use and operations of entire facility. Provide and maintain lights, barriers, and temporary passageways for free and safe access.

Wet down work during demolition operations to prevent dust from arising. Provide maximum practicable protection from inclement weather from materials, equipment, and personnel located in partially dismantled structures. Provide shoring or bracing where necessary to prevent settlement or displacement of existing or new structures. Do not overload floors. Complete demolition work on upper levels before disturbing supporting members on lower levels.

Clean wet well and pump chamber of materials unsuitable for fill, where below-grade portions of structures are not indicated to be removed. Demolish foundation walls to

a depth of not less than two-feet below existing ground level. Demolish wet well and pump chamber as indicated and specified.

Fill structures with acceptable solid fill resulting from removal operations and/or with sand to level of adjacent ground. Place and compact fill in accordance with applicable requirements. Do not place solid fill from removal operations above an elevation one-foot below final grade.

Cap or plug with brick and mortar, as indicated, pipes and other conduits abandoned due to demolition.

Materials, equipment, and appurtenances removed, that are not designated for relocation, become property of Contractor. Haul from site and dispose of at no additional compensation.

The Contractor shall protect or dig up, trees, cultivated hedges, lawns, shrubs, and plants which might be damaged by Contractor's operations, and temporarily replant and maintain. After construction operations have been substantially completed, replant as directed by the Engineer and maintain until growth is reestablished. If trees, cultivated hedges, shrubs, and plants are injured to such a degree as to affect growth or diminish their beauty or usefulness, replace at no additional compensation, by items at least equal to that existing at start of work. Trees which cannot be temporarily replanted and maintained are to be replaced with trees at least equal to that existing at start of work. Guarantee survival of trees and shrubs for 1 year after restoration is complete. Loam and seed lawns damaged by Contractor's operation, as specified.

8.4.3 Removal and Disposal of Existing A.C. Sewers

The contractor shall remove and dispose of asbestos cement (A.C.) sewer pipe as indicated on the contract drawings.

The Contractor must comply with all federal, state, and local regulations pertaining to the contract with regard to removal and disposal of A.C. sewer pipe. The regulations include:

1. OSHA: 29 CFR Part 1926.1011, Asbestos Construction Standards.
2. OSHA: 29 CFR Part 1910.1001, General Industry Standard for Asbestos.
3. OSHA: 29 CFR 1900 Series.
4. EPA: 40 CFR Part 61 Subparts A& M (revised Subpart B) NESHAPS.
5. DOT: 40 CFR Part 171-177, Hazardous Materials Regulations.
6. ANSI Z88.2: 1980, Respiratory Protection Equipment.
7. ANSI Z9.2: 1979, Fundamentals Governing the Design and Operation of Local Exhaust Systems.

- 8. MA DL1: 453 CMR Part 6.00 Removal, Containment or Encapsulation of Asbestos.
- 9. MA DEP: 310 CMR Part 7.00 Air Pollution Control Regulations.

The fact that these regulations are not explicitly spelled out in these documents does not relieve the Contractor of the responsibility to comply with the above regulations.

The Contractor shall obtain the services of an asbestos abatement company licensed by the Commonwealth of Massachusetts Department of Labor and Industries.

8.4.4 Removal and Disposal of Existing Manholes

The Contractor shall remove and dispose of existing manholes as indicated on the Contract Plans. The contractor shall clean and return the frame and cover to the Owner.

8.4.5 Measurement and Payment

Measurement and Payment for the demolition of the existing pump station shall be based on a lump sum basis. Payment shall include, but not limited to all materials, labor, tools, and equipment necessary for removal of the existing building, de-energizing the existing pump station, disconnecting and plugging existing force main and gravity sewer, removal and disposal of demolition materials, loaming, seeding and landscaping as indicated on the contract plans and as specified and not specifically paid for under other items.

Measurement and payment for the removal and disposal of existing A.C. sewers shall be based on the unit bid price for linear foot of A.C. sewer removed and disposed of. Payment shall include all materials, labor, tools, and equipment to remove and dispose of existing A.C. sewers, complete in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Measurement and payment for the removal and disposal of existing manholes shall be based on the unit bid price of manholes removed and disposed of. Payment shall include, all materials, labor, tools, and equipment excavated, backfill, clean and return frame and cover to the Owner and remove and dispose of existing manhole, complete in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

Payment Items:		Unit
8.4.5a	Demolition of Existing Pump Stations	Lump Sum
8.4.5b	Removal/disposal of A.C. Sewers	Linear Foot
8.4.5c	Removal/disposal of Manholes	Each

8.5 Pipeline cleaning and television inspection

8.5.1 General

- A. Television inspection shall be performed before and after pipe rehabilitation, as directed by the Engineer, in order to determine the specific extents of the repairs and verify adequacy of repairs performed as intended to prevent infiltration.
- B. After cleaning, the sewer pipes shall be visually inspected by means of closed-circuit television. The inspection shall be performed by a National Association of Sewer Service Companies (NASSCO) certified operator following NASSCO Pipeline Assessment & Certification Program (PACP) and Lateral Assessment & Certification Program (LACP) standards. The inspection shall be recorded on DVD and printed TV inspection logs. Data and all deliverables should be in a NASSCO approved format.
- C. Pan and Tilt TV Camera: Specifically designed and constructed for inspection of sewer lines; equipped with a minimum of four lights to allow a clear picture of the entire periphery of the pipe; operative in 100 percent humidity conditions; and equipped with manual or power winch, TV cable, powered rewinds or other devices that do not obstruct the camera view to move the camera through the line.
- D. The video system shall be capable of producing picture quality acceptable to the Engineer.
- E. The TV inspection equipment shall be equipped with a meter device to locate defects by measurement. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be acceptable to the Engineer. The camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the sewer condition, but no case will the television camera advance at a speed greater than 30 feet per minute.
- F. If, during the inspection operation, the television camera will not pass through the entire sewer line section, set up equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire sewer line section, the sewer line section shall be considered defective.
- G. Television Inspection Logs: Printed location records clearly showing the location, in relation to an adjacent manhole of each infiltration point observed during inspection and other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, broken pipe, presence of scale and corrosion, and other discernible features. Defect coding shall comply with NASSCO PACP criteria.
- H. Televising of sewer services must follow NASSCO LACP standards and begin at either the sewer main connection or connection to house using a flexible television devise.

8.5.2 Cleaning and Disposal Requirements

- A. The Contractor's attention is directed to the requirements set forth by the Commonwealth of Massachusetts, Department of Environmental Protection (MADEP) and Massachusetts Water Resources Authority (MWRA) regarding "Special Wastes" and the proper disposal thereof. All waste materials and debris, as designated by the Owner and/or Engineer including but not limited to any pump station, sewers and associated structures, or any portions thereof, including but not limited to sludge, grit sediment, dirt, sand, rock, grease, roots, root treatment chemicals, CIPP curing condensate, and other liquid, solid or slime-solid material contained therein, shall be considered, "Special Wastes".
- B. Remove dirt, grease, rocks, sand, iron tuberculation and other materials and obstructions from the pipeline.
- C. Pipeline Cleaning shall be performed by hydraulically propelled or high velocity jet cleaning equipment. Selection of equipment shall be based on such field conditions as access availability and type of debris to be removed.
- D. Clean pipeline to restore a minimum of 95 percent of the original carrying capacity of the pipe, and suitably to permit lining of the pipeline.
- E. The Contractor is required to test and dispose of any waste material removed from the pipeline in accordance with State and Federal requirements. Testing of waste material will be at the Contractor's expense.
- F. The Contractor shall notify the Engineer of the proposed disposal location and requirements of that disposal facility to allow disposal of waste material.
- G. The Contractor is required to store any waste material until all testing requirements of the proposed facility have been met and shall submit copies of all test results to the Engineer.

8.5.3 Cleaning Procedures

- A. Sewer Cleaning: The designated pipelines shall be cleaned using hydraulically propelled or high velocity jet cleaning equipment. Selection of the equipment used shall be based on the conditions of the lines at the time the work commences. The equipment and methods selected shall be satisfactory to the Engineer. The equipment selected for cleaning shall be capable of removing dirt, grease, rocks, sand, iron tuberculation and other deleterious materials and obstruction from the pipelines.
- B. Material Removal: All sludge, dirt, sand rocks, grease and other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section which could cause line stoppages.
- C. Disposal of Materials: All solids or semi-solids resulting from the cleaning operations shall be removed from the site and disposed as specified.

- D. **Cleaning Precautions:** During all pipeline cleaning operations, satisfactory precautions shall be taken to protect the pipelines from damage that might be inflicted by the improper use of cleaning equipment. Whenever hydraulically propelled cleaning tools, which depend upon water pressure to provide their cleaning force or any tools which retard the flow of water in the pipeline are used, precautions shall be taken to ensure that the water pressure created does not cause any damage or flooding to public or private property. The flow of sewage in the sewer lines shall be utilized to provide necessary pressures by hydraulic cleaning devices whenever possible. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant nor shall a hydrant be used for the purpose described unless a vacuum break is provided.
- E. **Root Removal:** All Roots shall be removed by mechanical methods. Any visible roots shall be removed if required.
- F. **Pumping and flow bypassing:** The Contractor shall supply the necessary pumps, conduits and other equipment to divert the flow of sewage around the pipeline section in which work is to be performed. Handling existing sewage flows and bypass pumping shall be in accordance with Section 8.8.
- G. **Flow Control Precautions:** Whenever flows in a sewer line are blocked, plugged or bypassed, sufficient precautions must be taken to protect the sewer lines from damage that might be inflicted by excessive sewer surcharging. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved. Coordination with private property owners is required.

8.5.4 Field Quality Control

Based on closed circuit television inspection, the Owner/Engineer shall be the sole judge for any final acceptance of pipeline cleaning. Specific areas of pipeline which have not been cleaned to the satisfaction of the Owner/Engineer shall be re-cleaned and re-inspected as necessary at the Contractor's expense.

8.5.5 Submittals

- A. Submit in accordance with General Conditions.
- B. Provide detailed plans and descriptions outlining cleaning and television inspection procedures and all provisions and precautions regarding the handling of existing sewage flows.
- C. Provide two DVDs, one original and one copy, to document conditions following completion of the cleaning process.

D. Quality assurance

1. Perform general work in accordance with NASSCO PACP and LACP standards for sewer collection system inspection.

8.5.6 Qualifications

Pipeline Television Inspection and Cleaning Company: Company specializing in performing the work of this section with minimum of three years experience.

8.5.7 Measurement and Payment

The unit price of cleaning and televising sewer main before and after pipeline rehabilitations, including CIPP, sort liners, etc., shall be measured by the linear foot as measured along the horizontal projection at the centerline from center of the upstream manhole to the center of the downstream manhole of sewer main cleaned and inspected, as indicated on the Drawings and/or as directed by the Engineer.

Measurement is only calculated once per pipe section regardless of multiple rehabilitations.

The unit price for heavy cleaning shall constitute heavy cleaning of sewers as indicated on the drawings and as directed by the Engineer and shall be paid per crew hour. Disposal of special wastes shall be incidental to this item.

The unit prices shall constitute full compensation for mobilization and demobilization; bypass pumping and controlling of existing sewage flows; cleaning of the sewer line and disposal of all debris in conformance with all local, state, and federal regulations; televising and recording sewer main; root removal (as necessary); and providing the appropriate number of recordings and type of media, as specified.

Water for the cleaning process will be supplied to the Contractor by the Owner. The Contractor must contact the Owner prior to use of any water for the Project.

Payment Items:		Unit
8.5.7a	Clean and TV Inspect Sewer Main before Rehabilitation (All Sizes)	Linear Foot
8.5.7b	Follow Up Clean and TV Inspect Sewer Main (All Sizes)	Linear Foot
8.5.7c	Heavy Cleaning (All Sizes and as needed)	Hour

8.6 SEWER LINE CHEMICAL ROOT TREATMENT (Foaming Method)

8.6.1 General

The intent of chemical root treatment is to kill tree roots in sanitary sewer lines and to inhibit root regrowth without damaging the trees, the environment, or the treatment plant.

Reference Specifications: The chemical root treatment material shall be EPA registered and labeled for use in sewer lines and acceptable to the state agencies including the Massachusetts Water Resources Authority (MWRA) having jurisdiction over its use.

The Contractor shall submit a shop drawing of the material to be used in chemical root treatment to the Engineer.

All materials and mixing/application procedures for chemical root treatment shall be consistent with the latest standards, requirements, and recommendations of the manufacturer of the chemical root treatment material used.

8.6.2 Materials

The active ingredient for killing roots shall be a non-systemic herbicide which will kill roots at low concentrations but not permanently affect parts of the plant distant from the treated roots. The active ingredient must be spontaneously detoxified by natural chemical/biochemical processes following its use. Manufacturers' maximum user guidelines should always be observed.

The active ingredient for inhibiting root regrowth in sanitary sewer shall inhibit root cell growth on contact but shall not be transported so as to damage other portions of the plant. The material shall form a persistent chemical barrier suppressing the growth of root tips. The material shall be sufficiently stable under conditions of use to provide protection for twelve months but shall be subject to decomposition in wastewater treatment plants without disturbing plant processes.

To improve transportation of the active ingredients into root tissues, the root treatment material shall contain emulsifiers, to degrease root masses and to remove fatty acids from root tissue, and surfactants to convert an aqueous solution of the root treatment agent into a volatile foam when using the proper aeration equipment. This

method insures root treatment material is held in line until chemical reaction is complete and roots are fully exposed to chemical.

8.6.3 Precautions and Responsibility

The Contractors attention is directed to the safety requirements and precautions associated with the use of the root treatment material.

The Contractor is required to be knowledgeable of and in compliance with federal and state requirements, including the MWRA, relative to the root treatment material and its use. Compliance with federal and state law shall supersede compliance with the provisions of this contract.

Mixing and application of the root treatment material shall be done under the supervision of a state-certified pesticide (herbicide) applicator as required by law.

The Contractor shall use precautions for the protection of all persons, vegetation, animals, and property. The Contractor is responsible for damage to private property, vegetation, animals and persons.

8.6.4 Preparatory Procedures

Root tips are the principal growth areas and are the surfaces most effectively penetrated by root treatment chemicals. When the root tips are damaged or removed by sewer line cleaning, chemical treatment will be less effective. Consequently, no cleaning is recommended in lines prior to chemical root treatment unless extensive grease, root masses, or debris preclude proper application of the material.

8.6.5 Flow Control

Existing flows shall be controlled in accordance with Section 8.8 of these specifications. In situations where it is necessary to shut down upstream pumping stations or block/bypass upstream flows, the Contractor shall coordinate their activities with the Engineer and Owner and do the work at night or during periods of low flow if requested by the Engineer or Owner.

8.6.6 Mixing Procedures

All materials shall be delivered to the site in undamaged, unopened containers bearing the manufacturer's original label. Mixing of the root treatment material shall be done at the time of application. The water used shall be clear and free of add, alkali, oxidizing agents, oil, or other organic materials. Mixing water temperature shall be between 40°F and 80°F. Mixing of root treatment material with water must be accomplished immediately before injection of foam into sewer line.

8.6.7 Application Procedures

Where conditions permit, the volume of foam shall be sufficient to completely fill the air space above the flow, from manhole to manhole. In all cases, the volume of foam delivered to the sewer line shall be sufficient to attach to and permeate all root masses.

The hose insertion method shall be used. It is the most common and lowest risk method of foam application. The foam shall be applied at sufficient pressure to penetrate a minimum of 5 (five) feet into service connections.

8.6.8 Root Removal

Removal of roots shall be conducted after initial cleaning and televising of the sewer main as indicated in Section 8.5.

Biological decomposition of dead root tissue occurs faster in septic conditions. Removal of dead roots, where required, should be postponed as long as possible after chemical mat treatment to facilitate easier cleaning. Sewer line cleaning shall be scheduled no less than six weeks after root treatment.

Use of high-velocity jet machines and mechanical sewer cleaning tools will reduce the persistence of the growth inhibitor ingredient and is advisable only in situations where the cleaning is necessary.

8.6.9 Discharges of Effluent

Sanitary Sewers: The chemical root treatment material shall be approved by MWRA. Discharge of chemical root treatment material to the sewer shall only be allowed if a permit from MWRA has been obtained. Contractor shall reimburse the Owner for all costs incurred including, but not limited to: fines, fees, and damages resulting from illegal discharges to the sewer. Contractor shall capture and dispose of root treatment material at the Contractor's expense if a permit is not obtained from MWRA prior to treatment.

8.6.10 Warranty

The Contractor shall provide to the Engineer a one year written guarantee. The Contractor shall guarantee that, within a short interval of application, virtually all root tissue present in the sewer pipe will be dead or unable to sustain life.

8.6.11 Measurement and Payment

The unit price of Chemical Root Treatment to be paid for under this item shall be measured by the linear foot as measured along the horizontal projection at the centerline from the beginning to the end of the pipe inspected and subject to root removal, as indicated on the Drawings and/or as directed by the Engineer.

The measurement of heavy cleaning is already included in Section 8.5 bid items and shall not be included in the unit price.

The unit price for this item shall include full compensation for: mobilization and demobilization; bypass pumping and controlling of existing sewage flows; cleaning and televising the sewer line before and after chemical root treatment; furnishing and applying chemical root treatment material; obtaining all permits, collection and disposal of debris and root treatment material, and all other work incidental to the installation of the chemical root treatment.

Payment Items:	Unit
8.6.11a Chemical Root Removal Sewer (All Sizes)	Linear Foot

8.7 SEWER PIPE JOINT TESTING AND SEALING

8.7.1 General

Sewer pipe joint testing and sealing using the internal pipe joint sealing process.

8.7.2 Manufacturers

- Avanti International, Webster, Texas
- 3M, St. Paul, Minnesota
- Acceptable equivalent product

8.7.3 Materials

Chemical Sealant Material (Grout)

Cured Material: Flexible as opposed to brittle; capable of withstanding freeze/thaw and wet/dry cycles without adversely affecting the seal; capable of withstanding submergence in water without degradation; capable of preventing the passage of water (infiltration) through the sewer pipe joint; and chemically stable and resistant to the mild concentrations of acids, alkalis, and organics found in normal sewage.

Mixing of the component materials shall be compatible with field operations and not require precise measurements of the ingredients by field personnel.

Residual sealing materials must be easily removable from the sewer line to prevent reduction or blockage of the sewage flow.

Herbicide must be an integral part of the chemical sealant material for root control.

8.7.4 Preparation

Bypass sewage flow to allow performance of work. Provide the necessary pumps, conduits and other equipment to divert the flow of sewage around the pipeline section in which work is to be performed. Handling existing sewage flows and bypass pumping shall be as specified in Section 8.8, *Bypass Pumping*.

Clean sewer lines as specified in Section 8.5, *Pipeline Cleaning and Television Inspection*.

Remove dirt, grease, rocks, sand and other materials and obstructions from the sewer lines to allow proper testing and sealing. All solids or semi-solids resulting from the cleaning operations shall be removed from the site and disposed as specified in General Conditions.

Remove all line obstructions that will prevent Testing and Sealing. Cut protruding services flush with the main pipe and grout to ensure proper seal with sewer main and service connection. If conventional sewer rehabilitation equipment cannot remove an obstruction, then the Contractor shall notify the Engineer.

8.7.5 Joint Testing

Each sewer pipe joint which is not visibly leaking shall be individually tested at the specified test pressure in accordance with one of the specified procedures.

The basic equipment used shall consist of a television camera, joint testing device (such as a packer), and test monitoring equipment. The equipment shall be constructed in such a way as to provide means for introducing a test medium, under pressure, into the void area created by the expanded ends of the joint-testing device and a means for continuously measuring the actual static pressure of the test medium within the void area only.

All test monitoring shall be above ground and in a location to allow for simultaneous and continuous observation of the television monitor and test monitoring equipment by the Engineer.

Prior to starting the pipe joint testing phase of the work, a two-part control test shall be performed as follows:

1. To ensure the accuracy, integrity, and performance capabilities of the testing equipment, a demonstration test will be performed in a test cylinder constructed in such a manner that a minimum of two known leak sizes can be simulated. This technique will establish the test equipment performance capability in relationship to the test criteria and insure that there is no leakage of the test medium from the system or other equipment defects that could affect the joint testing results. If this test cannot be performed successfully, the Contractor shall repair or otherwise modify their equipment and re-perform the test until the results are satisfactory to the Engineer. This test may be required at any other time during the joint testing work if the Engineer suspects the testing equipment is not functioning properly.
2. After entering each manhole section with the test equipment, but prior to the commencement of joint testing, the test equipment shall be positioned on a section of sound sewer pipe between pipe joints, and a test performed as specified. This procedure shall demonstrate the reality of the test requirement, as no joint will test in excess of the pipe capability. Should it be found that the barrel of the sewer pipe will not meet the joint test requirements, the requirements will be modified as necessary.

Joint testing shall be by one of the following procedures:

1. Liquid Test Procedure:

- a. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.
- b. The testing device end elements (sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient inflation pressure to contain the test liquid within the void without leakage past the expanded ends.
- c. Water or an equivalent liquid shall then be introduced into the void area until a pressure equal to or greater than the required test pressure is observed with the void pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test and shall be sealed as hereinafter specified.
- d. The flow rate of the test liquid shall then be regulated to a rate at which the void pressure is observed to be the required test pressure. A reading of the test liquid flow meter shall then be taken. If the flow rate exceeds $\frac{1}{4}$ gallon per minute (due to joint leakage), the joint will have failed the test and shall be sealed as hereinafter specified.

2. **Air Test Procedure:**

- a. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.
- b. The testing device end elements (sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient inflation pressure to contain the air within the void without leakage past the expanded ends.
- c. Air shall then be introduced into the void area until a pressure equal to or greater than the required test pressure is observed with the void pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test and shall be sealed as hereinafter specified.
- d. After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the void pressure decays by more than 2 psi within 15 seconds (due to joint leakage), the joint will have failed the test and shall be sealed as hereinafter specified.

3. **Test Pressure:**

- a. Joint test pressure shall be 3 psi higher than the groundwater pressure, if any, outside the pipe. Groundwater pressure may be determined by positioning the testing device on a visibly infiltrating joint and measuring the resulting void pressure with the void pressure monitoring equipment.
- b. In the absence of groundwater pressure data, the test pressure shall be equal to $\frac{1}{2}$ psi per vertical foot of pipe depth or 3 psi, whichever is greater.

8.7.6 **Joint Sealing**

Joints showing visible leakage, or joints that have failed the specified joint test shall be sealed as specified.

Joint sealing shall be accomplished by forcing chemical sealing materials into or through faulty joints by a system of pumps, hoses, and sealing packers. Jetting or driving pipes from the surface that could damage or cause undermining of the pipe lines shall not be allowed.

The basic equipment shall consist of a closed-circuit television system, necessary chemical sealant containers, pumps, regulators, valves, hoses, etc., and joint sealing packers for the various sizes of sewer pipes. The packer shall be cylindrical and have a diameter less than the pipe size and have cables attached at each end to pull it through the line. The packer device shall be constructed in a manner to allow a restricted amount of sewage to flow. Generally, the equipment shall be capable of performing the specified operations in lines where flows do not exceed the maximum line flows

for joint testing/sealing as recommended in NASSCO's Recommended Specifications for Sewer Collection System Rehabilitation.

The packer shall be positioned over the faulty joint by means of a measuring device and closed-circuit television camera in the line. The packer ends shall be expanded using controlled pressure. The expanded ends shall seal against the inside periphery of the pipe to form a void area at the faulty joint, now completely isolated from the remainder of the pipe line. Into this isolated area, sealant materials shall be pumped through the hose system at controlled pressures which are in excess of groundwater pressures. The pumping unit, metering equipment, and the packer device shall be designed so that proportions and quantities of materials can be regulated in accordance with the type and size of the leak being sealed.

Residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow shall be removed from the joint. The sealed joints shall be left reasonably flush with the existing pipe surface. If excessive residual sealing materials accumulate in the line, the manhole section shall be cleaned to remove the residual materials.

Upon completing the sealing of each individual joint, the packer shall be deflated until the void pressure meter reads zero pressure, then re-inflated and the joint retested as specified. Should the void pressure meter not read zero, the Contractor shall clean their equipment of residual grout material or make the necessary equipment repairs/adjustments to produce accurate void pressure readings. Joints that fail to meet the specified test criteria shall be resealed and retested until the test criteria can be met.

8.7.7 Testing and Sealing Records

Complete records shall be kept of joint testing and sealing performed in each manhole section. The records shall identify the following information:

1. Identification of the manhole section tested.
2. The test pressure used.
3. Location (footage) of each joint tested and/or sealed.
4. Test results for each joint tested.
5. Sealing verification results for each joint sealed.

Record on DVD all testing and sealing activities inside the sewer pipe. All DVD's and necessary playback equipment shall be readily accessible for review by the Engineer during the project, after which time a copy of each DVD shall be provided as per General Conditions

8.7.8 Lateral Testing and Sealing

Air testing laterals is accomplished by isolating the area to be tested with the packer and applying positive pressure into the isolated void area. A sensing unit is used for continuous monitoring of the void pressure. This sensing unit is located within the void area and accurately transmits pressure readout to the control panel.

The test procedure consists of applying air pressure into each isolated void area. To isolate a void, the lateral sealing packer is positioned straddling the lateral. The operator inflates the packer ends to isolate the lateral and inserts an inflatable inversion tube. Once the designated pressure in the isolated void is displayed on the meter of the control panel, the application of air pressure is stopped and a twenty-second waiting period commences. The void pressure is observed during this period. If the void pressure drop is greater than that allowed in the following Air Test Table, the lateral is considered to have failed the air test and shall be grouted.

AIR TEST TABLE

Initial Void Pressure (psi)	Void Pressure After 20 Seconds (psi)
12 – 11	4.8 – 4.4
11 – 10	4.4 – 4.0
10 – 9	4.0 – 3.6
9 – 8	3.6 – 3.2
8 – 7	3.2 – 2.8
7 – 6	2.8 – 2.4
6 – 5	2.4 – 2.0

After completing the air test for each individual lateral, the lateral packer is deflated, with the void pressure meter continuing to display void pressure. If the void pressure does not drop to approximately zero, the equipment is adjusted to provide a zero void pressure reading at the monitor.

Lateral sealing begins if the lateral does not pass the air test as described above. The lateral packer remains in position, maintaining the isolated void. Chemical grout sealant is pressure injected through the lateral packer into the annular space between the inversion tube and the lateral pipe. Under pressure, the grout material is then forced out into the soil through leaking joints and pipe defects.

The amount of chemical grout pumped is based on the number of pump strokes delivered to each lateral. The number is recorded on the sealing log.

Upon completion of the lateral sealing procedure the lateral is air tested a second time to verify the sealing of the connection. The air test is the same as outlined above. If the lateral fails the air test a second time, the grouting procedure is repeated. This sequence of air testing, grouting, and subsequent air testing is repeated until either the lateral is sealed, or it is determined that the grout consumption is too high and, may result in the blockage of the lateral pipe. The final determination to stop subsequent attempts to seal a lateral will be made by the Engineer.

Lateral flow is verified after the successful sealing of each lateral. With the lateral packer in position, the inversion tube is retracted, and air pressure is injected into the lateral. Should a pressure build in the lateral and not drop to approximately zero in a few seconds, the packer is moved off the connection and the connection is viewed with a television camera. With the camera viewing the connection point, an attempt is

made to obtain a water flush by the occupant. If no water is viewed during this procedure, it is assumed the building sewer is blocked with grout. The Contractor shall be responsible to locate the blockage and restore lateral flow to the service, at no additional cost to the Owner.

The Contractor shall leave a notification form with the homeowner stating their lateral sewer service has been restored.

The complete procedure is videotaped during the air testing and sealing operation. The videotapes are submitted to the Engineer on a DVD format for review and permanent record. The video shall display the date, manhole numbers, footage to the lateral, and void pressure readout. In addition, the data obtained during this operation shall be recorded on a lateral testing and sealing log provided by the Contractor.

8.7.9 Inspection

Within a period of not less than 6 months and not more than 12 months after Testing and Sealing each section of pipe and laterals, the Contractor shall conduct a television inspection of all locations. The Contractor shall notify the Engineer when the television inspection will take place. The television inspection shall include a pan-and-tilt inspection of all areas that were sealed. Copies of the sets of DVD's produced from this television inspection shall become the property of the Owner.

8.7.10 Warranty

The Contractor shall make all necessary repairs and replacements to remedy, in a manner satisfactory to the Engineer and at no cost to the Owner, any and all defects, breaks, or failures of the work occurring within one (1) year following the date of acceptance of the work due to faulty or inadequate materials or workmanship so long as the pipe service remains within initial project design parameters.

Except as otherwise specified, all work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, products, equipment, or workmanship for one (1) year from the date of final completion of the Contract.

8.7.11 Submittals

Submit under provisions of General Conditions.

Product Data: Indicate physical and chemical characteristics, technical specifications, limitations and general recommendations regarding each material.

Submit an outline of the procedures proposed to accomplish the work. Include a detailed description of the methods and equipment to be used for each operation.

TV Inspection Logs: Provide printed TV inspection logs as hereinafter specified.

Testing and Sealing Records: Provide printed testing and sealing records as hereinafter specified.

Videotapes: Visual and audio record documenting TV inspection of conditions prior to testing and sealing, and testing and sealing operations inside the pipe.

8.7.12 Qualifications

Testing and Sealing: Company specializing in performing the work of this section with minimum five (5) years documented experience.

8.7.13 Delivery, Storage and Handling

Deliver, store, protect and handle products to site under provisions of General Conditions.

Comply with instructions for storage, shelf life limitations and handling.

8.7.14 References

NASSCO Recommended Specifications for Sewer Collection System Rehabilitation

ASTM F2304 Standard Practice for Rehabilitation of Sewers Using Chemical Grouting

ASTM F2454 Standard Practice for Sealing Lateral Connections and lines from the mainline Sewer Systems by the Lateral Packer Method, Using Chemical Grouting

8.7.15 Measurement and Payment

Measurement and payment for sewer main testing and sealing *Item 8.7.15a* shall be based per linear foot of pipe.

Measurement and payment for sealing of wyes Payment *Item 8.7.15b* shall be based on the unit price per each. The unit price to be paid for under Payment *Item 8.8.15b*. shall be measured by the number of services, all sizes, sealed using chemical grout.

Cut gasket or lateral flush with the inside of the pipe using a mechanical cutting head deployed through the sewer. Measurement and payment for each of these items shall be per each item.

Payment shall include all materials, labor, tools and equipment to provide sewer service laterals complete and in place in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

The unit prices for these items shall constitute full compensation for testing and sealing sewer pipe joints and laterals, complete, as indicated and specified; including pipe cleaning; chemical grout; root removal; mobilization and demobilization; staging set-up and breakdown; bypass pumping and controlling of existing sewage flows; bypassing individual service connections if required due to high service flows as approved by Engineer; traffic control requirements; resident notification requirements; and including all work incidental thereto and not specifically included for payment under other items.

Water for the cleaning and curing process will be supplied to the Contractor by the Owner. The Contractor must contact the Owner prior to use of any water for the Project.

Payment Items:		Unit
8.7.15a	Sewer main testing and sealing	Linear Foot
8.7.15b	Sealing of wyes	Each

8.8 BYPASS PUMPING

8.8.1 General

This section includes requirements to implement and complete all bypass pumping required to complete all Work.

The Contractor will be responsible for the temporary backup sewer storage, installation and removal of the temporary bypass, all connections and disconnections to existing sewer system, burial of service under pavement, installation and removal of the relief valve, and ramping at driveways.

8.8.2 Performance

Notify all parties whose service laterals will be out of commission, in writing at least one (1) week prior to lining and a minimum of 24 hours prior to lining.

Interruption of flow or the discharge of flow onto adjacent ground surfaces, excavated trenches or storm drains throughout the duration of this work will not be permitted.

Bypass flow around the pipelines designated for reconstruction.

Plug the line at an existing upstream manhole and pump the flow into a downstream manhole or sewer system.

Maintain and operate all temporary facilities such as dams, primary and backup pumping units, conduits and electrical power required for the bypass operation.

Damage caused by failure of the Contractor to take adequate precautions in the prosecution of the Work, shall be fully repaired by the Contractor at no expense to the Owner.

8.8.3 Submittals

Submit detailed plans and descriptions outlining all provisions and precautions to be taken regarding the control and handling of existing sewage flows. Submission shall include such items as schedules, locations, elevations, capacities of equipment, pump calculations, materials, traffic maintenance plans, and all other incidental items

necessary and/or required by the Owner to ensure proper protection of the facilities and compliance with the requirements herein specified.

Submit qualifications as described herein.

Submit shop drawings for all pumping, piping, and appurtenances for type and size of equipment required to perform the bypass pumping work as required herein.

The Engineer reserves the right to limit and/or otherwise restrict the Contractor's overall proposal and/or operations without claim should the Engineer deem it to be in the Owner's or public's best interest to do so.

8.8.4 Equipment

All pumping units shall be sized properly to handle the flows encountered including increased flows due to wet weather. System shall be fully redundant.

Pump and bypass lines shall be of adequate capacity and size to handle the existing flows, in addition to increased flows due to wet weather.

Noise prevention measures for all equipment shall be used to insure minimum noise impact on surrounding areas. Noise shall be restricted to no louder than 50 dB at 20' unless otherwise stated by the Engineer.

8.8.5 Measurement and Payment

This item shall be considered incidental and shall be paid for under the requisite Bid Items in this section.

8.9 DISPOSAL OF SPECIAL WASTES

8.9.1 General

The Contractor's attention is directed to the requirements set forth by the State of Massachusetts, Department of Environmental Protection, (MA DEP) regarding "Special Wastes" and the proper disposal thereof. All waste materials and debris, as designated by the Owner and/or Engineer, including but not limited to any sewers, storm drains, catch basins, and combined system pipelines and associated structures, or any portions thereof, including but not limited to sludge, grit, sediment, dirt, sand, rock, grease, roots and other liquid, solid or semi-solid materials contained therein, shall be considered "Special Wastes". In addition, any excavated soils contaminated in any manner, as designated by the Owner and/or Engineer, shall also fall under this category and shall be handled the same. When so encountered, all such materials and debris shall be removed to the extent so ordered by the Engineer and properly disposed of in strict compliance with the requirements of the MA DEP and other regulating authorities to an approved and certified waste disposal site. It shall remain the sole responsibility of the Contractor to apply for and obtain all required permits, bonds and/or insurance relative to such disposal.

The Contractor shall also pay all costs associated with the disposal, required permits, bonds and insurance with no additional expense to the Owner. All handling of such “Special Waste” shall be done in strict compliance with the MA DEP requirements and/or any other federal, state or local agency having jurisdiction or authority over the same. Under no circumstances shall sewage, solids or other “Special Wastes” removed from the sewer lines be dumped or spilled onto the streets or into ditches, catch basins or storm drains. The Contractor must use watertight and State approved vehicles in transporting any wastes as here in before designated.

The Contractor shall indemnify and save harmless the Owner and Engineer and all persons acting for or on behalf of the Owner and Engineer from all claims and liability of any nature or kind, and all damages, costs and expenses, including attorney’s fees and penalties, arising from the improper handling, transportation or disposal of “Special Wastes” as determined by the MA DEP and/or any other federal, state or local agency having jurisdiction or authority over the same.

8.9.2 Measurement and Payment

This item is considered a result of incidental work and will be paid for under the requisite Bid Items in this section.

8.10 MANHOLE SEALING AND COATING

8.10.1 General

This section includes specifications for replacing missing, loose, or broken brick masonry, and mortar joints, and patching all holes, voids, and spalled areas, and the sealing of the manhole to eliminate infiltration.

8.10.2 Materials

Brick

Sound, hard and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Brick shall comply with ASTM C32 and AASHTO M91 for sewer brick type S.S.

Rejected brick shall be immediately removed from the work.

Mortar for Brickwork

Composed of Portland Cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volume of cement and lime. The proportions of cement and lime shall be 4:1.

Cement shall be Type II Portland Cement conforming to ASTM C150.

Hydrated lime shall be Type S conforming to ASTM C207. Hydrated lime shall be “Mortaseal” manufactured by US Gypsum, "4X Hydrate" manufactured by the New England Lime Company or an acceptable equivalent product.

Sand shall conform to ASTM C144.

Patching Material

A quick-setting, corrosion resistant cementitious material shall be used as a patching material and is to be mixed and applied according to manufacturer’s recommendations and shall have the following minimum requirements:

Compressive Strength	ASTM C109	1400 psi, 6 hours 4500psi, 28 days
Bond	ASTM C321	
Cement		sulfate resistant
Applied Density		105 pcf ± 5 lbs.
Shrinkage	ASTM C596	

The patching material shall be SprayWall, Strong Seal Systems, or an acceptable equivalent.

Infiltration Control Material

A rapid-setting cementitious product specifically formulated for leak control shall be used to stop minor water infiltration and shall be mixed and applied according to manufacturer’s recommendations and shall have the following minimum requirements:

Compressive Strength	ASTM C109	1 hour.....400-600 psi 24 hours....2000-2400 psi
Expansion	ASTM C827	1 day.... .10%
Freeze/Thaw	ASTM C827 “method A”	no weight loss after 15 cycles @ 2000 ppm, test continuing.
Pull-out Strength	ASTM C234	14,000 pounds
Placement Time		< 60 seconds

The infiltration control material shall be Strong Seal Systems or an acceptable equivalent product.

Grouting Material

Chemical Sealing Materials shall be made of Acrylamide base gel and shall meet or exceed the following requirements:

1. A minimum of 10% acrylamide base material by weight in the total sealant mix, higher concentration (%) of acrylamide base material may be used to increase strength or offset dilution during injection. The ability to tolerate some dilution and react in moving water during injection.
2. A viscosity of approximately 2 centipose which can be increased with additives.
3. A constant viscosity during reaction period.
4. A controllable reaction time from 10 seconds to 1 hour.
5. A reaction (curing) which produces a homogeneous, chemically non-biodegradable gel.
6. The ability to increase mix viscosity, density and gel strength by the use of additives.

The Chemical sealing materials shall be AV100 Grout by Avanti International, Webster, TX, or an acceptable equivalent product.

Liner Material

An acid resistant calcium aluminate cementitious liner product shall be used to form a structural/structurally enhanced monolithic liner covering all interior substrate surfaces and shall have the following minimum requirements at 28 days:

Compressive Strength	ASTM C109	>9000 psi
Tensile Strength	ASTM C496	>800 psi
Flexural Strength	ASTM C293	>1200 psi
Shrinkage @ 95% R. H.	ASTM C596	0%
Bond	ASTM C882	>1600 psi
Applied Density		150 pcf $\pm$ 5 lbs.
Freeze/Thaw	ASTM C666	300 cycles, no damage

The liner material shall be made with 100% calcium aluminate cement and calcium aluminate aggregates and shall be used according to manufacturer's recommendations for use where harsh hydrogen sulfide conditions exist within the municipal sanitary system. The liner material shall be manufactured by Strong Seal Systems or an acceptable equivalent product.

Corrosion Protection Material

An epoxy top coat shall be used to provide corrosion protection to surfaces that have been properly prepared and where deterioration has occurred. The Epoxy Top Coat shall meet the following minimum specifications and standards:

Tensile Properties of Plastics	ASTM –D638	7,500 psi
Flexural Properties of Unreinforced and Reinforced Plastics	ASTM-D790	10,000 psi
Pull-off Strength of Coatings using a Portable Adhesion Tester	ASTM-D-4541	Concrete Fails
Volatile Matter Content	ASTM-D2584	0%
Durometer Hardness, Type D	ASTM-D2240	>82%
Resistance of Plastics to Chemical Reagents	ASTM-D543	
The published Standard of the American Society of Testing and Materials, West Conshohocken, PA	ASTM	
The published Standard of National Association of Corrosion Engineers (NACE International), Houston, TX	NACE	
The published Standards of the Steel Structures Painting Council, Pittsburgh, PA	SSPC	

The airless spray equipment shall be specifically designed to accurately ratio and apply the Epoxy Top Coat lining materials and must be approved by the manufacturer.

8.10.3 Execution

A. Manhole sealing includes:

1. Cleaning; surface preparation; stopping active leaks; applying patching compound to all holes and voids around steps, joints, inverts, bench, pipes and all spalled areas; replacing missing bricks; and repointing all missing and loose mortar joints.
2. Applying coating compound and cementitious coating system to invert, bench, walls cone, corbel and chimney.

B. Examination

1. Verify that surfaces are ready to receive work.
2. Beginning of installation means acceptance of existing surfaces.

C. Preparation

1. Bypass sewage flow to allow performance of the work. Provide the necessary pumps, conduits, and other equipment to divert the flow of sewage around the manhole in which work is to be performed. Handling existing sewage flows and bypass pumping shall be as specified in Section 8.8.

2. Prepare surfaces in accordance with mortar and coating manufacturer's instructions.
3. Clean all concrete and masonry surfaces to be rehabilitated. Completely remove all sewage residue, grease, oil, laitance, coatings, loose bricks, mortar, unsound concrete and other foreign materials. Remove all cracked or disintegrated material to expose a sound sub-base.
4. All cracks not subject to movement and greater than 1/16 inch wide shall be routed out to a minimum width and depth of 1/2 inch.
5. Remove and dispose of all solids and semi-solids resulting from the preparation operations.
6. The primary means of cleaning the manhole shall be water blasting using high-pressure water only. Other methods such as dry sandblasting, acid wash, concrete cleaners, degreasers, or mechanical means may be required to properly clean the surface. All surfaces on which these other methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products.
7. Water blast equipment shall utilize a minimum pressure of 5,000 psi and be capable of providing up to 10,000 psi of pressure when required. Muriatic acid (hydrochloric acid) solution, if used, shall be one part acid to ten parts water and shall be applied by spraying from above the manhole.
8. After surface preparation and prior to application of mortars and coatings, infiltration shall be stopped by either plugging, chemical grout sealing, or channeled through "bleed" pipes installed at the bottom of the manhole.

D. Chemical Grout Sealing

1. At each point of leakage within the manhole structure a hole shall be drilled from within the manhole and shall extend through the entire wall or base. In cases where there are multiple leaks around the circumference of the manhole, fewer holes may be drilled, providing all leakage is stopped from these holes.
2. Install grout ports or sealant injection devices in these previously drilled holes in such a way as to provide a watertight seal between the holes and the injection device.
3. Inject chemical grout into the installed ports under pressure using equipment appropriate for the particular application. The injection equipment shall consist of chemical pumps, chemical containers, injection packers, hoses, valves, and all necessary equipment required to seal manholes. The chemical injection pumps shall be equipped with pressure meters that will provide for monitoring pressure during injection of the chemical grout.

4. Continue injection of grout until material refusal is recorded on the pressure gage of the pumping unit.
5. Care shall be taken during the pumping operation to avoid excessive pressures that may damage the manhole structure.
6. Upon completion of the injection remove the ports and fill the remaining holes with patching compound.

E. Installation – Bleed Pipes

1. Drill holes and install “bleed” pipes around the bottom of the manhole wall to act as relief ports for water to flow from other active leaks to allow performance of the work.
2. Remove bleed pipes and seal holes after all other manhole sealing work is complete.

F. Application – Plugging Compound

1. Apply plugging compound in accordance with manufacturer's instructions.

G. Application – Patching Compound

1. All material shall be mixed and applied in accordance with the manufacturer's instructions.
2. Installation to be performed by mechanics skilled in the application of the particular type of system.
3. Prior to application, dampen area to be patched. Pack material into the area to be patched, troweling the minimum amount required to achieve a level finish. Allow adequate curing time.

H. Brickwork

1. Only clean bricks shall be used. Bricks shall be moistened by suitable means, as directed, until they are neither so dry as to absorb water from the mortar, nor so wet as to be slippery when laid.
2. Each brick shall be laid in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and shall be thoroughly bonded as directed.

I. Invert Repair

1. After preparation has been completed, remove all loose material and wash wall again.

2. Any bench, invert or service line repairs shall be made at this time using the quick setting patching material (paragraph 2.1) and shall be used per manufacturer's recommendations.
3. Invert repair shall be performed on all inverts with visible damage or infiltration. After blocking flow through the manhole and thoroughly cleaning the invert, the quick setting patch material (paragraph 2.1) shall be applied to the invert in an expeditious manner. The mix shall be troweled uniformly onto the invert at a minimum thickness of $\frac{3}{4}$ inches, extending out onto the bench sufficiently to tie into the monolithic liner to be spray applied. The finished invert shall be smooth and free of ridges. The flow may be re-established in the manhole within 45 minutes after placement of the material.

J. Application – Cementitious Liner

1. All material shall be mixed and applied in accordance with the manufacturer's instructions.
2. Installation to be performed by mechanics skilled and licensed by the manufacturer in the application of the particular type of system.
3. Application of the cementitious liner shall be according to the manufacturers recommendations and as approved by the Engineer. Two coats of liner shall be applied with the minimum thickness of $\frac{1}{2}$ -inch per coat.

K. Application – Epoxy Top Coat

1. Application procedures shall conform to the recommendations of the Manufacturer, including material handling, mixing, safety, spray equipment and environmental controls during application.
2. The reconstructed substrate (cementitious liner) shall have cured at least 24 hours.
3. The reconstructed substrate shall be washed with a high-pressure water (minimum 1,500 psi).
4. Surface shall be free to surface moisture prior to applying Epoxy top coat. Forced air shall be used to dry surface.
5. Epoxy top coat shall be applied per manufacturers recommendations to a properly prepared surface but shall not be less than 80 mils or more than 250 mils.
6. Thickness shall be checked using standard paint mil gauges.
7. Manhole bench shall be sprayed in such a manner as to blend with wall liner.
8. Flow shall be withheld for 3 hours after application before releasing.

8.10.4 Final Acceptance

After the specified types of rehabilitation work have been completed, visually inspect each manhole in the presence of the Engineer for compliance with the Specifications and for watertightness against leakage. Repair all visible leaks and defects observed during inspection.

The Engineer reserves the right to inspect the rehabilitated manholes during the warranty period. Any leakage or defects in the work found by this inspection shall be corrected by the Contractor within thirty (30) days of notice, at no additional cost to the Owner.

8.10.5 Warranty

Except as otherwise specified, all work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, products, equipment, or workmanship for one (1) year from the date of final completion of the Contract.

8.10.6 Submittals

- A. Submit under provisions of General Conditions.
- B. Product Data: Provide data on grouting, plugging, patching, and coating materials; manhole steps; mortar components; manhole frames and covers; and sewer brick.
- C. Submit mortar design mix.
- D. Submit manufacturer's installation/application instructions for grouting, plugging, patching and coating materials.
- E. Submit an outline of the procedures proposed for the accomplishment of work. Include a detailed description of the methods and equipment to be used for each operation.

8.10.7 Qualifications

Installer: Company specializing in performing the work described in this section with a minimum of one (1) year documented experience. The installer shall be a licensed applicator by the manufacturer. They shall also be required to supply a minimum of three (3) references where this product has been utilized.

8.10.8 Quality Assurance

The materials used to plug, patch, and coat the manhole shall comprise of a system specifically recommended by the manufacturer for sanitary sewer manhole rehabilitation.

Perform work in accordance with NASSCO Recommended Specifications for Sewer Collection System Rehabilitation.

8.10.9 Delivery, Storage, and Handling

Deliver, store, protect and handle products to site under provisions of General Conditions.

Maintain packaged materials clean, dry and protected against dampness, freezing and foreign matter.

8.10.10 References

- A. AASHTO M91 - Red Sewer Brick Only Grade SS.
- B. ASTM C32 - Specification for Sewer and Manhole Brick (Made from clay or shale). Grade SS
- C. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens).
- D. ASTM C144 - Specification for Aggregate for Masonry Mortar.
- E. ASTM C150 - Specification for Portland Cement.
- F. ASTM C191 - Test Method for Time Setting of Hydraulic Cement by Vicat Needle.
- G. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes.
- H. ASTM C882 - Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
- I. NASSCO Recommended Specifications for Sewer Collection System Rehabilitation.
- J. ASTM D-638, Tensile Properties of Plastics
- K. ASTM D-790, Flexural Properties of Unreinforced and Reinforced Plastics
- L. ASTM D-695, Compressive Strength
- M. ASTM D-2240, Rubber Property - Durometer Hardness, Type D
- N. L.A. County, Standard Specifications for Public Works Construction, Chemical Resistance Test Section 210-2.3.1
- O. ASTM D-2288, Determination of Volatile Matter
- P. ASTM D-2566, Linear Shrinkage of Cured Thermosetting Casting Resins during Cure

8.10.11 Measurement and Payment

The unit price to be paid for under this item shall be the length of manholes rehabilitated measured by the vertical foot, as measured from the bottom of the manhole frame to the manhole invert.

The unit price for this item shall constitute full compensation for preparing manhole; bypass pumping or handling of existing sewage flow; mobilization and demobilization; removal of debris, sand, and roots; cleaning manhole; chemically sealing leaks, and application of cementitious liner into the manhole walls, cones, bench, and pipe inverts, and all other work incidental thereto and not specifically included for payment under other items.

Payment Items:	Unit
8.10.11a Manhole Rehabilitation	Vertical Foot

8.11 SEWER POINT REPAIR LINER

8.11.1 General

Furnish all labor, materials and equipment to install, televise and test the cured-in-place pipe as specified here in after.

The system shall provide for the rehabilitation of sanitary sewer lines by the installation of an epoxy resin impregnated fiberglass/polyester felt patch inserted against the inside of the existing sewer line utilizing an inflatable element and hydrostatic pressure. Curing shall be accomplished by circulating steam or another approved method to cure the resin into a hard impermeable pipe within a pipe. The cured-in-place pipe should extend over the length of the patch in a continuous tight fitting watertight pipe within a pipe.

8.11.2 Quality Assurance

The cured in place point repair process shall be installed by a licensed Contractor.

The cured-in-place pipe shall be the product of a manufacturing firm having experience in the manufacture of the type of products specified herein. A minimum of five (5) recent installations with references who can attest to the performance results will be required.

8.11.3 References

NASSCO (National Association of Sewer Service Companies) Recommended Specifications for Sewer Collection System Maintenance and Rehabilitation.

8.11.4 Submittals

Provide data on specified component products including specifications and manufacturer's installation instructions.

Provide detailed plans and descriptions outlining installation procedures and all provisions and precautions regarding the handling of existing sewage flows.

Provide the Owner and Engineer with copies of videos and inspection logs to document conditions prior to point repairing the pipeline and following completion of the work labeled.

Provide patent indemnification certified by the Contractor and the patent holder. Reference is hereby made to Specification Section 3, Article IX - Patents, regarding specific language to which the indemnification shall comply.

Provide hydrostatic pressure log of the inflation tube maintained during curing.

Provide certified results of cured-in-place pipe sample tests.

8.11.5 Acceptable Manufacturers

A. Econoliner by Avanti International, Webster, TX.

B. Acceptable equivalent product.

8.11.6 Materials

The fiber felt patch shall be fabricated to a size that when installed will tightly fit the internal dimensions of the sewer pipe. The minimum length shall be determined by field measurement to effectively span the distance from one end of the repair to the other end, generally overlapping a minimum of one foot on either end or the recommended overlap by the manufacturer/installer. Field verify the lengths required for the complete coverage of the repair prior to impregnation of the resins

The resin shall be a general purpose, unsaturated, epoxy resin and catalyst system compatible with the pipe point repair process.

The cured-in-place pipe shall be fabricated from materials which when cured are chemically resistant to withstand internal exposure to sewage.

8.11.7 Inspection

Following cleaning and before installation of the pipe point repair the interior of the pipeline shall be carefully inspected using closed circuit television and videotaped to verify that the existing pipe has been properly prepared to receive the cured-in-place pipe. Any condition which may prevent proper installation shall be corrected prior to installation of the cured-in-place pipe.

8.11.8 Preparation

During the work, sewage flows must be maintained at all times. For provisions for maintaining sewage flow, see Section 8.8.

Remove all internal debris from the existing pipeline. Pipes shall be cleaned with hydraulically-powered equipment, high-velocity jet cleaners or mechanically-powered equipment. All sludge, dirt, sand, rocks, grease and other solids or semi-solid material resulting from the cleaning operation shall be removed and disposed of, see Section 8.5.

8.11.9 Installation

Upon inspection of defect, any pipe requiring a repair thicker than normal or thicker than 10mm shall be discussed with and approved by the Engineer prior to any repairs being made.

The resin-impregnated tube shall be installed in accordance with manufacturer's instructions using a hydrostatically inflated tube or other method acceptable to the Engineer. No air inflatable equipment will be allowed.

The resin shall be cured in accordance with the resin manufacturer's instructions using circulated steam or other methods acceptable to the Engineer. Maintain a continuous log of temperature and pressure during curing.

The finished pipe shall be continuous over the entire length of the liner run and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes and delamination.

After the resin impregnated tube has cured, reconnect all existing service connections. Re-establish service connections using a television camera and a remote control cutting device.

Seal the cured-in-place pipe ends to the existing pipe using a resin mixture compatible with the cured-in-place pipe, the existing pipe, and the manhole walls.

Steam condensate and all other potential discharges shall be collected and disposed of. No discharge to the MWRA collection system will be permitted. Contractor shall reimburse Owner for any and all cost, fines, and losses due to prohibited discharge to the collection system.

8.11.10 Testing and Inspection

The water tightness of the cured-in-place pipe point repair shall be gauged during curing while the inflator is under a positive pressure.

Any cured-in-place pipe samples that can be removed by inspection, i.e., pieces cut out at a service connection, shall be presented to the Engineer for inspection.

After the work is completed, videotape the completed work including all restored conditions. Any defects in the cured-in-place pipe shall be repaired or replaced at no additional cost to the Owner.

8.11.11 Measurement and Payment

The quantity of liner to be paid for under this item shall be measured by each completed liner. Liners shall be a minimum of 5 feet long.

The unit price for this item shall include full compensation for: mobilization and demobilization; bypass pumping and controlling of existing sewage flows; installation of sewer point repair liner; removal of condensate or special waste as defined in Section 8.5.2, *Cleaning and Disposal Requirements*; re-instatement of sewer main and all sewer service connections; and all other work incidental to the installation of the cured-in-place point repair liner.

The measurement of Cleaning and televising the sewer line before and after the installation of the cured-in-place pipe is already included in Section 8.5 bid items and shall not be included in the unit price.

Water for the cleaning and curing process will be supplied to the Contractor by the Owner. The Contractor must contact the Owner prior to use of any water for the Project.

Payment Items:	Unit
8.11.11a Sewer Point Repair Liner 8"	Each

8.12 CURED IN PLACE PIPE INSTALLATION IN SEWER MAIN (INVERSION METHOD)

8.12.1 General

Requirements for reconstruction of pipelines by installation of resin impregnated flexible felt tube inverted into the existing pipeline utilizing steam pressure. Curing shall be accomplished by circulating steam to cure the resin composite into a hard, impermeable, structurally sound, continuous, tight fitting, water-tight pipe within a pipe.

The Owner shall supply all water required by the Contractor for the pipeline cleaning and CIPP curing process. The Contractor must coordinate acceptable supply locations and contact the Owner in advance prior to use of any water for the Project.

Contractor shall take all reasonable proactive measures to mitigate/prevent impacts of process odors to residents and businesses.

8.12.2 Design Requirements

The cured-in-place pipe (CIPP) shall be designed for a fully-deteriorated design condition in which it is assumed that the existing host pipe provides no structural

support. The CIPP shall be designed to carry soil, groundwater, and other superimposed loads.

The CIPP thickness shall be designed in accordance with ASTM F 1216 under the following conditions:

Fully-deteriorated gravity pipe	Pipe diameter and material type, per Contract Drawings
Height of ground water above invert	Assume at ground surface level
Height of soil above top of pipe	Per Contract Drawings
Live Load	AASHTO HS-20
Soil Weight	120 lbs./cubic foot
Ovality	2% to 8% as applicable per Contract Application

The CIPP design will assume no bonding to the original pipe.

Hydraulic Capacity: the hydraulic cross-section of the original pipe shall be maintained as much as possible. The completed CIPP shall provide a minimum of the full flow capacity of the original pipe before rehabilitation.

8.12.3 Safety Requirements

Perform all work in strict accordance with applicable OSHA standards. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

8.12.4 Scheduling

The Contractor shall notify all wastewater generators serviced by the sewer main being lined with coordination from the Owner and Engineer. Notification to such generators shall be done 72-hours and 24-hours prior to the scheduled installation of the liner

8.12.5 Warranty

Except as otherwise specified, all work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, products, equipment, or workmanship for one (1) year from the date of final completion of the Contract.

8.12.6 Test Reports

Furnish reports to the Engineer of third party test data for chemical resistance, physical properties, structural capabilities, performance (both short-term and long-term), and flow coefficient properties.

8.12.7 Manufacturers

Inversion process and materials shall be by:

Insituform Technologies, Inc., Memphis, TN;

Inliner USA, Inc., Houston, TX;

Pipeline Products, Mamaroneck, NY

8.12.8 Materials

In accordance with ASTM F 1216

Resin Impregnated Felt Tube:

- 1. Sized to tightly fit internal dimensions and overall length of original host pipe when installed.
- 2. Manufactured to withstand installation pressures.
- 3. Overlapping layers of felt in longitudinal seams that may cause lumps in the final product shall not be utilized.
- 4. Allow for circumferential stretching during installation including those necessary to accommodate and fit irregular pipe sections.
- 5. Provide tube length required to span distance between access points.
- 6. Have sufficient strength and capability to bridge areas of missing pipe or portions thereof.
- 7. Resin and catalyst system compatible with the inversion process.

Outside layer of Tube to be coated with impermeable, flexible membrane that will contain resin.

CIPP shall conform to the following:

Physical Property	Standard	Minimum Results
Flexural Stress	(Modified ASTM D 790)	4,500 psi
Flexural Modulus of Elasticity	(Modified ASTM D 790)	250,000 psi

- 1. Values are for commonly used polyester resins in the United States. Values for nontypical polyesters, vinyl esters and epoxies may be substituted when applicable as approved by the Engineer.

2. Chemically resist internal exposure to domestic sewage in accordance with ASTM F 1216 Appendix X.
3. Wall thickness shall be not less than the minimum required by ASTM F 1216, Appendix XI.
4. No materials to be included in the tube that may cause delamination in cured CIPP.
5. Homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers.
6. No dry or unsaturated layers shall be evident.
7. The CIPP shall not contain fiberglass.
8. Provide uniform wall thickness during wet-out process that when compressed at installation, pressures will meet or exceed the calculated minimum design thickness.

8.12.9 Acceptable Installers

Licensed by the patent holder/manufacturer of the cured-in-place inversion process with a minimum of five (5) active years of experience in installing similar size CIPP.

8.12.10 Examination

Verify all lengths between manholes prior to impregnation.

8.12.11 Preparation

A. Notification

1. The Contractor shall notify all wastewater generators serviced by the sewer main being lined with coordination from the Owner and Engineer. Two notifications to such generators shall be done 72-hours and 24-hours prior to the scheduled installation of the liner.

B. Cleaning Pipelines

1. Cleaning pipelines shall be in accordance with Section 8.5 with the following additional requirements.
2. Remove all internal debris from the pipe line prior to the inversion process by utilizing any one or combination of rodding machines, high velocity water jet machines, hydraulically propelled machines, etc.
3. Selection of the equipment used shall be based on the condition of the existing pipeline at the time the work commences.

4. Methods to be approved by the Owner/Engineer.
5. Debris resulting from the cleaning operation shall be removed from the downstream manhole of the section being cleaned.
6. Passing debris from one manhole section to another will not be permitted.
7. The Contractor shall remove all debris from site during the cleaning operation.
8. Based on closed circuit television inspection, the Owner/Engineer shall be the sole judge for any final acceptance of pipeline cleaning. Specific areas of pipeline which have not been cleaned to the satisfaction of the Owner/Engineer shall be re-cleaned and re-inspected as necessary at the Contractor's expense.

C. Television Inspection

1. Closed circuit television inspection using a "pan & tilt" camera shall be performed by experienced personnel trained in locating breaks, obstacles and service connections, using equipment specifically designed for this purpose.
2. Perform a before and after liner installation interior inspection of the pipeline to locate any conditions which may prevent proper inversion into the pipeline and to inspect the final pipeline condition. Log the location of these conditions for correction.
3. Two (2) copies of the DVDs and logs shall be provided to the Owner and the Engineer for record and future reference.

D. Bypassing Flow

1. Bypass flow around the pipelines designated for reconstruction following the procedures designated in Section 8.8.
2. Notify all parties whose service laterals will be out of commission on two occasions, in writing at least one (1) week prior to lining and a minimum of 24 hours prior to lining.

E. Line Obstructions

1. Clear lines of obstructions such as solids, dropped debris, protruding service connections, collapsed pipe, or other obstructions that may prevent normal installation at no additional cost to the Owner.

8.12.12 Installation

A. Staging Area

1. Designate location where the tube will be resin impregnated prior to installation.

B. Inspection

1. Allow Engineer to inspect materials, wet-out procedures, and all operations involved with television inspections, as well as installing and curing the liner.

C. Inversion

1. Insert the wet-out tube through an existing manhole or other approved access by means of inversion process and application of hydrostatic head sufficient to fully extend the tube to the next designated manhole or termination point.
2. Insert tube into the vertical inversion standpipe and attach to create leak-proof seal.
3. Turn tube inside out at the lower end of inversion standpipe and attach to create leak-proof seal.
4. Adjust inversion head to sufficient height to cause impregnated tube to invert from manhole to manhole while holding tube against existing pipe wall with sufficient pressure to produce dimples at the service connections and flared ends at the manholes. Maintain required pressure until curing process is complete.
5. Use of lubricant in accordance with ASTM F 1216 is recommended.

D. Curing

1. After inversion is complete, apply suitable heat source and steam recirculation equipment for the curing process.
2. Fit the heat source with suitable sensors to monitor the temperature of the incoming and outgoing thermal conditions. Fit another sensor between the impregnated tube and the pipe invert at the termination to monitor curing temperature.
3. Uniformly raise the temperature to a level required to effectively cure the resin as determined by the resin/catalyst system employed.
4. Maintain steam in tube to the temperature required in accordance to the resin manufacturer's instructions.

5. Initial cure deemed complete when inspection shows exposed portions of the tube to be hard and sound and remote temperature sensor indicates temperature is of a magnitude to realize a cure in the resin.
6. Continue cure period as recommended by the resin manufacturer, as modified for the cured-in-place inversion process, recirculate thermal conductor and cycle boiler to maintain temperature.
7. Leakage testing shall be performed on the liner according to the requirements of ASTM F1216.

E. Cool Down

1. Cool hardened pipe to temperature below 100-degrees F before relieving static head in the inversion standpipe.
2. Cool down may be accomplished by introducing a cool thermal conductor into the inversion standpipe.
3. Release static head with care to avoid developing a vacuum, which could damage new pipe.
4. The inversion condensate cannot be discharged into any sewer, drain, river, stream or wetland.

F. Finish

1. Cut new pipe at suitable location in manhole.
2. The finished pipe shall be continuous and watertight over the total length of the inversion run; and be free from defects, foreign inclusions, dry spots, pin holes, lifts, and instances delamination.
3. Remove and replace defective areas.

G. Sealing Pipe at Manhole

1. If due to existing broken or misaligned pipe at the manhole wall, the new pipe fails to make a tight seal, a seal shall be applied using a resin mixture compatible with the pipe and manhole materials.

8.12.13 Service and Drain Connections

After the new pipe has been cured-in-place, reestablish all existing active service lateral connections to no less than 95% of the existing pipe at the locations recorded on the DVDs and record.

Reconnect service lateral connections without excavation, and in the case of non-person entry pipes, from the interior of the pipe by means of a television camera and remote controlled cutter specifically designed for this purpose.

8.12.14 Field Quality Control

A. Site Tests

1. The water tightness of the pipe shall be gauged while curing under positive head.
2. Provide samples in accordance with ASTM F 1216.
3. Additional testing if required will be by the Owner.

B. Inspection

1. Provide the Owner with two (2) complete DVD copies of the televised internal pipe inspection demonstrating Contract compliance and showing the completed work including all restored conditions and appurtenant sewer service lateral connections.

8.12.15 Cleaning

Upon acceptance of the CIPP installation and any testing associated therewith, restore the project area affected during the operation to a condition at least equal to that existing prior to the work.

8.12.16 References

A. American Society for Testing and Materials (ASTM)

1. ASTM D790 - Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials.
2. ASTM F1216 - Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.

8.12.17 Measurement and Payment

The length of inversion liner to be paid for under the appropriate subdivisions of this item shall be by the linear foot along the horizontal projection of the completed liner as measured from centerline to centerline of manholes.

The unit price for the appropriate subdivisions of this item shall constitute full compensation for reconstructing those pipes indicated by the installation of a resin-impregnated flexible felt tube inverted into the existing pipeline and cured, complete, as indicated on the drawings and as specified including; mobilization and demobilization; bypass pumping and controlling of existing sewage flows; sealing

manhole connections; cutting of liner in manholes; addressing of protruding services, staging set-up and breakdown; resident notification requirements; bypassing individual service connections if required due to high service flows as approved by Engineer; reinstatement of sewer main and all sewer service connections; traffic control requirements; and all other work incidental thereto and not specifically included for payment under other items.

The payment for cleaning and televising the sewer line before and after the installation of the cured-in-place pipe is already included in Section 8.5 bid items and shall not be included in the unit price.

Water for the cleaning and curing process will be supplied to the Contractor by the Owner. The Contractor must contact the Owner prior to use of any water for the Project.

Payment Items:		Unit
8.12.17a	Cured-In-Place-Inversion – Liner 8"	Linear Foot
8.12.17b	Cured-In-Place-Inversion – Liner 12"	Linear Foot

8.13 SERVICE LATERAL CONNECTION LINER

8.13.1 General

It is the intent of this specification to provide for the rehabilitation of service lateral connections (SLC) to rehabilitated sewer lines, without excavation, by installation of a resin-impregnated, flexible liner in the form of an internal sleeve, consisting of a flange section (top hat) or full-wrap in the main and extending 25 feet up the lateral. Furnish all labor, materials, equipment and incidentals required and install and test the service lateral connection liner and appurtenances complete, as shown on the Contract Drawings and as specified herein.

Service lateral connections may be a combination of tees, wyes or break-in taps of varying sized and angle from 30 to 90 degrees.

There will be no access to the service pipe from an upstream cleanout, on or off private property. All work must take-place from the mainline sewer.

8.13.2 Submittals

Submit the following:

- A. Shop drawings and schedules of all SLC liner and appurtenances required. Design data and specification data listing all parameters used in the linear design and thickness calculations based on ASTM F1216 and D2412 for fully deteriorated pipe. ALL SLC Liner design calculations shall be sealed and signed by a professional engineer, licensed in the State of Massachusetts.

- B. Detailed procedure for installing the SLC.
- C. The name of the SLC liner manufacturer and the location of the facility where the SLC was manufactured.
- D. **Contractor's Qualifications:** Submit copy of manufacturer's licenses certificate. Submit list of ten (10) similar jobs within the past three (3) years as well. Provide project information including name of project, number or services connection laterals, date completed, and project references.
- E. **Material Certifications:** Written certification is required from the manufacturer that all materials used in the work were manufactured and tested in accordance with the appropriate ASTM specification, and are being used or installed in conformance with the manufacturer's recommendations.
- F. **Test Results:** Prior to the use of any materials. Contractor shall furnish, at their expense, the results of testing of the proposed materials by an independent laboratory in conformance with the specifications.
 - 1. All submitted test data shall have been performed on field installed samples within the last twelve (12) months.
 - 2. Testing by an independent laboratory shall verify that the products to be used meet all minimum strength standards as set forth in ASTM F1216, Table 1.
 - 3. Testing shall also verify that any product to be used on the project meets the minimum chemical resistance requirements as established in ASTM F1743, Table 2, where the testing is in accordance with Section 7.2.1 of ASTM F1743.

8.13.3 References

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 2. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 - 3. ASTM F1216 - Standard Practice for Rehabilitation of Existing pipelines and Conduits by the inversion and Curing of a Resin-Impregnated Tube.
- B. Where reference is made to one of the above standards, the revision in effect at the time of the bid opening shall apply.

8.13.4 Quality Assurance

The purpose of the SLC liner is to provide for a permanent seal of the annular space of a lined sewer pipe after service lateral re-instatement, to lock the liner in place with the service connection, to provide a seal of the first joint in the service lateral, and to provide for the repair of a tapped service in a lined sewer pipe.

The Contractor performing the SLC lining work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner.

The SLC liner shall be provided by a single manufacturer. The supplier shall be responsible for the provision of all test requirements specified herein as applicable. In addition, all SLC liners to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory provided by the Owner, at their own expense. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection will be the responsibility of the Owner.

All lining work shall be fully guaranteed by the Contractor and manufacturer for a period of one year from the date of acceptance. A written warranty shall be submitted. During this period, all serious defects discovered by the Owner shall be removed and replaced in a satisfactory manner at no additional cost to the Owner. The Owner will conduct an independent television inspection, at their own expense, of the lining work prior to the completion of the guarantee period. Any defects replaced at that time shall be fully guaranteed by the Contractor and manufacturer for a period of one year from the date the defect was repaired. Wrinkles, blisters, dry spots in resin, or other defects in the finished SLC which, in the opinion of the Engineer, negatively affect the integrity or strength of the SLC or the flow capacity of the pipe, are unacceptable. Contractor will be responsible to remove and repair, at Contractor's expense, all such defects in a manner that is satisfactory to the Engineer.

8.13.5 System Description

The SLC liner may be a seamless one piece or two piece product affixed to the walls of the lateral pipe end at the junction between the pipe and main sewer. The portion of the liner that adheres to the mainline pipe shall be either; flanged type or a full-wrap type. The junction between the flange and the lateral sleeve must be watertight and will consist of a lateral portion and a mainline portion. The wall thickness shall be uniform. The material shall be capable of conforming to offset joints, bells and disfigured pipe sections. The carrier packer shall be specifically designed for laterals from 4-inch to 6-inch diameter services connections, but contractor must confirm before installation. It shall be manufactured to conform to either a wye, tee or break-in type connections. The mainline portion of the carrier packer will accommodate pipe diameters from 8-in to 12-in. A corrosion resistant resin compatible with the installation process shall be used.

8.13.6 Materials

The SLC lining shall be a resin-impregnated, flexible polyester felt, glass fiber reinforced plastic or equivalent material tube which is cured-in-place by an acceptable curing method. The resin shall be suitable for the design conditions as well as the curing process. The SLC shall provide a service life of 50 years and shall have the minimum structural properties listed below.

MINIMUM STANDARD		
Mechanical Property	Polyester/Vinylester Resin	Epoxy Resin
Flexural Sinn* (ASTM D790)	4,500 psi	5,000 psi
Flexural Modulus of Elasticity (ASTM D790)	250,000 psi	400,000 psi

The SLC shall be designed, fabricated, and installed for the actual conditions encountered for this application including the material of the host pipe, in accordance with the applicable provision of ASTM F1216. and shall meet the following minimum design conditions:

- 1. AASHTO H-20 live load, with one truck passing.
- 2. Soil Weight: 120 pounds per cubic foot.
- 3. Coefficient of friction K u' .130.
- 4. Groundwater: assume that 5 feet of groundwater force will be exerted onto the pipe when pipe crown is 0' to 10' below ground surface. For each additional foot of pipe crown depth, add 1 ft. additional of groundwater.
- 5. Fully deteriorated pipe with 2 percent (min.) ovality. If ovality of existing pipe is found to be worse, use actual percent – up to 5 percent (max.)
- 6. Soil Modulus: 1,000 psi.
- 7. Factor of Safety = 2
- 8. Soil Depth: Depth of Cover (shall be determined by field measurements).
- 9. Short Term Flexural Modulus: 300,000 psi

The SLC shall be designed to withstand all imposed loads, including live loads and, if applicable, hydrostatic pressure. The SLC Liner shall have sufficient wall thickness to withstand all anticipated external pressures and loads that may be imposed after installation. The design shall be performed and certified by a professional engineer licensed by the Commonwealth of Massachusetts.

The SLC liner shall be manufactured and installed by Top Hat Systems by Amerik Supplies, Easy Liner, Prime Liner, Mix-Liner, or equal.

The SLC product shall extend from the mainline into the Lateral connection in a continuous tight fitting, watertight pipe-within-a-pipe to eliminate any visible ground water leakage and future root growth at the lateral to mainline connection. SLC product system shall be compatible with the mainline anchor lateral pipe or liner. The portion of the liner that adheres to the mainline pipe shall be either a flanged type or full-wrap. However for lateral Liners installed in mainline pipe that has NOT been lined, a full-wrap type MUST be used.

The finished SLC product shall be which when cured is chemically resistant to domestic sewage over the expected lifetime of the rehabilitated pipe. The liner material and resin shall be completely compatible.

The insert shall seal to the inside wall of the sewer main a minimum of 3 inches around the lateral opening, and to the lateral wall 25 feet up into the lateral pipe from the main.

An epoxy-sealing component may be used to form a sealing bond between the SLC product and the host lateral and main pipe walls. The liner shall be capable of fitting into irregularly shaped pipe connections and through bends and dips within the pipeline.

When cured, the liner shall form a continuous, tight fitting, hard, and impermeable liner that is chemically resistant to the chemicals found in domestic sewage.

The resin system shall meet the requirements of ASTM F1216, Section 5.2. The resin installed SLC liner system shall produce an SLC that will comply with the structural requirements specified herein and shall provide chemical resistance for the flow media in the gravity pipe. The resin shall be compatible with the rehabilitation process, shall be able to cure in the presence or absence of water, and shall have an initiation temperature for cure as recommended by the resin manufacturer. Unless otherwise specified, provide a general purpose or enhanced strength unsaturated, thermosetting, polyester, vinylester, or epoxy resin and a catalyst system compatible with the installation process.

Submit documentation from the resin manufacturer specifically describing the chemical characteristics of the resin system, including: allowable mixing, impregnation and handling time; transportation and storage time; and recommended curing cycle—including temperature, pressures, and times.

The resin manufacturer's documentation must also include maximum allowable time for handling the impregnated tube prior to insertion and the maximum allowable elapsed time from insertion to exotherm. If remedial measurements are available to extend either of these maximum times without affecting the physical properties of the resin, the resin manufacturer must describe these measures and the associated time limits beyond which even these remedial measures will not prevent the manifestation of anomalies in the physical properties of the resin.

8.13.7 Preparation

Each lateral shall be inspected using a launch style camera, or equal technology to allow inspection of the entire lateral from the main line to the property line. A video taped survey in conformance with Section 8.5, must be done on the main run to confirm the proposed repair falls within the limitation parameters set by the manufacturer on the following aspects: The location and clock reference of the latest junctions to be lined, any offsets, any intrusion from the lateral into the main; the angle at which the connection comes in; any changes in angle of approach of the lateral for the length of the repair; the potential flows going through the lateral pipe; the potential flows coming through the main pipe; the diametric size of the connection for the length of the liner; the size of the main pipe at the point of the SLC and the presence of active infiltration within the vicinity of the work area.

Prior to installing the SLC product the area around the lateral sealing surface in both the main and lateral shall be inspected. Waste product build-up, hard scale, roots, lateral cutting debris or resin slugs must be removed using high pressure water jetting or in-line cutters. All laterals to be lined shall be cleaned as required prior to lining. The term "cleaned" shall mean the removal of all sand, dirt, roots, grease, and all other solids or semisolid materials from the interior face of the sewer lines.

Built-up deposits on the main and lateral pipe walls shall be removed. The removal shall reach at least one foot beyond the SLC product to allow the bladder to inflate tightly against the pipe walls ensuring a smooth transition from SLC product to the existing pipe wall.

The Contractor shall televise the lateral to provide a detailed record of existing conditions and lateral connections. Two copies of the pre-lining inspection shall be submitted to the Engineer. The Contractor shall be responsible for having a copy of the pre-lining inspections in the field as well. Immediately prior to liner insertion, the camera shall traverse the lateral to inspect for debris which may have entered the line after the existing condition videotaping.

Where the main pipe has been lined previously with a CIPP liner, a check should be made to ensure the prior lateral reopening work created a lateral opening that is flush with the lateral pipe. If this is not the case, the mainline CIPP must be trimmed back using a lateral cutter at no additional cost to the Owner.

Where active infiltration is present and when it is recommended by the SLC manufacturer the infiltration must be stopped in advance by grouting.

Additional precautions need to be taken when applying the sleeve to a main pipe lined with a CIPP liner with a polyolefin coating. The coating is to be lightly scarified, scraping off the coating in the main pipe CIPP in the vicinity of the SLC liner.

The Contractor shall be responsible, if needed, for bypassing of sewage during the installation of the SLC product. In cases where the temporary backup of sewage is

accepted as a replacement for bypassing, the Contractor is responsible for all damage caused.

8.13.8 Installation

The SLC product shall be loaded on the applicator apparatus, attached to a robotic manipulator device and positioned in the main line pipe at the service connection that is to be rehabilitated. The robotic device together with a television camera will be used to align the repair product with the service connection opening. The inserted product will then be inspected using a TV camera to confirm the SLC product is correctly positioned and/or centered in the lateral opening prior to curing. The insertion pressure will be adjusted to fully deploy the SLC product into the lateral connection and hold the SLC product tight to the main and lateral pipe walls.

The pressure apparatus shall include a bladder of sufficient length in both the main and lateral lines such that the inflated bladder extends beyond the ends of both the lateral tube and main line brim segments of the SLC product pressing the end edges flat against the internal pipe wall thus forming a smooth transition from SLC product to pipe diameters without a step, ridge or gap between the SLC product and the inner diameters of the lateral and mainline pipes.

After insertion is completed, recommended pressure must be maintained on the impregnated SLC product for the duration of the curing process. Curing time and pressure shall be in accordance with the manufacturer's instructions. In no instance will sewage be used to invert or cure liners or calibration tubes. Condensate cannot be discharged into any sewer, drain, river, stream or wetland.

The finished SLC product shall be free of dry spots, lifts and delamination. The installed SLC product should not inhibit the post installation video inspection, using a closed circuit television camera, of the mainline and service lateral pipes or future pipe cleaning. During the warranty period any defects with the SLC that affect the performance or cleaning of the lateral connection shall be repaired at the contractor's expense in a manner acceptable to the owner.

After the work is completed the Contractor will provide the Engineer with an electronic picture and recorded data identifying the location and showing the completed work and restored condition of all the rehabilitated SLCs. The Contractor shall televise the rehabilitated lateral to provide a detailed record of finished conditions. When complete, the Contractor shall submit two (2) copies of the rehabilitated lateral inspections along with the accompanying logs.

The Contractor shall inform the Engineer of service laterals in which a SLC product cannot be installed. These services will be identified, documented, video recorded, and the Engineer will be informed of the conditions encountered. The Contractor will not attempt to install a SLC product in the services unless directed by the Engineer.

Notify all properly owners who discharge sewage directly into the sewer to be lined that their sewage service will be discontinued while the liner is being installed. Notify

each affected property owner at least 48 hours in advance of commencement of the work, giving the date, start time and time when service will be completely restored. Also provide a telephone number that property owners may call for information during the work.

Following installation of the liner and reopening of the service connections, conduct a final videotaped color television inspection of the completed work. Copies of these tapes and the videotapes made prior to the liner installation shall be submitted to the Engineer for approval and shall be retained by the Owner.

8.13.9 Testing

Field acceptance of the liner shall be based on the Engineer’s evaluation of the installation including TV videotapes and a review of certified test data for the installed pipe samples.

Groundwater infiltration of the liner shall be zero. All service connections shall be open, clear and watertight. There shall be no evidence of splits, cracks, breaks, lifts, kinks, delaminations, or crazing in the liner.

If any defective liner is discovered after it has been installed, it shall be removed and replaced with either a sound liner or a new pipe at no additional cost to the Owner.

8.13.10 Measurement and Payment

The quantity of liner to be paid for under these items shall be measured by each completed liner of 25’ in length.

The unit price for this item shall include full compensation for: mobilization and demobilization; installation of lateral liner; bypass pumping and controlling of existing sewage flows; re-instatement of the sewer service connections; and all other work incidental to the installation of the lateral liner.

Water for the cleaning and curing process will be supplied to the Contractor by the Owner. The Contractor must contact the Owner prior to use of any water for the Project.

For laterals requiring a liner longer than 25’, payment will be for 1 liner, at the per each price; and payment for each additional foot beyond 25’ at a price per linear foot.

The unit price of cleaning and televising sewer services before SLC rehabilitation shall be per each as indicated on the Drawings and/or as directed by the Engineer and shall be full compensation to furnish labor, materials and equipment to clean and inspect the sewer laterals including, but not limited to, using a launch style camera for inspection of the laterals. Post rehabilitation inspection is incidental to the appropriate lining bid item.

Payment Items:	Unit
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8.13.10a	Service Lateral Connections Liner – Flanged Style	Each
8.13.10b	Service Lateral Connections Liner – Full Wrap	Each
8.13.10c	Service Lateral Connections Liner – Additional LF beyond 25'	Linear Foot

8.14 REFERENCES

A. American Society for Testing and Materials Publications (ASTM)

1. D 790 - ASTM Standard Test Methods for Flexural Properties of Unreinforced Plastics and Electrical Insulating Materials.
2. F 1216 - ASTM Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
3. D 3034 - Specification for Type PSM Polyvinyl chloride (PVC) Sewer Pipe and Fittings.
4. F679 - Specification for Polyvinyl chloride (PVC) Large - Diameter Plastic Gravity Sewer Pipe and Fittings.
5. F477 - Specification for Elastometric Seals (Gaskets) for Joining Plastic Pipe.
6. D 3212 - Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastometric Seals.
7. F 2561 – Standard Practice for Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner.
8. National Association of Sewer Service Companies (NASSCO)
9. NASSCO Recommended Specifications for Sewer Collection System Rehabilitation.

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