CITY OF HALLANDALE BEACH
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Hallandale Beach
PROGRESS. INNOVATION. OPPORTUNITY.

INVITATION TO BID (ITB)
BID # FY 2017-2018-019

CITY OF HALLANDALE BEACH
INFLOW AND INFILTRATION REMOVAL PHASE 2

EXHIBIT A – TECHNICAL SPECIFICATIONS

PREPARED BY:
CITY OF HALLANDALE BEACH
DEPARTMENT OF PUBLIC WORKS
AND
PROCUREMENT DEPARTMENT

TECHNICAL SPECIFICATIONS

INFILTRATION AND INFLOW REMOVAL PHASE 2

City of Hallandale Beach Bid No. 18-00x

CONTRACT DOCUMENTS

Prepared by:

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P.O. Box 221890
Hollywood, Florida 33022

April 2018

Document 00002

PROJECT DATA

Project Title:	City of Hallandale Beach Infiltration and Inflow Removal Phase 2
Project Number:	City Bid No. 18-00x
Project Address:	Throughout the City of Hallandale Beach
Project Owner:	City of Hallandale Beach, Florida 100 West Hallandale Beach Boulevard Hallandale Beach, Florida 33004
Owner's Representative:	James Sylvain Deputy Utilities Director City of Hallandale Beach 400 S Federal Highway Hallandale Beach, Florida 33009 Phone: 954-457-1669 Fax: 954- 457-1624
Project Consultant	Fred Bloetscher, PhD. P.E. Public Utility Management and Planning Services, Inc. P.O. Box 221890 Hollywood, Florida 33022 Phone: 239-250-2423 Fax: 954-581-5076

END OF PROJECT DATA

Document 00004

LIST OF DRAWINGS

SHEET NO.	TITLE
1	Map of City Sewer Lines Needing Televising

END OF LIST OF DRAWINGS

BID SHEET

Item	Original Quantity	Unit	Unit Cost	Original Total cost
Mobilization	1	LS		
Clean 8 inch piping identified on Appendix A map	83,000	LF		
Clean 10 or 12 inch piping identified on Appendix A map	14,000	LF		
Clean 15 or 18 inch piping identified on Appendix A map	0	LF		
Televise 8 inch Piping identified on Appendix A map	83,000	LF		
Televise 10 or 12 inch Piping identified on Appendix A map	14,000	LF		
Televise 15 or 18 inch Piping identified on Appendix A map	0	LF		
Televise service line - up to 30 ft from connection	9,000	LF		
8 inch pipe Short section Repairs	300	EA		
10 or 12 inch pipe Short section Repairs	50	EA		
15 inch pipe Short section Repairs	0	EA		
18 inch pipe Short section Repairs	0	EA		
8 inch pipe lining	30,000	LF		
10 or 12 inch pipe lining	5,000	LF		
15 inch pipe lining	0	LF		
18 inch pipe lining	0	LF		
Line non-metallic service laterals 4 or 6 in	4,500	LF		
Line metallic service laterals 4 or 6 in	4,500	LF		
Install full circle lateral connection to 8-12 in pipe with 4or 6 in lateral, plus 30 ft of liner pipe	300	ea		
Reconnect laterals repaired	300	ea		
Repairs to Manholes	10	ea		
Traffic Control (time and material)	1	LS		
Root Removal	10	points		
Bypass	25	ea		
Repair and raise Top LS 3	1	LS		
Contingency	1	LS	$50,000.00	$50,000.00
TOTAL BID AMT				

SCOPE OF SERVICES

The CITY has previously conducted inflow and infiltration analysis. It has identified approximately 30% of the sewer system that needs to be televised to identify the breaks and leaks in the system and to identify appropriate repairs. These areas are identified on the maps in Drawing #1.

The protocol for the project is as follows:

1. Clean and televise the lines highlighted,
2. Video tape the lines,
3. Identify defects in the gravity sewer and the service lines
4. Submit a list of defects to the ENGNEER for approval.
5. Line pipes as needed
6. Repair services lines as needed
7. Re-televise pipes to verify work completion

a It is anticipated that the majority of used corrections can be corrected with liners. It is also anticipated that about half the pipes televised will reveal service lines leaks as opposed to gravity sewer leaks, and therefore only about half the lines televised will be lined

The CITY desires that the time between cleaning, televising and corrections will be minimized to minimize impact to customers. Work may need to be done at night.

There may be corrections in services which will be identified during the televising that require point repairs. This work will occur during phase 3. CONTRACTOR will suggest, and make the appropriate repairs. The video information and CONTRACTOR's experience will be used for same. The CITY may need to concur with the recommended corrections.

The quantities in the bid sheet are an estimate of the number of linings, number of service repairs, feet of televising and cleaning, etc. for the project. This is a unit price contract so repairs will be based on the unit prices. CONTRACTOR will endeavor to minimize the costs to the CITY, while insuring that the appropriate repairs are made. CITY will estimate the savings resulting from this Contract as a result of the reduction of the flow.

Note that this bid is being funded through a State Revolving Loan.

SECTION 01000 - CONTRACTOR SPECIAL CONDITIONS

1. DEMONSTRATING WORK EXPERTISE

CONTRACTOR shall demonstrate competence to perform the work. CONTRACTOR, as the bidder, shall at minimum, provide the following:

- List of public utility clients in Florida (a minimum of five; the minimum value of work with one utility of $1,000,000 or greater, is required). The list shall include a minimum of five clients noting the work completed (manhole sealing, smoke testing, manhole inspection/chimney sealing and installation of cleanout plugs with the specified products).

- Where similar projects have been completed, including name, address, phone number and position of utility contact.

- An example of the report provided to a public utility client as a result of performing the work

- Five years of experience dealing with the specified products and examples of completed work.

- Lining at least 500,000 LF of sewer pipe

- Repairing at leak 2,500 service laterals in place.

2. INVESTIGATION AND UTILITIES.

2.1. CONTRACTOR shall have the sole responsibility of satisfying itself concerning the nature and location of the Work and the general and local conditions, and particularly, but without limitation, with respect to the following: those affecting transportation, access, disposal, handling and storage of materials; availability and quality of labor; water and electric power; availability and condition of roads; work area; living facilities; climatic conditions and seasons; physical conditions at the work-site and the project area as a whole; topography and ground surface conditions; nature and quantity of the surface materials to be encountered; subsurface conditions; equipment and facilities needed preliminary to and during performance of the Work; and all other costs associated with such performance. The failure of CONTRACTOR to acquaint itself with any applicable conditions shall not relieve CONTRACTOR from any of its responsibilities to perform under the Contract Documents, nor shall it be considered the basis for any claim for additional time or compensation.

2.2. CONTRACTOR shall locate all existing roadways, railways, drainage facilities and utility services above, upon, or under the Project site, said roadways, railways, drainage facilities and utilities being referred to in this Sub-Section 2.2 as the "Utilities". CONTRACTOR shall contact the owners of all Utilities to determine the necessity for relocating or temporarily interrupting any Utilities during the construction of the Project. CONTRACTOR shall schedule and coordinate its Work around any such relocation or temporary service interruption. CONTRACTOR shall be responsible for properly shoring, supporting and protecting all Utilities at all times during the course of the Work.

3. BID QUANTITIES

Quantities given in the Bid Schedule, while estimated from the best information available, are approximate only. Payment for unit price items shall be based on the actual number of units installed for the Work. Bids shall be compared on the basis of number of units stated in the Bid Schedule as set forth in the Bidding Documents. Said unit prices shall be multiplied by the bid quantities for the total Bid price. Any Bid not conforming to this requirement may be rejected. Special attention to all Bidders is called to this provision, for should conditions make it necessary or prudent to revise the unit quantities, the unit prices will be fixed for such increased or decreased quantities. Compensation for such additive or subtractive changes in the quantities shall be limited to the unit prices in the Bid.

4. PROGRESS PAYMENTS.

4.1. Prior to submitting its first monthly Application for Payment, CONTRACTOR shall submit to CITY, for their review and approval, a schedule of values based upon the Contract Price, listing the major elements of the Work and the dollar value for each element. After its approval by the CITY AND ENGINEER, this schedule of values shall be used as the basis for the CONTRACTOR's monthly Applications for Payment. This schedule shall be updated and submitted each month to the ENGINEER along with a completed and notarized copy of the Application for Payment.

4.2. Prior to submitting its first monthly Application for Payment, CONTRACTOR shall submit to CITY AND ENGINEER a complete list of all its proposed SUBCONTRACTORs and materialmen, showing the work and materials involved and the dollar amount of each proposed subcontract and purchase order. The first Application for Payment shall be submitted no earlier than thirty (30) days after the Commencement Date.

4.3. If payment is requested on the basis of materials and equipment not incorporated into the Project, but delivered and suitably stored at the site or at another location agreed to by the CITY in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that the CITY has received the materials and equipment free and clear of all liens, charges, security interests and encumbrances, together with evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect CITY's interest therein, all of which shall be subject to the CITY's satisfaction.

5. DAILY REPORTS, AS-BUILTS AND MEETINGS.

5.1. Unless waived in writing by CITY, CONTRACTOR shall complete and submit to ENGINEER on a weekly basis a daily log of the CONTRACTOR's work for the preceding week in a format approved by the ENGINEER and CITY. The daily log shall document all activities of CONTRACTOR at the Project site including, but not limited to, the following:

5.1.1. Weather conditions showing the high and low temperatures during work hours, the amount of precipitation received on the Project site, and any other weather conditions which adversely affect the Work;

5.1.2. Soil conditions which adversely affect the Work;

5.1.3. The hours of operation by CONTRACTOR's and SUBCONTRACTOR's personnel;

5.1.4. The number of CONTRACTOR's and SUBCONTRACTOR's personnel present and working at the Project site, by subcontract and trade;

5.1.5. All equipment present at the Project site, description of equipment use and designation of time equipment was used (specifically indicating any down time);

5.1.6. Description of Work being performed at the Project site;

5.1.7. Any unusual or special occurrences at the Project site;

5.1.8. Materials received at the Project site;

5.1.9. A list of all visitors to the Project site; and

5.1.10. Any problems that might impact either the cost or quality of the Work or the time of performance.

The daily log shall not constitute nor take the place of any notice required to be given by CONTRACTOR to CITY or ENGINEER pursuant to the Contract Documents.

SECTION 01025 - MEASUREMENT AND PAYMENT

1. MEASUREMENT

1.1 The quantities for payment under this Contract shall be determined by actual measurement of the completed items, in place, ready for service and accepted by the CITY unless otherwise specified. The CITY or ENGINEER will witness all field measurements.

1.2 When depth of cuts are indicated in the bid items, they shall be measured vertically from the existing grade at excavation point, paved or unpaved, to the finished pipe invert.

1.3 The quantities stated in the Bid Proposal are approximate only and are intended to serve as a basis for the comparison of bids and to fix the approximate amount of the cost of the Project. The CITY does not expressly or impliedly agree that the actual amount of the work to be done in the performance of the contract will correspond with the quantities in the Bid Proposal; the amount of work to be done may be more or less than the said quantities and may be increased or decreased by the CITY as circumstances may require. The increase or decrease of any quantity shall not be regarded as grounds for an increase in the unit price or in the time allowed for the completion of the work, except as provided in the Contract Documents.

1.4 Payment items for cleaning and televising of mains will apply when sewer is cleaned and televised for inspection only, or when a sewer repair is not performed due to changed field conditions revealed by the pre-repair video inspection. Cleaning and television inspection performed to prepare for a repair or to document a completed repair are not considered separate pay items. Costs for such cleaning and TV inspection shall be included in the contract unit cost for each particular repair. Lateral inspection shall be performed using a camera launched from the main unless conditions within the sewer require lateral inspection from the cleanout. Reference Table 01025-1 for the television inspection requirements pertaining to each type of repair.

2 PAYMENT ITEMS

2.1 Various Items

2.1.1 Items with Bid form units of “EA” will be measured and paid at the unit price per each as delineated by the pipe size named in the Bid Form. Each unit price bid shall include, but not be limited to, all necessary or required labor, equipment, tools, and materials for traffic control, added sewer pipe cleaning and preparation of the existing sewer, including blocking or plugging incoming lines; removal, transportation and disposal of material generated by cleaning and preparation; television surveys; pipe liner; cleaning; testing; cleanup; documentation and reporting; and all labor, materials and equipment required to provide a complete and acceptable liner installation.

2.1.2 Items with Bid form units of “LF” will be measured and paid for at the unit price per foot. This item will be full compensation for all additional costs associated with the work. Each linear foot price bid shall include, but not be limited to, all necessary or required labor, equipment, tools, and materials for traffic control, added sewer pipe cleaning and preparation of the existing

sewer, including blocking or plugging incoming lines; removal, transportation and disposal of material generated by cleaning and preparation; television surveys; pipe liner; cleaning; testing; cleanup; documentation and reporting; and all labor, materials and equipment required to provide a complete and acceptable liner installation.

Notes: The initial cleaning and televising of the pipes is separate from the lining pay items. Likewise, televising laterals will be paid separately from the lateral repairs.

Reconnection of service laterals to pipe is assumes as a part of the lining pay item.

2.1.3 Payment for bypass pumping, if required (other than because of damage caused by the CONTRACTOR) will be paid for under a separate item.

2.2 Install CIP mainline/lateral connection interface seal (minimum 3') in 8 10 or 12-inch mains with 4-inch to 6-inch laterals, all depths.

2.2.1 This item will be paid at the unit price per each and shall include furnishing all labor, equipment, and materials needed to install a mainline/lateral connection interface seal that extends a minimum of 3-feet into the lateral and has a minimum 3-inch “brim”. Each unit price bid shall include, but not be limited to, all necessary or required labor, equipment, tools, and materials for traffic control, sewer pipe cleaning and preparation of the existing sewer, including blocking or plugging incoming lines; removal, transportation and disposal of material generated by cleaning and preparation; television surveys; pipe liner; recovering all waste material from the sewer; testing; cleanup; performing all repairs required due to damage caused by the CONTRACTOR; documentation and reporting; and all labor, materials and equipment required to provide a complete and acceptable liner installation.

2.2.2 Coating removal / Surface preparation will be required when an interface seal is installed over an existing CIP liner, and will be compensated as a part of the interface seal.

2.3 Televise service lateral and locate from mainline (up to 30 feet)

This item of work will be compensated as a part of the liner installation..

2.4 Televise service lateral and locate from mainline (beyond 30 feet)

This item of work will be compensated as a part of the liner installation.

2.5 Televise lateral from cleanout (up to 30 feet)

This item of work will be measured and compensated as a part of the liner installation..

2.5 Televise lateral from cleanout (beyond 30 feet)

This item of work will be measured compensated as a part of the liner installation..

2.6 Lateral grouting (if required in preparation for FCLRL, lateral liner, or mainline/lateral connection interface seal installation)

This item of work will be measured and paid at the unit price per each lateral grouting performed, with the advance concurrence of the CITY, in association with the performance of a lateral liner, or mainline/lateral connection interface seal installation. Payment of the unit price per each will provide complete compensation for furnishing materials and all labor, tools and equipment and incidentals, to chemically grout leaking laterals prior to the installation of a lateral connection, lateral liner, or mainline/lateral connection interface seal, complete in place. Payment for this item, when authorized by the CITY, shall be in addition to a lateral connection, lateral liner, or mainline/lateral connection interface seal.

2.7 Reconnect Laterals in 8 10 or 12-inch mains with 4-inch to 6-inch laterals, all depths.

2.7.1 This item will be paid at the unit price per each and shall include furnishing all labor, equipment, and materials needed to the reconnect the laterals Each unit price bid shall include, but not be limited to, all necessary or required labor, equipment, tools, and materials for traffic control, sewer pipe cleaning and preparation of the existing sewer, including blocking or plugging incoming lines; removal, transportation and disposal of material generated by cleaning and preparation; television surveys; pipe liner; recovering all waste material from the sewer; testing; cleanup; performing all repairs required due to damage caused by the CONTRACTOR; documentation and reporting; and all labor, materials and equipment required to provide a complete and acceptable liner installation.

2.7.2 Coating removal / Surface preparation will be required when an interface seal is installed over an existing CIP liner, and will be compensated as a part of the interface seal.

SECTION 02751 – CLEANING

SECTION 02751 - PREPARATORY CLEANING AND ROOT REMOVAL

1 -- GENERAL

1.1 Scope

This Section covers the preparatory cleaning of sewer lines and manholes as needed prior to the internal survey of the sewer lines by closed-circuit television. It also covers the preparatory cleaning and root removal of sewer lines and the cleaning of manholes prior to rehabilitation. The CONTRACTOR shall furnish all necessary material, labor, equipment and services required for cleaning the specific sewer lines.

1.2 General

1.2.1 Sewer Line Cleaning. The intent of sewer line cleaning is to remove foreign materials from the lines and restore the sewer to a minimum of 95% of the original carrying capacity or as required for proper seating of internal pipe joint sealing packers or performance of other specified work. It is recognized that there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued. Should such conditions be encountered, the CONTRACTOR will not be required to clean those specific sewer sections. If, in the course of normal cleaning operations, damage does result from preexisting and unforeseen conditions such as broken pipe, the CONTRACTOR will not be held responsible.

1.2.2 Manhole Cleaning General. All concrete and masonry surfaces must be cleaned prior to repair. Grease, laitance, loose bricks, mortar, unsound concrete, and other materials must be completely removed. Water blasting (minimum 1,200 psi) utilizing proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers or mechanical means may be required to properly clean the surface. Surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products.

1.2.3 Cleaning and Preparation for Cementitious Liner Rehabilitation

1.2.3.1 The manhole or chamber surface shall be clean, structurally sound and free from oil, grease, loose mortar, paints, protective coatings, efflorescence, laitance and airing compounds. The conditions of the manhole or chamber may require the use of an environmentally safe degreasing compound; if so, the surface shall be thoroughly rinsed to eliminate any residue.

1.2.3.2 Place covers over invert to prevent extraneous material from entering the sewer lines.

1.2.3.3 All foreign material shall be removed from the manhole wall and bench using a high pressure water spray (minimum 4,000 psi). Loose and protruding brick, mortar, and concrete shall be removed using a mason's hammer, chisel and/or scraper. Fill any large voids with quick setting patching material.

1.2.3.4 If the 4,000 psi high water pressure water spray is not successful in removing all grease and contaminants, then a chemical wash shall be used to clean and degrease the interior of the manhole or chamber. The entire structure shall be thoroughly water- and/or sand-blasted to remove any loose or deteriorated material. The CONTRACTOR shall clean all accumulations of debris, such as dirt and grease, loose mortar, bricks and concrete, and dispose or properly. Care shall be taken to prevent any loose material from entering outlet sewer lines by inserting a 2-inch or smaller mesh protective screen into the manhole's outlet.

1.2.3.5 Any existing manhole steps shall be removed prior to sealing (waterproofing) the structure walls, and installing liners.

1.3 Hydraulic Cleaning Equipment

1.3.1 Hydraulically Propelled Equipment. The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery to insure removal of grease. If sewer cleaning balls or other equipment which cannot be collapsed is used, special precautions to prevent flooding of the sewers and public or private property shall be taken.

1.3.1.1 High-Velocity Jet (Hydrocleaning) Equipment. All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel.

1.3.1.2 Mechanically Powered Equipment: Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat-treated steel. To insure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

3 -- EXECUTION

3.1 General

3.1.1 The designated sewer sections shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment. The equipment shall dislodge, transport and remove all sludge, mud, sand, gravel, rocks, bricks, grease, roots, sticks, and all other debris from the interior of the sewer pipe and manholes. The equipment and methods selected shall be based on the conditions of lines and manholes at the time the work commences and shall be satisfactory to the ENGINEER. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed, or the equipment fails to traverse the entire manhole section, the cleaning effort shall be stopped and sufficient

inspection performed so that the ENGINEER can be notified of the reason for inability to continue. CITY And the ENGINEER, in consult with CONTRACTOR, will identify a solution.

3.1.2 Cleaning Precautions

3.1.2.1 During all cleaning and preparation operations all necessary precautions shall be taken to protect the sewer from damage. During these operations, precautions shall also be taken to insure that no damage is caused to public or private property adjacent to or served by the sewer or its branches.

3.1.2.2 Satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work 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.

3.3 Material Removal

3.3.1 All sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.

3.3.2 Under no circumstances shall sludge or other debris removed during these operations be dumped or spilled into the streets, ditches, storm drains or other sanitary sewers. The CONTRACTOR shall remove from the site and properly dispose of all solids or semi-solids recovered during the cleaning operation. The CONTRACTOR shall obtain permits and make arrangements as required to properly dispose of solids.

3.3.3 The CONTRACTOR is advised that he shall not dispose of this material by legal or illegal dumping on private or public property, by sale to others, or any means other than those given above.

3.3.4 The CONTRACTOR shall keep his haul route and work area(s) neat and clean and reasonably free of odor, and shall bear all responsibility for the cleanup of any spill which occurs during the transport of cleaning/surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this Contract and in accord with applicable law and regulations. The CONTRACTOR shall immediately cleanup any such spill, or waste. If the CONTRACTOR fails to cleanup such spill, or waste immediately, the CITY shall have the right to cleanup or arrange for its cleanup and may charge to the CONTRACTOR all costs, including administrative costs and overhead, incurred by the CITY in connection with such cleanup. The CITY may also charge to the CONTRACTOR any costs incurred or penalties imposed on the CITY as a result of any spill, dump or discard. Under no circumstances is this material is to be discharged into the waterways or any place other than where authorized to do so by the

appropriate authority. The term "CONTRACTOR" as used in this section shall include the CONTRACTOR's SUBCONTRACTORs and other CONTRACTORs.

3.3.5 The general requirements for vehicles hauling such waste materials are as follows: Transport vehicles must be of type(s) approved for this application by the political jurisdictions involved. General requirements are that the vehicles have watertight bodies, that they be properly equipped and fitted with seals and covers to prohibit material spillage or drainage, and that they be cleaned as often as is necessary to prevent deposit of material on roadways. Vehicles must be loaded within legal weight limits and operated safely within all traffic and speed regulations.

3.3.6 The routes used by the CONTRACTOR for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

3.4 DISPOSAL OF MATERIALS

All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of by the CONTRACTOR in a legal and sanitary manner as approved by appropriate authorities, at the CONTRACTOR's cost. Copies of records of all disposal shall be furnished to the CITY, indicating disposal site, date, amount and a brief description of material disposed. All materials shall be removed from the site no less often than at the end of each workday. Under no circumstances will the CONTRACTOR be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers and as acceptable to the ENGINEER.

3.5 ROOT REMOVAL

Roots shall be removed in the designated sections and manholes where root intrusion is indicated on the work order. Special attention should be exercised during the cleaning operation to assure almost complete removal of roots from the joints. Any roots which could prevent the traveling of the packer or could prevent the proper application of chemical sealants, or could prevent the proper seating and application of cured-in-place, fold-and-formed or sectional cured-in-place liners, shall be removed. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters and porcupines, and equipment such as high-velocity jet cleaners. When specifically directed, chemical root treatment shall be used before the root removal operation, in accordance with Section 02762 - Chemical Root Treatment, and grouting will take place after root removal in accordance with Section 02763 - Chemical Grouting. CONTRACTOR shall capture and remove all roots from the line.

3.6 CHEMICAL ROOT TREATMENT

To aid in the removal of roots, manhole sections that have root intrusion shall be treated with an acceptable herbicide when specifically directed. The application of the herbicide to the roots shall be done in accordance with the manufacturer's recommendations and specifications in such a manner to preclude damage to surrounding vegetation. Any damaged vegetation so designated by the ENGINEER shall be replaced by the CONTRACTOR at no additional cost to the CITY. All safety precautions as recommended by the manufacturer shall be adhered to concerning handling and application of the herbicide.

3.7 ACCEPTANCE OF CLEANING OPERATION

3.7.1 Acceptance of sewer line cleaning shall be made upon the successful completion of the television survey and shall be to the satisfaction of the ENGINEER. If television survey shows the cleaning to be unsatisfactory, the CONTRACTOR shall be required to reclean and reinspect the sewer line until the cleaning is shown to be satisfactory. In areas where television survey is not performed, the ENGINEER may require the CONTRACTOR to pull a double squeegee (with each squeegee the same diameter as the sewer) through each manhole section as evidence of adequate cleaning. If internal sealing is to follow the television survey, particular attention should be given to the adequacy of the cleaning to insure that proper seating of the sealing packer can be achieved.

3.7.2 In addition, on all those lines which have sags or dips, to an extent that the television camera lens becomes submerged for three (3) or more feet during the television inspection, the CONTRACTOR shall pull double squeegee and/or sponges through the line in order to remove the water from those dips or sags, or draft the water by means of high-velocity jet cleaners. Water removal shall be performed until the television camera lens will no longer be submerged. This requirement may be waived by the ENGINEER if the water in which the camera lens is submerged, is clear enough to allow the identification of pipe defects, cracks, holes and location of service taps.

- END OF SECTION -

SECTION 02752 - TELEVISION SURVEY

PART 1 -- GENERAL

1.1 SCOPE

1.1.1 The work consists of furnishing all labor, materials, accessories, equipment, tools, transportation, services and technical competence for performing all operations required to execute the internal closed circuit television survey to inspect the entire barrel of sewers up to 30 inches in diameter in the areas denoted on the plans and record same to DVD. Drawing A identifies sections of the sewer system where excessive infiltration is occurring and denoted same on the attached drawings. CONTRACTOR will televise and provide to CITY and ENGINEER copies of all DVDs.

1.1.2 The survey shall show all defects, identify the locations, determine amount of infiltration entering the sewer system and suggest repairs for same. These repairs may be lining, point repairs or other mechanism. ENGINEER will render a decision of the appropriate repair.

1.2 GENERAL

1.2.1 After cleaning as specified in Section 02751- Preparatory Cleaning, and before and after rehabilitation operation/replacement work, the pipe sections shall be visually surveyed by means of closed-circuit television in the presence of the ENGINEER. The survey shall be performed one manhole-to-manhole section at a time and the flow in the section being surveyed shall be suitably controlled.

1.2.2 Pre- and post-construction survey video on CD-ROM or DVD shall be delivered to the ENGINEER on a one-line-per CD-ROM basis, accompanied with the corresponding work order, and pre- and post-TV log, for each sewer line surveyed. The video on CD-ROM shall be direct from a live video source into a video file, format MPEG1.

1.3. DIGITAL CCTV INSPECTION

1.3.1 The CONTRACTOR shall use a color pan and tilt camera or wide angle camera specifically designed and constructed for both sewer and manhole inspection. Each sewer to be televised shall be suitably isolated to control flow during the inspection. The CONTRACTOR shall provide a recording of the televised sewer inspection, locating each sewer service connection entering the sewer.

1.3.2 Lighting for the pan and tilt camera or wide angle camera shall provide a clear picture of the entire periphery of the existing sewer or manhole inspected.

1.3.3 The pan and tilt camera shall pause, pan, and visually inspect all service connections, pipe ends, and maintenance or structural defects. If utilizing a camera with fish eye capabilities, pausing and panning of each lateral is not necessary during the inspection if the image clearly depicts the inside of the lateral for post processing. If a blockage cannot be removed and hampers the televising of the sewer in one direction then the CONTRACTOR shall attempt to complete the section by televising from the other manhole to complete the section, this reversal should immediately follow the initial direction. The CONTRACTOR must report the obstructions to the

ENGINEER daily.

1.3.4 If the image quality is not adequate, the CONTRACTOR shall be required to repeat the survey at the CONTRACTOR's expense. The equipment utilized in 8"-12" sewers shall be specifically designed with multiple camera lenses to limit the requirement for repeated inspections in the event a camera lens becomes obscured during inspection unless prior approved in writing by ENGINEER.

1.3.5 The CONTRACTOR shall perform all pipe CCTV inspections in accordance with NASSCO's Pipeline Assessment Certification Program (PACP). CCTV inspections will be delivered entirely in electronic format. The entire survey shall be recorded in an approved electronic format submitted with electronic links between the data and the video. All television inspection reports shall be with-in +/- two (2) feet of the measured linear footage between manholes along the existing sewer centerline from the start of pipe to end of pipe. All ENGINEER and PACP required header information must be fully and accurately entered on all CCTV reports. Work not following these specifications may be rejected for payment and the CONTRACTOR may be required to re do the work.

1.3.6 The CONTRACTOR shall perform all manhole CCTV inspections in accordance with NASSCO's Manhole Assessment Certification Program (MACP). CCTV inspections will be delivered entirely in electronic format. The entire survey shall be recorded in an approved electronic format submitted with electronic links between the data and the video. All MACP Level 1 mandatory header information must be collected and fully and accurately entered on all CCTV reports including northing and easting to submeter accuracy. Work not following these specifications may be rejected for payment and the CONTRACTOR may be required to re do the work.

1.3.7 The CONTRACTOR shall provide a NASSCO certified operator on site at all times during the entire survey. If video is to be coded separately from the actual recording, both the onsite Operator and the individual performing the PACP coding shall be PACP certified. The CONTRACTOR shall provide proof of certification prior to commencement of work, prior to a change in personnel involved in data collection, and as requested by the ENGINEER

1.3.8 The importance of minimization of disturbances and requirements for traffic control is emphasized. The CONTRACTOR shall utilize equipment specifically designed to perform multiple simultaneous inspections via autonomy (allowing an operator to conduct multiple inspections at one time) from each access point unless specifically approved in writing by the ENGINEER.

1.3.9 The video camera shall include a title feature capable of showing on the tape the following information:

1. City and State
2. Date/Time
3. CONTRACTOR's Name
4. Line Size, Material, and Depth
5. Manhole Identification (both manholes)

6. On-going Footage Counter

1.4 SUBMITTALS

1.4.1 Submittals required seven (7) days prior to the Pre-construction Meeting upon request

1. Name of the project supervisor and resumes
2. Documentation of NASSCO PACP certification for all CCTV operators, database and software
3. Site Safety Plan. A complete site safety plan, specific for the project, must be submitted one week prior to the pre-construction meeting. Work will not begin until an approved site safety plan is in place
4. Sample inspection CCTV data and video or data from other approved inspection method

1.4.2 Submittals Required for the Pre-construction Meeting upon request

1. An initial schedule of work, (To be approved by the ENGINEER)
2. Management Organization: Provide an organization chart depicting the essential organizational elements and senior personnel of the proposed CONTRACTOR and the functions and interrelationships of the personnel proposed to provide technical support, project management and supervision for this project. Provide succinct resumes of the personnel proposed to provide technical support and project management for this project. The personnel designated in the management summary for essential positions shall not be changed except with the permission of ENGINEER. The ENGINEER will only approve such a change when, in its opinion, the substitute personnel have equal or greater qualifications and experience to those intended to be replaced

1.4.3 Submittals Required One Week Prior to Any Televising Work.

1. Site specific site safety plan addenda
2. Entry releases, if applicable
3. itemization and justification to ENGINEER or representatives of any inspections to be performed not utilizing autonomous equipment to perform simultaneous inspections

1.4.4 Weekly Submittals

1. Detailed updates to the work schedule will be provided to the ENGINEER no later than 3:00 p.m. on the Friday preceding the next week's cleaning and televising work
2. Electronic logs, and / or electronic worksheets submitted seven (7) days prior to work. All field paperwork must be submitted before the CONTRACTOR’s invoice will be processed for payment
3. Corrections to punch list items as required by the ENGINEER to fulfill the requirements of this specification
4. itemization and justification for any inspections that could not be completed according to schedule in the CONTRACTOR’s opinion due to inability to locate the access structure, the structure being in an inaccessible area (including paved over, buried, under water prohibited areas, etc.), inoperable due to

damage or locking mechanisms, requiring specialized tools such as excavators or action outside of the intended scope of work such as legal action

1.4.5. CCTV Reports, logs, electronic reports, and worksheets must include the following information and conform to the applicable guidelines:

1. CCTV media, NASSCO PACP and MACP Certified Databases, and electronic worksheets must accompany all inspection work.
2. All ENGINEER and NASSCO PACP mandatory header information must be fully and accurately entered on all PACP CCTV reports.
3. All MACP Level 1 Mandatory header information and detail must be fully and accurately entered on all MACP CCTV reports

2 -- PRODUCTS

All inspection information and data (including video) written to digital media (CD-ROM or DVD).

3 - USE OF AUTONOMOUS PLATFORM/TRANSPORT

3.1 Th contractor has the option to use autonomous platform systems (Redline). The provision of a platform capable of operating in 8-12" (200-300mm) wastewater pipelines without operator monitoring. The system must function such that an operator is capable of initiating multiple segment inspections by utilizing more than one platform for the purpose of increasing throughput without loss in data quality ("force multiplication"). To accomplish these objectives, the platform must possess sufficient onboard sensors, and artificial intelligence to traverse a pipe segment and return to the starting manhole autonomously. Other systems, such as power and tether, must be self-contained so that no special transport/vehicle or other fixed equipment is required that would prevent force multiplication. The tether must have a safety factor of 12x (break strength divided by robot weight) to facilitate safe robot self-retrieval and reduce the risk of becoming lost in a pipeline. The platform must also support one or more sensors that collect pipe information in a manner that is sufficiently dense and comprehensive to enable offline data analysis.

3.1.1. Autonomous Platform Detailed Minimum Capabilities - It is required that the platform be capable of force-multiplication, which requires conducting an inspection beneath a closed manhole without operator monitoring. The platform must be completely self-contained, including onboard computing, data storage, power, and tether. It must be pressurized and capable of operating in fully submerged conditions.

3.1.2. The platform shall be driven by dual, independently powered full-coverage tracks. It must steer itself such that it remains upright and centered in the pipeline.

3.1.3 Autonomous Platform Equipment Specifications

1. Platform Weight: 25lb (11kg) weight class
2. On-board Power: Rechargeable batteries
3. Drive: Electric motors with self-activated winch-assist
4. Steering: Independent track control with powered forward and reverse

5. Tether: On-board high-strength non-conductive, non-communicating tether for robot self-retrieval
6. Max Drawbar Pull: Laying onboard tether (versus pulling) requires minimal drawbar pull
7. Construction: Aluminum and synthetic body with rubber treads
8. Speed: 0-30 ft/min (0-9 m/min) for single robot per NASSCO requirements, equivalent to 120 ft/min (36 m/min) with four robots deployed

3.1.4 Distance Measurement - An onboard distance-reading device which uses tether length to accurately measure the location of the platform in the pipe shall be incorporated into the platform. This device shall be accurate to ±1% the length of the inspection and measure to a resolution of at least 4000 data points per foot (14,000 per meter). Distance data must be automatically logged with sensor data.

3.2 Transport **-** No special transport (i.e. vehicle) shall be required for transportation or use of the equipment. Platform and all support equipment must be of minimum weight and bulk such that they can be easily hand-carried for operator safety and usage in easement or off-road areas.

4 Spherical Video Data Collection

If using an autonomous platform vehicle, it must include spherical veidoe capability. purpose of Spherical Video data collection is to gather a complete view of the pipeline for off-line processing to identify features and defects. Data is obtained from dual 180º field-of-view (hemispherical) fisheye lenses, one each at the front and rear of the platform. When the data from these two lenses is combined, 360º is captured and a Spherical Video is created. The work shall include an autonomous inspection of the pipeline and the preparation of all CCTV video, digital, and written reports.

4.1 Spherical Video Camera System

4.1.1 A pair of digital cameras must capture Spherical video from dual fisheye lenses each with field-of-view of 180º or greater. This video must be stored onboard the robot in a format that allows for post-processing and “virtual” transport through the pipe in forward or reverse direction and with off-site pan-tilt-zoom capabilities.

4.1.2 “Sidescan” or other similar technology that utilizes a single lens will not be accepted as it does not offer a sufficient view of laterals entering at angles beyond the field-of-view of the single lens. Equipment that captures image data at a low frame-rate that prevents observation of flow, drippers, or other relevant movement in the pipe will also not be accepted.

4.2 Illumination The primary means of illumination should be via high-intensity LED lighting that maximizes output while being impact resistant and reducing the possibility for failure during operation relative to traditional means. The general illumination shall be such as to allow an even distribution of light around the pipeline perimeter without the loss of contrast, flare, or abnormal shadowing on the dry portion. The camera system must actively and automatically adjust light output to maximize image quality regardless of pipe size or material transitions.

4.3 Camera Data Post-Inspection Review - Imagery from any point in the pipeline must be made available for operator review via a wireless interface immediately following an inspection.

4.4 Operator Certification

4.4.1 CCTV experience and/or PACP coding certification is not required for data collection. Any operator shall be able to collect data utilizing this equipment with maximum one day on-site training.

4.4.2 Data review with certified coding must be conducted by the equipment manufacturer or authorized party utilizing a NASSCO PACP certified individual using NASSCO certified software.

4.4.3 Information Delivery & Viewer **-** Collected data shall be processed so that the information obtained is presented in a useful format. The information shall be packaged and delivered together along with access to a viewing application. This application must support multiple methods of viewing the data along with export capabilities.

4.4.4 Information Data Delivery **-** All information data shall be delivered in digital format on an appropriately sized medium (DVD, Hard Drive, etc.) to minimize the number of separate delivered components. All data should be accessible from a single Viewing Application.

4.4.5 iewing Application **-** The viewing application shall be available via online download and automatically check for updates.

4.4.6 The application shall provide a list of all pipeline segments included in the project identified by manhole number or segment ID. Selecting a segment should present detailed header information as well as a distance-based chart of the observations associated with that segment. Within each selected segment, the user should be able to conduct activities such as Playback and Export.

4.4.6.1 Spherical Video Playback

4.4.6.1.1 The viewing application shall include the ability to load the Spherical Video of a selected segment. Controls associated with the video should allow the user to navigate *Forward* and *Reverse* as well as *Pan*, *Tilt*, and *Zoom* at desired levels. The user shall also have the option to select a distance or an observation on the distance-based chart and the Spherical video should jump to that location at the ideal Pan-Tilt-Zoom level.

4.4.6.2 Distributable Data

4.4.6.2.1 Information shall be made available, either via export functionality or included with the deliverable, in the form of a NASSCO PACP database or Microsoft Excel spreadsheet for import into common 3rd party applications. In addition, it shall include the capability to generate segment summary reports in PDF format that can be easily printed or distributed electronically via third party software.

4.5 Legacy Video

4.5.1 Spherical Video data must be able to be recorded in MPEG-2 format, if requested, inclusive of all Pan-Tilt-Zoom operations, payout, and observations as per conventional CCTV for viewing on television equipment or import into legacy systems.

5 -- EXECUTION

5.1 PRECONSTRUCTION SURVEY

5.1.1 Procedure

5.1.1.1 Prior to any repair work, the entire sewer line (from manhole to manhole) shall be televised. The camera shall be placed at the center of the manhole and videotaping shall commence prior to entering the pipe. The CONTRACTOR shall show the inside of the manhole walls and the pipe connection to the wall at both the upstream and downstream manhole.

5.1.1.2 The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case shall the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, powered rewinds and tractors or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If the camera is being pulled through the sewer line by a hydraulic cleaning unit hose the cleaning nozzle shall be located a minimum of eight (8) feet away from the camera to allow a clear, unobstructed view. Jet nozzle shall be used in front of camera while televising through a dip to draft out water. If, during the survey operation, the television camera will not pass through the entire manhole section, the CONTRACTOR shall set up his equipment so that the survey can be performed from the opposite manhole.

5.1.1.3 Whenever non-remote powered and controlled winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being surveyed to insure good communications between members of the crew.

5.1.1.4 Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Measurement meters shall be accurate to tenths of a foot over the length of the section being surveyed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, electronic distance meter or other suitable device. Manhole numbers and linear footage shall be shown on screen during taping.

5.1.1.5 Movement of the television camera shall be temporarily halted for a minimum of ten seconds at each visible point source of infiltration and/or inflow until the leakage rate from that source is quantified. The camera shall be stopped at all service connections and the service lateral shall be inspected with the pan and tilt camera. The camera shall also be stopped at active service connections where flow is discharging. If the discharge persists, the property involved shall be checked to determine whether or not the discharge is sewage. If no flows are being discharged from the building, it shall be considered that the observed flow is infiltration/inflow.

5.1.2 Field Documentation

5.1.2.1 Television Inspection Forms (Survey Logs). Printed and electronically stored location records shall be kept by the CONTRACTOR and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during survey. Upstream footage at face of manhole (0) and downstream footage at face of manhole (e.g., 250) shall be shown on the log. The television inspection forms to be utilized by the CONTRACTOR shall be those mandated by NASSCO's (National Association of Sewer Survey Companies) PACP (Pipe Line Assessment and Certification Program). Both the Header and Details information of the form shall be entered as indicated in the PACP standards. The survey logs shall include, but not be limited to the following information:

1. Correct pipe segment/manhole numbers
2. Correct address of manhole location
3. Pipe size, length and material
4. Manhole depth (up and downstream)
5. Lift station service area number
6. CD number and index
7. Footage locations, descriptions and estimated leak rates for visible point sources of infiltration inflow
8. Footage locations and descriptions of structural defects such as obstructions, any remaining root intrusion, offset joints, cracked pipe, fractured pipe, holes, collapses, sags, protruding service connections and/or blockages in the pipe.

The terminology to be used shall follow NASSCO's PACP standards. All information will be recorded and a copy of such electronic records and a hard copy will be supplied to the ENGINEER.

5.1.2.2 Photographs. Digital photographs of the television picture of problems shall be taken by the CONTRACTOR upon request of the ENGINEER.

5.1.3 Video Recordings. The purpose of video (CD-ROM or DVD) recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. CD-ROM recording playback shall be at the same speed that it was recorded. Slow motion or stop motion playback features shall be supplied by the CONTRACTOR. Once recorded, the CD-ROM becomes property of the CITY. The CONTRACTOR shall have all CD-ROM and necessary playback equipment readily accessible for review by the ENGINEER during the Project.

The observation terminology utilized during audio narration shall be consistent with NASSCO's PACP standards. The television inspection shall be video recorded on high quality CD-W. The CD shall be clearly labeled with the lift station number and individual manhole numbers clearly listed. The CDs are to be furnished to the ENGINEER with a printed hard copy (Survey Logs) and electronic data inspection report.

Video CDs displaying poor video quality will be deemed unacceptable and no payments will be made until lines are re-televised and a new CD is submitted. Poor video quality refers to, but is not limited to, the following: grease or debris on the lens, camera under water, picture too dark, excessive camera speed through the line, lines improperly cleaned, poor/no audio, etc.

5.1.4 Audio. All CD-ROM shall have audio record. As a preamble, at the beginning of the CD-ROM, the CONTRACTOR shall state the following: (CONTRACTOR's Name) is performing a pre/post TV survey for Job No. 10-01 - Hallandale Beach. State the date, time, operator's name, area, upstream manhole number to downstream manhole number, pipe size and material, upstream manhole depth, and TV survey will be from up- to downstream, or down- to upstream. The CONTRACTOR shall verbally state station and position of all laterals and defects. At the end of each line, state: End of line, upstream manhole number to downstream manhole number, and total linear footage.

5.2 POST CONSTRUCTION SURVEY

5.2.1 Procedure

1. The same procedures shall be used as indicated in Section 3.1 PRECONSTRUCTION SURVEY.

2. In addition, the CONTRACTOR shall stop camera at all point repairs, sectional repairs, and reinstated laterals, and inspect entire repaired pipe section.

3. The CONTRACTOR shall invert white foreground to black as needed in the line section with light background.

5.2.2 Documentation

1. The same documentation shall be provided as indicated in Section 3.1 PRECONSTRUCTION SURVEY.

- END OF SECTION –

SECTION 02765 - CURED-IN-PLACE PIPE LINING

1 -- GENERAL

1.1 Scope

1.1.1 It is the intent of this specification to provide for the reconstruction of pipelines and conduits by the installation of a resin-impregnated flexible tube which is formed to the original conduit by use of a hydrostatic head. The resin is cured using hot water under hydrostatic pressure within the tube. The Cured-In-Place Pipe (CIPP) will be continuous and tight fitting.

1.1.2 The work specified in this Section includes all labor, materials, accessories, equipment and tools necessary to install and test cured-in-place pipe lining in main lines and in service laterals.

1.2 General

1.2.1 The finished pipe in place shall be fabricated from materials which when cured will be chemically resistant to withstand internal exposure to domestic sewage.

1.2.2 This specification references ASTM F1216 (Rehabilitation of pipelines by the inversion and curing of a resin-impregnated tube), ASTM F1743 (Rehabilitation of pipelines by pulled-in-place installation of a cured-in-place thermosetting resin pipe), and ASTM D790 (Test methods for flexural properties of unreinforced plastics) which are made a part hereof by such reference and shall be the latest edition and revision thereof. In case of conflicting requirements between this specification and these referenced documents, this specification will govern.

1.3 Submittals

The CONTRACTOR shall submit shop drawings and other information to the ENGINEER for review in accordance with Section 01300, "Submittals". Included shall be design calculations for the work.

1.4 Product And Installer Acceptability

1.4.1 Since sewer products are intended to have a 50 year design life, and in order to minimize the CITY'S risk, only proven products with substantial successful long term track records will be approved.

1.4.2 Products seeking approval must meet all of the following criteria to be deemed commercially acceptable:

1.4.2.1 For a product to be considered commercially proven, a minimum of 1,000,000 linear feet or 10,000 manhole-to-manhole line sections of successful wastewater collection system installations in the U.S. must be documented to the satisfaction of the CITY to assure commercial viability. In addition, at least 500,000 linear feet of the product shall have been in successful service within the State of Florida for a minimum of five years.

1.5 For an Installer to be considered as commercially proven, the installer must satisfy all insurance, financial, and bonding requirements of the CITY, and must have had at least 5 (five) years active experience in the commercial installation of the product. In addition, the installer must have successfully installed at least 500,000 feet of the product in wastewater collection systems. Acceptable documentation of these minimum installations must be submitted to the ENGINEER.

1.6 Sewer rehabilitation products submitted for approval must provide third party test results supporting the long term performance and structural strength of the product and such data shall be satisfactory to the ENGINEER. Test samples shall be prepared so as to simulate installation methods and trauma of the product. No product will be approved without independent third party testing verification.

1.7 Documentation for products and installers must be satisfactory to the ENGINEER and must be submitted prior to contract award.

1.8 The bidder must have this expertise of 10,000 manhole connections and 500,000 feet of the product in wastewater collection systems.

2 -- Products

2.1 Materials For Main Lines

2.1.1 The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216 or ASTM F1743, Section 5. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.

2.1.2 The wetout tube shall have a uniform thickness that when compressed at installation pressures will meet or exceed the Design thickness.

2.1.3 The tube shall be sewn to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion. Overlapped layers of felt in longitudinal seams that cause lumps in the final product shall not be utilized.

2.1.4 The outside layer of the tube (before wetout) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wetout) procedure.

2.1.5 The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

2.1.6 The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

2.1.7 Seams in the tube shall be stronger than the unseamed felt.

2.1.8 The outside of the tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 ft. Such markings shall include the Manufacturers name or identifying symbol. The tubes must be manufactured in the USA.

2.1.9 The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that when properly cured within the tube composite meets the requirements of ASTM F1216 and ASTM F1743, the physical properties herein, and those which are to be utilized in the Design of the CIPP for this project. The resin shall produce CIPP which will comply with the structural and chemical resistance requirements of this specification.

2.2 STRUCTURAL REQUIREMENTS

2.2.1 The CIPP shall be designed as per ASTM F1216, Appendix X1. The CIPP design shall assume no bonding to the original pipe wall.

2.2.2 The CONTRACTOR must have performed long-term testing for flexural creep of the CIPP pipe material installed by his company. Such testing results are to be used to determine the Long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (tube and resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D-790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Values in excess of 50% will not be applied unless substantiated by qualified third party test data. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in design.

2.2.3 The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occur during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

2.2.4 The cured pipe material (CIPP) shall conform to the structural properties, as listed below.

Property	Test Method	Cured Composite per ASTM F1216
Modulus of Elasticity	ASTM D-790 (short term)	250,000 psi
Flexural Stress	ASTM D-790	4,500 psi

2.2.5 The required structural CIPP wall thickness shall be based at a minimum, on the physical properties described above and in accordance with the design equations in the appendix of ASTM F 1216, and the following design parameters:

Design Safety Factor	2.0
Retention Factor for Long-Term Flexural Modulus to be used in Design *(as determined by Long-Term tests described in paragraph 2.02.B)*	50 %
Ovality*	5 %
Groundwater Depth = Pipe Depth (above invert)*	ft.
Soil Depth (above crown)*	ft.
Soil Modulus	700 psi
Soil Density	120 pcf
Live Load	Two H20 passing trucks
Design Condition	Fully deteriorated
**Denotes information which can be provided here or in inspection video tapes or project construction plans. Multiple line segments may require a table of values.*	

2.2.6 Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

2.2.7 The lining manufacturer shall submit to the ENGINEER for review complete design calculations for the liner, signed and sealed by a Professional ENGINEER registered in the State of Florida and certified by the manufacturer as to the compliance of his materials to the values used in the calculations. A safety factor of 2 shall be applied in the design calculation. The host pipe shall be considered fully deteriorated. The liner shall be designed to withstand a live load equivalent to two H-20 passing trucks plus all pertinent dead loads, hydrostatic pressure and grout pressure (if any). For design purposes, the water table shall be considered at grade elevation. The liner shall be designed in accordance with ASTM F 1216. The buckling analysis shall account for the combination of dead load, live load, hydrostatic pressure and grout pressure (if any). The liner side support shall be considered as if provided by soil pressure against the liner. The existing pipe shall not be considered as providing any structural support. Modulus of soil reaction shall be 700, corresponding to a moderate degree of compaction of bedding and a fine-grained soil as shown in AWWA Manual M45, Fiberglass Pipe Design.

2.2.8 Because of the nature of the calculations and constants utilized, the minimum liner thicknesses shall be 5 percent greater than the amount specified.

2.2.9 As part of the design calculation submittal, the liner manufacturer shall submit a tabulation of time versus temperature. This tabulation shall show the lengths of time that exposed portions of the liner will endure without self-initiated cure or other deterioration beginning. This tabulation shall be at five degree Fahrenheit increments ranging from 70 degrees F to 100 degrees F. The manufacturer shall also submit his analysis of the progressive effects of such "pre-cure" on the insertion and cured properties of the liner. This information shall be submitted in a timely fashion prior to the preconstruction conference so that the ENGINEER may set procedures for dealing with such an instance caused by construction delays. The minimum liner thicknesses are for materials with characteristics as shown.

2.2.10 Liner shall be neither accepted nor installed until design calculations are acceptable to the ENGINEER. Liner shall be as manufactured by Insituform Technologies, Inc., 702 Spirit 40 Avenue, Chesterfield, MO 63005, Phone No. 800-325-1159, or approved equal.

2.3 Testing Requirements

2.3.1 Chemical Resistance - The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

2.3.2 Hydraulic Capacity - Overall, the hydraulic profile shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.

2.3.3 CIPP Field Samples - When requested by the CITY, the CONTRACTOR shall submit test results from field installations in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Section 2.2.4 have been achieved in previous field applications.

2.3.4 CIPP samples shall be prepared and physical properties tested in accordance with ASTM F1216 or ASTM F1743, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in Table 1 of the applicable ASTM.

2.3.5 Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F1743. The minimum wall thickness at any point shall not be less than 87.5% of the design thickness as calculated in Section 2.2.5, of this document.

2.3.6 Visual inspection of the CIPP shall be in accordance with ASTM F1743, Section 8.6.

2.4 Materials for Service Laterals

2.4.1 Intent: It is the intent of this portion of this specification to provide for the reconstruction of lateral sanitary sewer pipelines with the installation of resin impregnated, flexible felt tubes. They shall be installed into the existing service using a pull rope or a push rod. Curing shall be accomplished with hot water or other methods approved by the ENGINEER, the curing method shall be suitable for the selected resin, such that the resin produces a hard, impermeable pipe wall. The cured-in-place pipe (CIPP) should extend throughout the service lateral in a jointless, continuous, tight-fitting, watertight pipe-within-a-pipe.

2.4.2 Structural Requirements: The structural performance of the finished pipe must be adequate to accommodate all anticipated loads throughout its design life. No CIPP reconstruction technology will be allowed that requires bonding to the existing pipe for any part of its structural strength. Since the pipe strength is related to the uniformity and density of the pipe wall, only resin vacuum impregnation will be allowed. Resin impregnation without vacuum entraps air and creates voids which weaken the pipe wall. If reinforcing materials (fiberglass, etc.) are used, the reinforcing material must be fully encapsulated within the resin to assure that

the reinforcement is not exposed, either to the inside of the pipe or at the interface of the CIPP and the existing pipe.

2.4.3 Structural Design Methods: Design methods are to be derived from traditionally accepted pipe formulae for various loading parameters and modes of failure. All equations will be modified to include ovality as a design parameter. The design method shall be submitted to the ENGINEER for review. Design calculations shall be signed and sealed by a Professional ENGINEER registered in the State of Florida.

2.4.4 Continuous Structure: The lateral CIPP must bridge breaks and missing sections of the existing pipe, substantially reducing or eliminating infiltration or exfiltration. The new jointless pipe-within-a-pipe must fit tightly against the old pipe wall and consolidate all disconnected sections into a single continuous conduit.

2.4.5 Useful Life: The lateral CIPP must have a minimum design life of fifty (50) years. The minimum design life may be documented by submitting life estimates by national and/or international authorities or specifying agencies. Otherwise, long-term testing and long-term in-service results (minimum ten (10) years) may be used, with the results extrapolated to fifty (50) years.

2.4.6 Materials: All constituent materials will be suitable for service in the environment intended. The final product will not deteriorate, corrode or lose structural strength that will reduce the projected product life.

2.4.7 Physical Strength: The design for the lateral CIPP wall thickness will be based on the following strengths as shown herein, unless otherwise submitted and approved by the ENGINEER:

Test Parameter	**Magnitude**	**Test Standard**
Flexural Stress	4,500 PSI	Modified ASTM D790
Flexural Modulus of Elasticity	250,000-500,000 PSI	Modified ASTM D790

2.4.8 Service lateral liner shall be neither accepted nor installed until design calculations are acceptable to the ENGINEER. Liner shall be as manufactured by Insituform of North America, Inc., or approved equal.

3 -- EXECUTION

3.1 Cleaning/Surface Preparation

It shall be the responsibility of the CONTRACTOR to clean the pipeline with a high-pressure water jet and to remove all internal debris out of the pipeline in accordance with Section 02751, "Cleaning and Root Removal".

3.2 Sewer Repairs

3.2.1 Any protruding pieces of concrete, dropped joints or broken pipe shall be subjected to point repairs, so that the pipe is left in a clean smooth condition in all respects ready for lining.

3.2.2 If conditions such as broken pipe and major blockages are found that will prevent proper cleaning, or where additional damage would result if cleaning is attempted or continued, the CONTRACTOR, with the concurrence of the ENGINEER, shall perform the necessary point repair(s), and then complete the cleaning.

3.3 Flow Control

Flow control shall be exercised as required to ensure that no flowing sewage comes into contact with sections of the sewer under repair. See Section 02750, "Wastewater Flow Control" for additional information.

3.4 Liner Installation For Main Lines

3.4.1 The prepared pipe shall be reviewed and be acceptable to the ENGINEER for cleanliness and smoothness before the CONTRACTOR begins to line the pipe.

3.4.2 The CONTRACTOR shall present to the ENGINEER, for review, a description of his methods for avoiding liner stoppage due to conflict and friction with such points as the manhole entrance and the bend into the pipe entrance. He shall also present plans for dealing with a liner stopped by snagging within the pipe. This information shall be rendered to the ENGINEER in a timely fashion prior to the preconstruction conference.

3.4.3 The CONTRACTOR shall have on hand at all times, for use by his personnel and the ENGINEER, a digital thermometer or other means of accurately and quickly checking the temperature of exposed portions of the liner.

3.4.4 The CONTRACTOR shall immediately notify the ENGINEER of any construction delays taking place during the insertion operation. Such delays shall possibly require sampling and testing by an independent laboratory of portions of the cured liner at the ENGINEER's discretion. The cost of such test shall be born by the CONTRACTOR and no extra compensation will be allowed. Any failure of sample tests or a lack of immediate notification of delay shall be automatic cause for rejection of that part of the work at the ENGINEER's discretion.

3.4.5 The CONTRACTOR shall designate a location where the tube will be vacuum impregnated prior to installation. The CONTRACTOR shall allow the CITY to inspect the materials and the "wet-out" procedure.

3.4.6 A scaffold or elevated platform shall be erected at the upstream or downstream access point. The tube shall be inverted using an "inversion elbow" at the bottom of the manhole or an "inversion ring" above ground. The tube shall be inverted (turned inside-out) with water pressure.

3.4.7 After the inversion is complete, the CONTRACTOR shall supply a suitable heat source and water recirculation equipment. The equipment shall be capable of uniformly raising the water temperature to a level required to effectively cure the resin.

3.4.8 The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gage shall be placed between the tube and the host pipe in the downstream manhole at or near the bottom to determine the temperatures during cure. Water temperature in the pipe during the cure period shall be as recommended by the resin manufacturer.

3.4.9 Initial cure shall be deemed complete when the exposed portions of the tube appear to be hard and sound and the temperature sensor indicates that the temperature is of a magnitude to realize an exotherm. The cure period shall be of a duration recommended by the resin manufacturer and may require continuous recirculation of the water to maintain the temperature.

3.4.10 IPP installation shall be in accordance with ASTM F1216, Section 7, or ASTM F1743, Section 6, with the following modifications:

3.4.10.1 Resin Impregnation: The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used. To insure thorough resin saturation throughout the length of the felt tube, the point of vacuum shall be no further than 25 feet from the point of initial resin introduction. After vacuum in the tube is established, a vacuum point shall be no further than 75 feet from the leading edge of the resin. The leading edge of the resin slug shall be as near to perpendicular as possible. A roller system shall be used to uniformly distribute the resin throughout the tube. If the Installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven.

3.4.10.2 Tube Insertion: The wetout tube shall be positioned in the pipeline using either inversion or a pull-in method. If pulled into place, a power winch should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

3.4.10.1Temperature gauges shall be placed inside the tube at the invert level of each end to monitor the temperatures during the cure cycle.

3.4.10.4 Curing shall be accomplished by utilizing hot water under hydrostatic pressure in accordance with the manufacturer's recommended cure schedule.

3.4.10.5 Cooldown: The CONTRACTOR shall cool the hardened pipe to a temperature below 100 F before relieving the hydrostatic head. Cooldown may be accomplished by the introduction of cool water into the inversion standpipe to replace water being pumped out of the manhole.

3.4.10.6 Finish: The new pipe shall be cut off in the manhole at a suitable location. The finished product shall be continuous over the length of pipe reconstructed and be free from dry spots, delamination and lifts. Should the liner not make a tight seal at the inside manhole wall, a seal shall be made by use of extra polyester fiber felt and epoxy resin. Pipe entries and exists shall be smooth, free of irregularities, and watertight. No visible leaks shall be present and the CONTRACTOR shall be responsible for grouting to remove leaks or fill voids between the host pipe and the liner. During the warranty period, any defects which will affect the integrity or

strength of the product shall be repaired at the CONTRACTOR's expense, in a manner mutually agreed upon by the ENGINEER and the CONTRACTOR.

3.4.11 After the pipe has been cured in place, the CONTRACTOR shall reconnect the existing service connections. This shall be done from the interior of the pipeline without excavation using a robotic cutter. Where holes are cut through the liner, they shall be neat and smooth in order to prevent blockage at the service connections. Cut-in service connections shall be opened to a minimum of 95 percent of the flow capacity of the building sewer. Cuts shall be wire-brushed to remove jagged edges. All coupons shall be recovered at the downstream manhole and removed. The CONTRACTOR shall stop all visible leaks, including at service connections as required. All reinstated service lateral connections (between the liner and the existing pipe) shall be grouted. The reinstatement of the service connections shall be a separate pay item. The CONTRACTOR should not reactivate any line sections until accepted by the ENGINEER.

3.5 Reinstatement of Branch Connections

It is the intent of these specifications that branch connections to buildings be reopened without excavation, utilizing a remote controlled cutting device, monitored by a video TV camera. The CONTRACTOR shall certify he has a minimum of 2 complete working cutters plus spare key components on the site before each inversion. Unless otherwise directed by the owner or his authorized representative, all laterals will be reinstated. No additional payment will be made for excavations for the purpose of reopening connections and the CONTRACTOR will be responsible for all costs and liability associated with such excavation and restoration work.

3.6 Liner Installation For Service Laterals

3.6.1 Site Disruption: The lateral CIPP usually requires an access point to be established at the reconstruction termination point remote from the mainline pipe. The authorization for the access point and required location and excavation shall be obtained and performed by the CITY of the system. The CITY may install a clean-out, if required. The clean-out will be constructed of a polyvinyl chloride fitting or its equivalent with a riser pipe of equal diameter to the service pipe. The riser will be extended to the existing grade elevation and capped.

3.6.2 Internal Mainline Connection: The lateral CIPP shall be installed to effect a bond with the mainline invert-and-cure pipe to substantially reduce or eliminate the infiltration into the mainline pipe. The mainline pipe opening shall be prepared to accept the lateral CIPP. The lateral CIPP will protrude into the mainline pipe and form a seal with the inside surface of the mainline invert-and-cure pipe surface. The bonding area of the lateral CIPP and the mainline invert-and-cure pipe shall be maximized to obtain the best possible bond. The protrusion shall not inhibit the closed circuit television post video inspection of the mainline or service lateral pipes.

3.6.3 Flow Requirements: The lateral CIPP will provide at least 100 percent of the flow capacity of the host pipe before reconstruction. In lieu of actual measurements, calculated capacities may be derived using commonly accepted equations and values of the Manning flow coefficients (designated "n" coefficients). The original pipe material and condition at the time of reconstruction will determine the Manning coefficient used in the host pipe. A Manning coefficient of 0.009 for a jointless, relatively smooth-wall cured-in-place pipe will be used for the lateral CIPP flow calculation.

3.6.4 Inspection: The materials and processes must be reasonably available for pre-installation, installation and post-installation inspections. Areas which require inspection include, but are not limited to, the following:

3.6.5 Product materials should exhibit sufficient transparency to visually verify the quality of resin impregnation.

3.6.6 Temperature sensing devices, such as thermocouples, shall be located between the existing pipe and the lateral CIPP to ensure the quality of the cure of the wall laminate.

3.7 Time of Construction:

Construction schedules will be submitted and approved by the ENGINEER. At no time will any service lateral remain inoperative for more than an eight (8)-hour period. Any service that will be out of service for more than eight (8) hours will be temporarily by-passed into a mainline sanitary sewer. This will be done at the CONTRACTOR's expense.

3.8 Acceptance

The finished liner shall be continuous over the entire length of the installation. The liner shall be free from visual defects, damage, deflection, holes, delamination, uncured resin, and the like. There shall be no visible infiltration through the liner or from behind the liner at manholes and service connections. Cut-ins and attachments at service connections shall be neat and smooth.

3.9 Cleanup

After the liner installation has been completed and accepted, the CONTRACTOR shall cleanup the entire project area and return the ground cover to the original or better condition. All excess material and debris not incorporated into the permanent installation shall be disposed of by the CONTRACTOR.

3.10 Television Survey

Television survey, including Preconstruction Survey, Post Construction Survey, and Warranty Survey, as indicated in Section 02752 "Television Survey", is required for all cured-in-place lining, including main lines and service laterals.

3.11 Public Notification

3.11.1 The CONTRACTOR shall make every effort to maintain service usage throughout the duration of the project. In the event that a service will be out of service, the maximum amount of time of no service shall be 8 hours for any property served by the sewer. A public notification program shall be implemented, and shall as a minimum, require the CONTRACTOR to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be conducted, and when the sewer will be off-line. The CONTRACTOR shall also provide the following:

3.11.1.1 Written notice to be delivered to each home or business the day prior to the beginning of work being conducted on the section, and a local telephone number of the CONTRACTOR they can call to discuss the project or any problems which could arise.

3.11.1.2 Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

3.11 Warranty

The liner shall be certified by the manufacturer for specified material properties for a particular job. The manufacturer warrants the liner to be free from defects in raw materials for one year from the date of acceptance. During the warranty period, any defects which affect the integrity or strength of the pipe shall be repaired at the CONTRACTOR's expense in a manner mutually agreed by the CITY and the CONTRACTOR.

- END OF SECTION -

SECTION 02770 – CIP STRUCTURAL LATERAL CONNECTION LINING

1 -- GENERAL

1.1 Scope

The work specified in this section consists of providing for the reconstruction of a particular mainline section and the adjacent lateral sewer pipe without excavation while providing a structural one piece leak free connection at the interface of the mainline and lateral pipelines.

1.2 General

The reconstruction will be accomplished using a non-woven fabric tube of particular length and a thermoset resin with physical and chemical properties appropriate for the application. The lateral tube within a translucent inversion bladder is vacuum impregnated with the resin then placed inside a protective carrying device. The mainline liner that is physically attached to the lateral tube is affixed around a rigid launching device. The launching device and protective carrying device are winched into the existing sewer. When the launching device is properly positioned at the lateral connection, the mainline liner is inflated and the resin saturated tube is inverted up through the lateral pipe, using air or water pressure, by the action of the inversion bladder. Once the tube/resin composite is cured, the inversion bladder and launching/carrying devices are removed. The cured-in-place mainline/lateral connection repair system shall be “T-Liner” as manufactured by LMK Enterprises, Inc., or approved equal.

1.3 Submittals

The CONTRACTOR shall submit shop drawings, samples of materials, and other information to the CITY for review in accordance with Section 01300, “Submittals”. Included shall be design calculations for the work.

1.4 Qualifications

1.4.1 The Qualifications of the CONTRACTOR shall be submitted with the bid. The CONTRACTOR is defined as the entity that holds the contracting license (“the state or county licensed company”) to perform contracting work under these bid documents, the CONTRACTOR Qualifications must be submitted in this name. Individual qualifications will not be considered in the product experience. These Qualifications shall include detailed descriptions of the following:

1.4.1.1 Name, business address and telephone number of the CONTRACTOR.

1.4.1.2 Name(s) of all supervisory personnel to be directly involved with this project.

1.4.2 The CONTRACTOR shall sign and date the information provided and certify, that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel submitted will be directly involved with and used on this project. Substitutions of personnel will not be allowed without written authorization of the CITY.

1.4.3 Specialty technicians shall be certified by the proposed product manufacturer and/or its authorized representative. Certifications shall be submitted to the CITY.

1.4.4 The CONTRACTOR shall provide the references of previous project lists going back five years including his customer's names, city contact name, phone number, city project number, city project name. The list must include the number of laterals rehabilitated as well as the number and type of connection seals installed. If there have been any changes in the materials it shall be brought to the attention of the CITY and is to be noted on the submitted projects used for references showing the date and type of the changes.

1.4.5 To be acceptable, the company bidding must have a minimum of 2,500 full circle structural connection installations of the specific product bid, which must be documented, in Florida.

1.4.6 To be acceptable, the installer (the company bidding) must have had a minimum of five years active experience in the commercial installation of the product bid.

2 -- PRODUCTS

2.1 General

The finished liner shall be fabricated from material as specified in this section which when cured will be resistant to the corrosive effects of the raw sewage and hydrogen sulfide.

2.2 Liner Sizing

The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the conduit to be repaired as specified by the CITY.

2.3 Liner Material

2.3.1 The liner shall be one piece and will consist of a lateral portion and the mainline portion with one or more layers of flexible needled felt or an equivalent non-woven material. The liner will be continuous in length and the wall thickness shall be uniform. No overlapping sections shall be allowed in the circumference or the length of the lateral liner. The tube will be capable of conforming to offset joints, bells, and disfigured pipe sections. The mainline liner will be flat with one end overlapping the second end and sized accordingly to create a circular lining equal to the diameter of the mainline pipe. The resin will be polyester or vinyl ester or epoxy, with proper catalysts as designed for the specific application. The cured-in-place pipe shall provide a smooth bore interior. Both the lateral pipe and the main connection shall have a design report documenting the design criteria, fully deteriorated pipe section for the lateral and partially deteriorated for the main (if the main has already been lined), relative to the hydrostatic pressures, depth of soil cover, and type of soil. The mainline sectional liner shall be a full-circle 16-inch long CIPP liner integrally manufactured to the lateral liner providing a seamless connection between the mainline pipe liner and the lateral liner. Installation will be accomplished remotely using air or water for inversion and curing. The cured pipe repair system shall be watertight and shall conform to the existing pipe and eliminate any leakage or connection to the outside of the host pipe/service.

2.3.2 The liner shall meet or exceed ASTM F2561-06.

2.3.3 The composite of the materials above will, upon installation inside the host pipe, exceed the minimum test standards specified by the American Society for Testing Methods.

Physical Characteristics	**Test Procedure**	**Minimum Value**
Flexural Strength	ASTM D790	4,500 psi
Flexural Modulus	ASTM D790	250,000 psi
Long Term Modulus	Reduction for Creep	50%

Design Considerations	**Criteria**	
Tube Design	ASTM F 1216 or F2561	Appendix X1
Hydrostatic Buckling	ASTM F 1216 or F2561	Appendix X1

The CIPP design for the lateral tube and mainline structural connection shall assume no bonding to the original host pipe.

2.4 Liner Design

2.4.1 The minimum required structural CIPP wall thickness shall be based on the physical properties described above and in accordance with the design equations in the appendix of ASTM F 1216, and the following design parameters:

Design Safety Factor	2.0
Retention Factor for Long-Term Flexural Modulus to be used in Design	50 %
Ovality*	2 %
Groundwater Depth = Pipe Depth (above invert)*	ft.
Soil Depth (above crown)*	ft.
Soil Modulus	700 psi
Soil Density	120 pcf
Live Load	One H20 passing truck
Design Condition (lateral pipe)	Fully deteriorated
Design Condition (main pipe) Lined Main Pipe	Partially deteriorated
Design Condition (main pipe) Unlined Main Pipe	Fully deteriorated
**Denotes information which can be provided here or in inspection video tapes or project construction plans. Multiple line segments may require a table of values.*	

Note: There are two conditions that require design calculation in accordance with ASTM F1216. 1) Lateral piping. 2) The connection in the main, lined or unlined main.

2.4.2 The lining manufacturer shall submit to the CITY for review complete design calculations for the liner, both main connection and lateral pipe designs, signed and sealed by a Professional ENGINEER registered in the State of Florida and certified by the manufacturer as to the compliance of his materials to the values used in the calculations. A safety factor of 2 shall be applied in the design calculation. The lateral host pipe shall be considered fully deteriorated, the previously lined main pipe shall be considered partially deteriorated. The liner shall be designed to withstand a live load equivalent to one H-20 passing truck plus all pertinent dead

loads, hydrostatic pressure and grout pressure (if any). For design purposes, the water table shall be considered at grade elevation. The liner shall be designed in accordance with ASTM F 1216. The buckling analysis shall account for the combination of dead load, live load, hydrostatic pressure and grout pressure (if any). The liner side support shall be considered as if provided by soil pressure against the liner. The existing lateral pipe shall not be considered as providing any structural support. If the main pipe has been lined a partially deteriorated condition is to be used for the design of the main. Hydrostatic loads must be considered in three existing pipe conditions 1) mainline design, for previously lined mains and 2) unlined mains as well as 3) the lateral pipe design for unlined pipe. Modulus of soil reaction shall be 700, corresponding to a moderate degree of compaction of bedding and a fine-grained soil as shown in AWWA Manual M45, Fiberglass Pipe Design.

2.4.3 Liner shall be neither accepted nor installed until design calculations are acceptable to the CITY for the three existing pipe conditions.

3 -- EXECUTION

3.1 Cleaning Sewer Lines

Prior to any lining of a pipe, it shall be the responsibility of the CONTRACTOR to remove internal deposits from the pipeline in accordance with Section 02751 - Preparatory Cleaning and Root Removal. Both mainline and lateral line shall be cleaned.

3.2 Television Survey

3.2.1 Television survey shall be performed in accordance with Section 02752 - Television Survey, including Preconstruction and Post Construction Surveys. Both main line and lateral line shall be televised under separate pay items utilizing a pan and tilt camera for both mains and laterals.

3.2.2 The interior of the pipeline shall be carefully surveyed to determine the locations and extent of any structural failures. The location of any conditions which may prevent proper installation of lining materials into the pipelines shall be noted so that these conditions can be corrected. A video and suitable log in PACP format shall be kept and a copy turned over to the CITY.

3.3 Flow Bypassing

The CONTRACTOR, when required, shall provide for the transfer of flow, through or around section or sections of pipe that are to be repaired. The proposed bypassing system shall be acceptable in advance by the CITY. The acceptance of the bypassing system in advance by the CITY shall in no way relieve the CONTRACTOR of his responsibility and/or public liability. The flow bypassing shall be done in accordance with Section 02750 - Wastewater Flow Control.

3.4 Line Obstructions

It shall be the responsibility of the CONTRACTOR to clear the line of obstruction. If survey reveals an obstruction that cannot be removed by conventional cleaning equipment, the CONTRACTOR shall make a point repair excavation in accordance with Section 02757 - Point

Repair of Sanitary Sewers to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the CITY prior to the commencement of the work.

3.5 Liner Installation

3.5.1 The tube is inspected for tears and frayed sections. The tube, in good condition, will be vacuum impregnated with the thermostat resin. The resin will be introduced into the tube creating a slug of resin at the beginning of the tube. A calibration roller will assist the resin slug to move throughout the tube. All air in the tube shall be removed by vacuum allowing the resin to thoroughly impregnate the tube. All resin shall be contained to ensure no public property or persons are exposed to the liquid resin. The mainline liner will be saturated upon a wet-out platform. The resin impregnated sample (wick), shall be retained by the installer to provide verification of the curing process taking place in the host pipe.

3.5.2 The saturated tube along with the inversion bladder will be inserted into the carrying device. The mainline liner is affixed on the launching device. Both the launching and carrying device is pulled into the pipe using a cable winch. The pull is complete when the open port of the launching device is aligned with the interface of the service connection and mainline pipe. The resin saturated lateral tube is completely protected during the pull. No resin shall be lost by contact with manhole walls or the pipe during the pull. The resin saturated mainline liner is supported upon the rigid launcher that is elevated above the pipe invert by means of rotating skid system. The mainline liner should not be contaminated or diluted by exposure to dirt, debris, or water during the pull.

3.5.3 The installer shall document the placement of the liner by internal video inspection with the camera being inserted from the lateral pipe down to the mainline pipe.

3.5.4 The mainline liner is expanded against the mainline pipe and lateral tube is inverted out of the launcher/carrying device by controlled air or water pressure. The installer shall be capable of viewing the lateral liner contacting the lateral pipe from the beginning to the end of the repair. The mainline liner and the lateral tube are held tightly in place against the wall of the host pipe by controlled pressure until the cure is complete.

3.5.5 When the curing process is complete, the pressure will be released. The inversion bladder and launching device shall be removed from the host pipe with the winch. No barriers, coatings, or any material other than the cured tube/resin composite, specifically designed for desirable physical and chemical resistance properties, should ever be left in the host pipe. Any materials used in the installation other than the cured tube/resin composite are to be removed from the pipe by the installer.

3.6 Acceptance And Testing

3.6.1 The finished liner shall be continuous over the entire length of the installation. The liner shall be free from visual defects, damage, deflection, holes, delamination, uncured resin, and the like. There shall be no visible infiltration through the liner or from behind the liner.

3.6.2 Verification of a non-leaking lateral liner and service connection shall require an air test in accordance with the following specifications. Testing shall be performed at the CITY'S discretion but at a frequency not to exceed one test for every ten liners installed. The cost for the test shall be included in the liner installation cost, and no separate payment shall be made.

3.6.2.1 A camera shall be inserted into the lateral pipe via a clean-out upstream of the upper most portion of the cured in-place lateral liner. The camera is then moved through the lateral pipe until it becomes positioned at the lateral/main connection. The camera is utilized to assist in positioning and placing a pair of plugs in the mainline on either side of the lateral opening. A test device with a minimum of a ten-inch clear separation shall be centered on the lateral opening and spanning the brim of the lined connection.

3.6.3 Next, an air test plug shall be introduced into the lateral pipe. The test plug will be placed inside of the cured in-place lateral liner at its upper most portion. The test plug shall be inflated and sealed against the cured in-place lateral liner at the upstream end of the liner.

3.6.4 The testing device within the mainline are then inflated and sealed across the service connection.

3.6.5 Air-pressure not less than 4 PSI shall be introduced through the test plug. The void area between the three plugs shall be pressurized at 4 PSI, held for 2 minutes and during this time the pressure shall not drop below 3.0 PSI.

3.6.6 If an installed cured in-place lateral liner fails the specified air test, the following corrective measures shall be taken.

3.6.7 The cured in-place lateral liner shall be re-inspected by use of a closed circuit television camera in attempt to identify the defect.

3.6.8 Any repairs made shall consist of materials that are structural and meet or exceed the same criteria as the cured in-place lateral liner is required to meet in a domestic sewer collection system. Such materials shall have a minimum life expectancy of 50 years in accordance with ASTM F-1216 (most recent standard) Appendix X1 Design Considerations and Appendix X2 Chemical-Resistance Test.

3.6.9 Once the defect has been corrected, the renewed lateral pipe shall be re-tested in accordance with the air test procedure as described above.

3.6.10 Any corrective measures shall be performed at the CONTRACTOR’s expense.

3.7 If any of the air tests fail, the CITY at its option may require the CONTRACTOR to test an additional lateral at no additional charge to the CITY. If a second air test shall fail, the CITY at its option may require the CONTRACTOR to test additional or all of the installed cured in-place lateral linings at no additional charge to the CITY.

3.7 Cleanup

After the liner installation has been completed and accepted, the CONTRACTOR shall clean up the entire project area and return the ground cover to grade. All excess material and debris not incorporated into the permanent installation shall be disposed of by the CONTRACTOR.

3.8 Warranty

The liner shall be certified by the manufacturer for specified material properties for a particular job. The manufacturer warrants the liner to be free from defects in raw materials for one year

from the date of acceptance. During the warranty period, any defects which affect the integrity or strength of the pipe shall be repaired at the CONTRACTOR's expense in a manner mutually agreed by the CITY and the CONTRACTOR.

END OF SECTION

SECTION 02771 –STRUCTURAL LATERAL CONNECTION LINING

Section 02770

CURED-IN-PLACE PIPE LINING – Laterals & Cleanouts

1.0 INTENT

This specification covers material requirements, installation practices, and test methods for the reconstruction of a sewer service lateral pipe and the main connection without excavation. The pipe renovation shall be accomplished by the inversion and inflation of a resin impregnated, single-piece lateral and main connection liner. When cured, the liner extends over a predetermined length of the service lateral and the full circumference of the main pipe at the connection (CIPP) outfitted with gasket seals. The Materials and Installation practices shall, at a minimum, adhere to the requirements of ASTM F2561-11 “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”

This specification also covers the installation of a CIPP cleanout riser liner. The cleanout riser liner shall be accomplished by the inversion of a resin impregnated, single-piece cured-in-place pipe (CIPP) lateral and riser liner.

This specification takes precedence over any other similar lateral specification that may be found in other sections of the bid documents.

2.0 GENERAL

The lateral reconstruction shall be accomplished using a resin absorbent textile tube of particular length and a thermo-set resin with physical and chemical properties appropriate for the application. The launching device and launching hose is winched through the mainline and positioned at the appropriate service lateral connection. The mainline bladder is inflated seating the hydrophilic seals and presses the connection liner against the main pipe at the connection while the lateral tube inverts up into the lateral pipe by the action of the inversion bladder. The resin-saturated liner is cured, the hydrophilic gaskets are in place then the inversion bladder and launching device are removed.

The cleanout riser lining shall be accomplished by the inversion of a resin impregnated, single-piece cured-in-place pipe (CIPP) lateral and riser liner outfitted with engineered, molded hydrophilic gasket seals that are designed specifically for sealing the CIPP termination ends through a T-shaped cleanout connection. When cured, the liner renews the cleanout riser pipe and the connection to the lateral piping.

3.0 PRODUCT AND INSTALLER ACCEPTABILITY

A. All sewer products are intended to have a minimum 50 year design life, in order to minimize the owner's long term risk of failure, only proven products and installers with substantial successful long term track records will be considered.

B. Products and installers must document the following minimum criteria to be deemed commercially acceptable:

Product	Unit	Florida Minimum Requirement	U.S. Minimum Requirement
Lateral Liner	LF	100,000	500,000
Main / Lateral Connections	EA	5,000	50,000
Stack Single or Double Wye	EA	50	50
Lateral Transitions	EA	100	500

3.1 For materials and product to be considered commercially proven, the above referenced minimum units of successful wastewater collection system installations must be documented to the satisfaction of the owner to assure commercial viability of the proposed liner system. If changes in the product (installation, resin, materials, configuration, assembly, seals) did occur the date and scope of changes must be part of the product history documentation for the owner to review and tabulated to show the quantity of each specific product type or version. Any modifications to the finished product bid must show the date and reason the change was made.

3.2 All sewer rehabilitation products submitted for approval must provide third party test results supporting the long term performance and structural strength of the product and such data shall be satisfactory to the owner. Tests are to include the main, laterals, and main/lateral connection materials and hydrophilic gasket seals. Test samples shall be prepared so as to simulate installation methods and trauma of the product. No product will be approved without independent third party testing verification for all components proposed.

3.3 The Contractor (the firm bidding) must meet the minimum requirements above. This is a company requirement; personal history is valuable, however will not be considered in evaluating the company's ability to meet the minimum requirements of this specification. The Contractor must have installed the same product (in the same constructed configuration) proposed for a minimum of five years.

4.0 MATERIAL

4.1 *Liner Assembly*- The liner assembly shall be continuous in length and consist of one or more layers of absorbent needle punched felt, circular knit or circular braid that meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8. No intermediate or encapsulated elastomeric layers shall be in the textile that may cause de-lamination in the CIPP. The textile tube and sheet shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe segments, and flexibility to fit irregular pipe sections. The resin saturated textile tube and sheet shall meet ASTM F 1216, 7.2 as applicable, and the tube shall have 5% to 10% excess resin distribution (full resin contact with the host pipe) that when compressed and cured will meet or exceed the design thickness.

4.2 *Mainline Liner Tube*- The main liner tube shall be formed from a flat sheet of resin absorbent material suitable for CIPP. The forming of the tube is accomplished by one end of the textile sheet overlapping the second end and sized accordingly to create a circular lining equal to the inner diameter of the lined main pipe. The interior of the textile sheet shall be laminated with an impermeable, translucent flexible membrane. The textile sheet before insertion shall be permanently marked on the membrane as a “Lateral Identification” correlating to the address of the building the lateral pipe provides service.

4.3 *Lateral Liner Tube*- The exterior of the lateral liner tube shall be laminated with an impermeable, translucent flexible membrane. Longitudinal seams in the tube shall be stitched and thermally sealed. The lateral tube will be continuous in length. The lateral tube will be capable of conforming to offset joints, bends, bells, disfigured pipe sections and pipe diameter transitions.

4.4 *Mainline Connection*- The main tube and lateral tube shall form a one-piece assembly by stitching the lateral tube to the mainsheet aperture. The connecting end of the lateral tube shall be shaped to match the aperture and curvature of the main tube. The lateral tube and main tube shall be sealed by use of a flexible UV cured adhesive/sealant. The main/lateral tube assembly shall take the shape of a “TEE” or “WYE” with corresponding dimensions such as a curved circle or a curved elliptical opening in the pipefitting. Submittals for the liner assembly must include the manufacturer’s assembly methods and test protocol for the main/lateral liner assembly to be certified as airtight prior to resin saturation. Each liner assembly must include this test data and be certified by the manufacturer to be airtight prior to resin saturation.

4.5 *Gasket Seals*- The mainline connection shall include a seamless molded flange shaped gasket attached to the main liner tube. The gasket must be a minimum of 2.5mm and must retain this minimum thickness under installation pressures. The lateral tube shall include a compression O-ring gasket attached six-inches from the terminating end of the lateral tube. The gasket seals required must be a manufactured molded neoprene seal. Paste or caulk type of sealants are inconsistent in their placement and application and are not acceptable. All seals must be visible after the installation to verify their proper placement.

4.6 *Mainline End Seal Test Data*- The hydrophilic gasket seals shall include test data that supports substantial expansion properties so to form a watertight compression end seal at the terminating ends of the CIP-lateral liner. The test protocol shall simulate subterranean conditions and hydraulic loading at surface. Gasket seal submittals must include tests data simulating hydration/ dehydration conditions for a period of 10,000-hours and the test results must successfully demonstrate and document long-term performance without deterioration, loss of material, flexibility, and expansion of the gasket during repeated cycles of hydration and dehydration.

4.7 *Bladder Assembly*- The liner assembly shall be surrounded by a second impermeable, inflatable, invertible, flexible translucent membrane bladder that will form a liner/bladder assembly. The translucent bladder shall facilitate vacuum impregnation while monitoring the resin saturation process.

4.8 *Cleanout Riser Liner*- The liner shall be constructed of a resin absorbent textile tube and a thermo-set resin with physical and chemical properties appropriate for the application.

5.0 RESIN SYSTEM

5.1 The resin/liner system shall conform to ASTM D5813 Section 8.2.2.

5.2 The resin shall be a corrosion resistant polyester, vinylester, epoxy or silicate resin and catalyst system that when properly cured within the composite liner assembly, meets the requirements of ASTM F1216, the physical properties herein, and those which are to be utilized in the design of the CIPP, for this project.

5.3 The resin shall produce a CIPP, which will comply with the structural and chemical resistance requirements of ASTM F1216.

Table 1 CIPP INITIAL STRUCTURAL PROPERTIES

Property	ASTM Test	Minimum Value	
		PSI	(MPa)
Flexural Strength	D 790	4,500	(31)
Flexural Modulus	D 790	250,000	(1,724)

6.0 DESIGN CONSIDERATIONS

6.1 The CIPP shall be designed per ASTM F1216, Appendix X1.

6.2 The CIPP design for the lateral tube and main sheet shall assume no bonding to the original pipe.

6.3 The resin saturated lateral tube and the main sheet must place the resin in full contact with the host pipe. The cured liner must have any coating on the interior of the lateral piping.

6.4 The liner must be smooth and have an average roughness coefficient “n” factor of 0.013 or lower.

7.0 REFERENCES

7.1 ASTM 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.

7.2 ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.

7.3 ASTM D-790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

7.4 ASTM D-792 Standard Test Methods for Density and Specific Gravity of Plastics by displacement.

7.5 ASTM D-2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

7.6 ASTM D5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe.

ASTM F2561-11 references several complementing standards; one of which is ASTM F1216. The ASTM F1216 standard is referenced for purposes of tube design considerations for a CIPP. ASTM F1216 is not a lateral pipe lining standard and is not applicable to the sealing of lateral connections to mainline pipe and a branch pipe using CIPP. ASTM F2561 is the industry standard for renewing lateral pipes and main/lateral connections with CIPP and pre-molded compression gaskets.

8.0 INSTALLATION RECOMMENDATIONS

8.1 *Access Safety* – Prior to entering access areas such as manholes, an excavation pit, performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen shall be undertaken in accordance with local, state, or federal safety regulations.

8.2 *Cleaning and Inspection* – As per NASSCO Standards.

8.3 *Cleaning Accessing the Lateral Pipe* – A cleanout is required to be located on the exterior of the building. The cleanout fitting shall be TEE shaped so to allow upstream and downstream access to the lateral pipe. The cleanout shall be located within two (2) feet of where the finished liner is to terminate.

8.4 *Plugging* – The upstream side of the cleanout shall be plugged during insertion and curing of the liner assembly ensuring no flows enter the pipe and no air, steam or odors will enter the building. When required, the main pipe flows will be by-passed. The pumping system shall be sized for peak flow conditions. The upstream manhole shall be monitored at all times and an emergency deflating system will be incorporated so that the plugs may be removed at any time without requiring confined space entry.

8.5 *Inspection of Pipelines* – The interior of the pipeline shall be carefully inspected to determine the location of any condition that shall prevent proper installation, such as roots, severe offsets, and collapsed or crushed pipe sections. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection of pipelines.

8.6 *Line Obstructions* – The existing lateral pipe shall be clear of obstructions that prevent the proper insertion and expansion of the lining system. Changes in pipe size shall be accommodated, if the lateral tube is sized according to the pipe diameter and condition. Obstructions may include dropped or offset joints of no more than 20% of inside pipe diameter.

8.7 *Resin Impregnation* – The liner assembly is encapsulated within the translucent bladder (liner/bladder assembly), the entire liner including the flat sheet shall be saturated with the resin system (wet-out) under controlled vacuum conditions. The volume of resin used shall be sufficient to fill all voids in the textile lining material at nominal thickness and diameter. The volume shall be adjusted by adding 5% to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe. No dry or unsaturated area in the mainline sheet or lateral tube shall be acceptable upon visual inspection.

8.8 7.8 *Liner Insertion* – The lateral tube and inversion bladder shall be inserted into the launching hose. The main bladder and flat textile sheet (main liner tube) shall be wrapped around a “T” launching device, formed into a tube and secured by use of rubber bands. A seamless molded flange shaped gasket shall be attached to the main liner tube by use of stainless steel snaps. The flanged gasket shall be inserted into the lateral pipe at the main/lateral juncture so that the brim of the flanged gasket is firmly seated against the mainline pipe liner. An O-ring end seal shall be positioned 6-inches from the terminating end of the lateral liner tube. The launching device is inserted into the pipe and pulled to the point of repair. The pull is complete when the lateral tube is exactly aligned with the lateral pipe connection. The lateral tube is completely protected during the pull. The mainline liner is supported on a rigid “T” launcher that is elevated above the pipe invert through the use of a rotating skid system. The liner assembly shall not be contaminated or diluted by exposure to dirt or debris during the pull.

8.9 *Bladder* – The main bladder shall be inflated causing the main sheet to unwrap and expand; pressing the main tube firmly into contact with the main pipe and embedding the flange shaped gasket between the main tube and the main pipe at the lateral opening. The lateral tube is inverted through the main tube aperture

by the action of the lateral bladder extending into the lateral pipe to a termination point that shall be no less than 2-feet from the exterior cleanout. The bladder assembly shall extend beyond each end of the liner, so the liner remains open-ended and no cutting shall be required.

8.9.1 *Cleanout Riser Liner* - The tube shall be resin impregnated under a controlled vacuum within the translucent bladder. The liner/bladder assembly is then inserted into a mobile air-inversion device. The mobile air-inversion device shall include a camera port for inspecting the resin saturated tube inflated in the pipe before the resin is cured, and for visually verifying the liner has been fully deployed and the ends are open.

9.0 CIPP LATERAL PROCESSING

9.1 *Curing* – After the liner has been fully deployed into the lateral pipe, pressure is maintained pressing the liner firmly against the inner pipe wall until the liner is cured at ambient temperatures or by a suitable heat source. The heating equipment shall be capable of delivering a mixture of steam and air throughout the liner bladder assembly to a uniform raise the temperature above the temperature required to cure the resin. The curing of the CIPP shall take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of the soil). The heat source temperatures shall be monitored and logged during the cure and cool down cycles. The manufacturer's recommended cure schedule shall be submitted and followed.

9.2 *CIPP Processing* – Curing shall be done without pressure interruption with air or a mixture of air and steam for the proper duration of time per the resin manufacturer's recommendations. The curing process is complete when the temperature of the CIPP reaches 100 degrees Fahrenheit or less.

10.0 FINISH

The finished CIPP – CIPP Shall be a homogenous CIPP liner assembly located within a lateral service pipe for a specific length, and extending into the main pipe to renew 18-inches of the main pipe at the main/lateral service connection. The CIPP shall be smooth with minimal wrinkling and shall increase flow rate. The CIPP shall be free of dry spots, lifts, and delamination. The CIPP shall include a textile taper at each end providing a smooth transition to the host mainline liner for accommodating video equipment and maintaining proper flow in the mainline. After the work is completed, the installer will provide the owner with video footage documenting the repair and the visual markings on the CIPP liner assembly identifying the building address. The finished product shall provide a verifiable non-leaking connection between the mainline liner and the CIP-Lateral liner.

11.0 RECOMMENDED INSPECTION AND TESTING PRACTICES

11.1 *Sampling* – As designated in the purchase agreement, the preparation of a CIPP sample is required. The sample shall be prepared by securing a flat plate mold using the textile tube material and resin system as used for the rehabilitated pipe.

11.2 *Pressure* – The pressure applied on the plate sample will be equal to the highest pressure exerted on the lateral tube during the inversion process.

11.3 *Length* – The minimum length of the sample must be able to produce at least five specimens for testing in accordance with ASTM D-790-03.

11.4 *Conditioning* – Condition the test specimens at 73.4 ± 3.6º F (23 ± 2ºC) and 50 ± 5% relative humidity for not less than 40 hour prior to test in accordance with Practice ASTM D 618, for those tests where conditioning is required.

11.5 *Short-Term Flexural (Bending) Properties* – The initial tangent flexural modulus of elasticity and flexural stress shall be measured for gravity and pressure pipe applications in accordance with Test Method D 790 and shall meet the minimum requirements of Table 1.

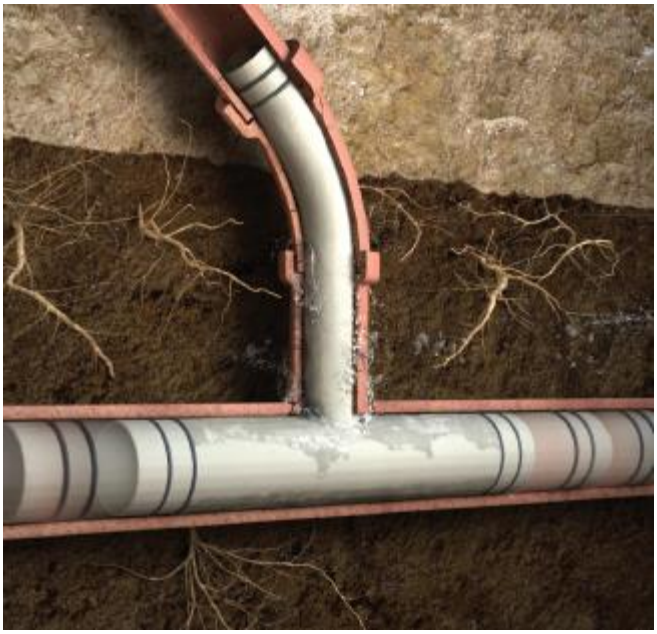
11.6 *Gravity Pipe Leakage Testing* – If required by the owner in the contract documents or purchase order, gravity pipes should be tested using an air test method where a test plug is placed adjacent to the upstream and downstream ends of the main sheet CIPP and at the upper most end of the lateral tube. This test should take place no less than 72-hours after returning the lateral pipe back into service. This test is limited to pipe lengths with no service connections. The test pressure shall be 4-PSI for a test time of three-minutes; the pressure shall not drop below 3.5 PSI.

12.0 WARRANTY

All CIPP liners shall be certified by the manufacturer for specified material properties for the particular repair. The manufacturer warrants the liner to be free from defects in raw materials for ten years from the date of acceptance. The contractor guarantees the work to be free from defects caused by faulty workmanship for a period of five years from the date of acceptance. During the warranty period, any defects which affect the integrity, strength or water tightness of the installed pipe shall be repaired at the contractor's expense.

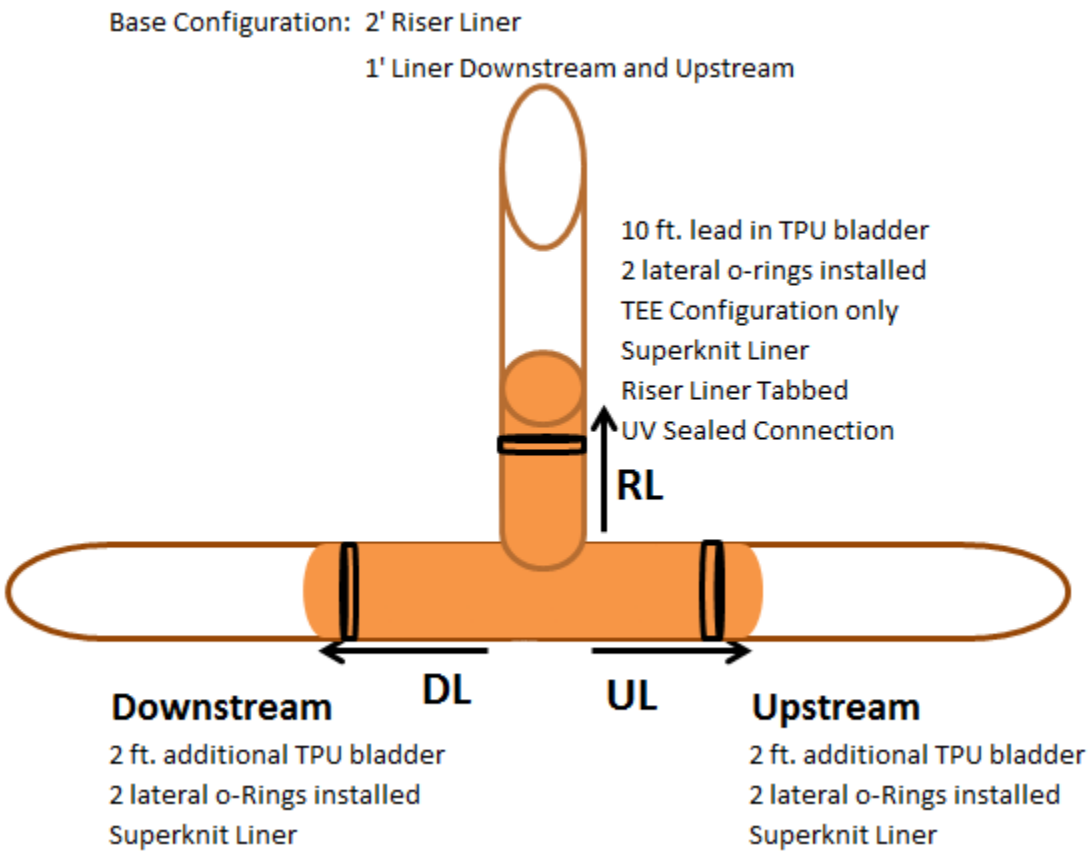
– END OF SECTION –

Watertight seal for lateral



Main to tee connection

Spot repair



Riser Liner

SECTION 27700 – Fiberglass Repair for short sections

PART 1 – GENERAL

1.1 SCOPE

This specification defines the approved methodology and materials for the rehabilitation of a sectionalized portion of a structurally damaged or leaking gravity flow system, service line, joint, crown failure, and the bridging of offset pipe joints (AS INDICATED IN APPENDIX C), by the installation of cured-in-place, thermosetting epoxy-impregnated structural liner system.

1.2 DESCRIPTION

Trenchless point repairs are to be made with a cured-in-place sectional liner containing a polyester-fiberglass liner, impregnated with a thermosetting epoxy resin that is placed on a sleeve carrier and inserted into the pipeline. A pan and tilt 360 degree optical lens camera, capable of viewing the complete circumference of the pipe, will assist in positioning the carrier in the area to be repaired. The bladder is pressurized to a pressure that will maintain the liner pipe interface during the entire cure period. The impregnated composite liner co-cures forming a mechanically bonded, monolithic, seamless repair with the internal circumference of the host pipe, with no annular space. The length of the liner must be reviewed by a qualified engineer, and shall effectively span the designated defective section, plus one foot at each end.

1.3 significance and use

This specification is for use by Regulatory Agencies, Engineers, Commissioner of Public Works, Superintendent of Public Works, Department of Transportation, and others who are authorized and are involved in the rehabilitation of a sectionalized portion of a structurally damaged or leaking gravity flow system.

Part 2 – products

2.1 patented reinforcement liner

The INFRASTRUCTURE REPAIR SYSTEM, INC. POINT REPAIR SYSTEM and/or ENGINEER approved EQUAL: Polyester-fiberglass felt composite liner, consisting of non-woven polyester felt and bonded to 32 oz. per square yard woven 0/90 fiberglass and fitted with a hook and loop fastening system. The reinforced liner must be capable of accepting sufficient volume to compensate for any migration of the resin into defects in the pipe, which will effectively prevent intrusion of water and soil, while retaining its integrity.

2.2 resin

The resin shall be a two-component 100% thermosetting epoxy containing zero grams per liter VOC’s and having a cure time of approximately two (2) hours without the need of external sources of heat. The resin formulation contains wetting agents, defoamers, and surfactants to ensure complete wet out of the reinforcement liner, also assuring that the liner will achieve

superior mechanical bond strength to the substrate under both dry and wet conditions in both warm and cold climates.

2.3 alternative materials

No alternative materials shall be employed without prequalification and written approval from the ENGINEER.

2.4 chemical & corrosion resistance

The system (epoxy and liner) must meet the standards for domestic sewage resistance in accordance with testing as outlined by the American Society of Testing and Materials ASTM D 543 (Table 1).

2.5 Mechanical & Physical Properties

The cured impregnated epoxy liner must meet the minimum mechanical & physical properties in accordance with testing as outlined by the American Society of Testing and Materials in Table 2; ASTM D 638 Tensile Properties of Plastics, ASTM D 695 Compressive Properties of Rigid Plastics, ASTM D 790 Flexural Properties of Unreinforced and Reinforced Plastics, ASTM D 2583 Indentation Hardness of Rigid Plastics by Means of Brachial Impressor, ASTM D 648 Deflection Temperature of Plastics Under Flexural Load, ASTM D 2412 (Modified) Parallel-Plate Loading.

2.6 independent testing

An approved chemical, structural and composite independent testing laboratory must corroborate all mechanical and physical ASTM testing with the results being made part of this specification.

2.7 liner thickness

The CONTRACTOR shall submit to the engineer for approval, complete design calculations for the liners, signed and sealed by a Professional Engineer and certified by the manufacturer as to the compliance of his materials to the values used in the calculations. The liners shall be designed to withstand a live load equivalent to two H-20 passing trucks plus all pertinent dead loads, hydrostatic pressure and grout pressure (if any). For design purposes, water table shall be considered at grade elevation. The liner shall be designed in accordance with Appendix X1 of ASTM F1216-09 (Table 3). The existing pipe shall not be considered as providing an structural support. Modulus of soil reaction shall not be greater than 1,000 psi; the soil density shall be taken as 120 pounds per cubic foot; the minimum ovality of the host pipe shall be 5 percent; the enhancement factor, K, shall not be greater than 7.0; the flexural modulus of elasticity shall be reduced by fifty percent, account for long term effects and used in the design equation as E sub L; the minimum safety factor shall be 2.0.

Part 3 – Execution

3.1 contractor

All contractors bidding rehabilitation projects using the product specified must show proof of successfully completing the repairs using the product and training certification programs.

3.2 material

The materials required for the rehabilitation project must be delivered to the site in undamaged, unopened containers bearing the manufacturer's original label and stored in an area that will ensure the materials maintain a temperature not to exceed 90 degrees F. the material must be mixed at a temperature per manufacturer's specification. Do not alter in any way.

3.3 material safety data sheet

The MSDS will be included with each shipment and shall be kept on the job during the entire time work is in progress and a copy submitted to the ENGINEER.

3.4 safety

Prior to entering access areas, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen must be undertaken in accordance with local, state, or federal safety regulations. Safety shall be in strict accordance with all applicable OSHA standards: protective clothing, safety glasses, and gloves that the workers should use while working with the epoxy.

3.5 cleaning

The intent of this procedure is the removal of internal foreign materials and all debris from the host pipe. This procedure is critical for the successful rehabilitation of the pipe. The procedure is accomplished with the use of hydraulically propelled high velocity jet spray.

3.6 pre-installation television inspection

Closed circuit television inspection is to be carried out immediately after cleaning to document sewer line conditions. The pipeline documentation shall be carried out using a pan and tilt 350-degree optical lens camera, capable of viewing the complete circumference of the pipe. The camera lens is an auto-iris type with remote controlled manual override. The camera light head includes a high intensity side viewing lighting system to provide illumination of internal portions of the pipe, and shall be pulled through the sewer line from either direction at a speed not to exceed 30 feet per minute, and stopping as necessary to document the condition of the pipe. The documentation of the pipe's condition is recorded in color on a readable CD format, along with computer generated reports that accompany the discs.

3.7 flow control

As a result of the use of a flow-through bladder, bypass pumping is normally not necessary.

3.8 installation procedure

Installation shall follow strict certified guidelines. All installers must be trained and certified by Product supplier and proof of that certification shall be supplied upon request.

3.9 finish & defects

The cured liner shall overlap the repair by at least one (1) foot at each end while providing a smooth transition from the host pipe to the repair. The remaining portion of the liner shall be free of any defects (such as: sags, bottom lift-up, rips, pinholes, fins and wrinkles, and dry spots) that would affect the integrity or strength of the repair.

3.10 remedial actions

If any defect, poor finish, uncured resin, and/or faults are found by the ENGINEER, the CONTRACTOR shall remove and reinstall the liner at the CONTRACTOR's expense.

3.11 lateral reinstatement

Immediately following the curing process of the installed liner, all laterals shall be reinstated using a remote lateral opener. Appendix C indicates laterals that are anticipated to require reinstatement; this represents an estimate and must be confirmed by the CONTRACTOR.

3.12 post installation television & video recording

All liner installations and lateral reinstatements shall be Televised and Video Recorded for review by the ENGINEER.

3.13 video

The CONTRACTOR shall supply two copies of the video recordings on a readable CD format.

Table 1
Minimum Chemical Resistance Requirements for
Domestic Sanitary Sewer Applications
ASTM D 543
Minimum One Month at 73.4° F (23° C)

Chemical Solution	Percent of Concentration
Tap Water	pH 100%
Nitric Acid	5%
Phosphoric Acid	10%
Sulfuric Acid	10%
Gasoline	100%
Vegetable Oil	100%
Detergent	0.1%
Soap	0.1%

28 Day Immersion Chemical Resistance
Maximum Percent of Weight Gain

Toluene	100%	.2%
Ethanol	100%	5.5%
Acetic Acid	10%	12.1%
Sulfuric Acid	70%	0.4%
Sodium Hydroxide	50%	0.0%
Distilled Water	100%	0.0%

Table 2
Minimum Mechanical and Physical Properties
Test Method Standards

ASTM D 256	Impact Strength	9.95 FT.-LB/ IN
ASTM D 638	Tensile Strength	16,577 PSI
ASTM D 638	Tensile Modulus	1,119000 PSI
ASTM D 695	Compressive Strength	23,595 PSI
ASTM D 695	Compressive Modulus	1,446,000 PSI
ASTM D 790	Flexural Strength	33,266 PSI
ASTM D 790	Flexural Modulus	822,000 PSI
ASTM 648	Stress	264 PSI
ASTM 648	Stress Deflection	139° F
ASTM D 732	Shear Strength	12,303
ASTM D 2583	Average Hardness Reading	81.2

ASTM D 2412	Strength (lb/in length)	Std. Dev. (lb/in length)	Load (lbs.)	Std. Dev. (lbs.)
Standard Liner	156	11	303	20
8-3/8” OD PVC	154	3	305	5

Liner Thickness (mm) Minimum 3.8 mm

Product Properties
Density: 9.07 lbs. per Gallon
Viscosity: 800 cps
% Vehicle Solids: 100%
% Volatile: 0%
VOC: 0 g/L
Working Time: 20 minutes @ 75° F (23° C).
Shelf Life: 1 year @ 75° F in Original Containers

Table 3
Maximum Groundwater Loads for
Partially Deteriorated Gravity Pipe Condition
ASTM F1216

Diameter (inches) (inside diameter of original pipe)	Nominal CIPP Thickness (mm)	CIPP Thickness, t, in.	Maximum Allowable Groundwater Load[A] (above invert)	
			ft	m
8	6	0.236	40.0	12.2
10	6	0.236	20.1	6.1
12	6	0.236	11.5	3.5
15	9	0.354	20.1	6.1
18	9	0.354	11.5	3.5
18	12	0.472	27.8	8.5
24	12	0.472	11.5	3.5
24	15	0.591	22.8	6.9
30	15	0.591	11.5	3.5
30	18	0.709	20.1	6.1

[A] Assumes K=7.0, E = 125,000 psi (862 MPa) (50-year strength), v = 0.30, C = 0.64 (5% ovality), and N = 2.0

SECTION 027800 - INFILTRATION AND INFLOW PROGRAM – SEALING SYSTEM FROM INFLOW OR REPAIRS OF SYSTEM

1 - Not used

2 – CONTRACTOR's Responsibility

2.1 CONTRACTOR agrees to do everything required by this Agreement and to comply with any and all other provisions in the documents and items incorporated by reference into this Agreement. CONTRACTOR also agrees to perform all clean-up and bear the expense of any off-site disposal, which is or may be necessitated by its Project work.

2.2 CONTRACTOR agrees that all work performed under this Agreement shall be done in a professional manner and that CONTRACTOR's efforts will produce a quality result.

2.3 CONTRACTOR represents to City, with full knowledge that City is relying upon these representations when entering into this Agreement with CONTRACTOR, that CONTRACTOR has the expertise, experience and work force sufficient to timely perform the services to be provided by CONTRACTOR pursuant to the terms of this Agreement.

2.4 CONTRACTOR represents to City that CONTRACTOR is properly licensed by all applicable federal, state and local agencies to provide the services specified under this Agreement. If any of the CONTRACTOR's licenses are revoked, suspended or terminated for any reason by any governmental agency, CONTRACTOR shall notify the City immediately.

2.5 CONTRACTOR agrees to conduct all work and services under this Agreement in accordance with all applicable federal, state and local laws and regulations. CONTRACTOR will identify all governmental authorities and agencies having jurisdiction to approve work involved in the Project and CONTRACTOR agrees to obtain all permits and approvals from any and all such governmental authorities which have jurisdiction. If permitted by the permitting agency, and if City can realize a cost savings by such action, City may authorize the CONTRACTOR to seek required permits on behalf of and in the name of City as its CONTRACTOR; provided, however, that CONTRACTOR agrees to fully indemnify and hold harmless the City in all respects as a result of the obtaining of any and all such permits and approvals. Without limiting the foregoing, City agrees to reimburse CONTRACTOR, upon City's receipt of adequate proof that CONTRACTOR has paid same, the amounts of all permit fees incurred by CONTRACTOR in connection with the applications, processing and securing of approvals or permits which are required to be obtained from all governmental authorities which have jurisdiction over any and all aspects of this work, except City permits and fees which shall be waived and except for so much of any fees as to which the City is required to remit to other governmental agencies.

2.6 ENGINEER, or other designated representative, will be the person through whom CONTRACTOR must communicate all information pertaining to the Project.

2.7 CONTRACTOR shall guarantee the entire Project work against poor workmanship and faulty materials for a period of one (1) year after final payment and shall immediately correct any defects which may appear during this period upon written notification by the City's ENGINEER or designated representative. CONTRACTOR waives any and all rights to claim any statute of limitations defense as to any condition that may arise under this guarantee.

3 – not used

4 – not used

5 - Repair Of Benches And Manholes Wall

5.1 The work covered under this section includes, but is not limited to all labor, equipment, materials, supervision and any other efforts required to repair concrete and mortal damaged inside the manhole that is, or may in the future permit, leaks into the sewer system. .

5.2 The chimney seal shall be installed using Sewpercoat® or equivalent as approved by the ENGINEER that creates a concrete impregnating hard seal. The seal is to be of a resistant material to account for corrosion potential in the manhole. The sealing materials shall have the following parameters:

- Specific gravity > 1.0
- Compressive strength > 7000 psi after 24 hours as measured by ASTM C495
- Compressive strength > 9000 psi after 28 days as measured by ASTM C495
- Flexural strength > 1200 psi after 24 hours as measured by ASTM C293
- Flexural strength > 1400 psi after 28 days as measured by ASTM C293
- Splitting Tensile strength 800 psi after 24 hours as measured by ASTM C496
- Adhesive strength > 1600 psi after 28 days on concrete as measured by ASTM C882
- Shrinkage after 2 days <0.06 % cured at 90 percent humidity
- Nonflammable as measured by ASTM D-93 in a Pensky-Martens closed cup
- Temperature Range -65 to 200 F
- Minimal water absorption capacity (<0.5%)
- Material shall contain VOCs.

5.3 Installation

5.3.1 All loose mortar, concrete brick or other materials shall be removed by CONTRACTOR as they would interfere with seal performance and adhesion.

5.3.2 High pressure sandblast manhole as necessary to create a dry, clean surface with appropriate roughness for adhesion designated as CPS 4 by the International Concrete Repair Institute guideline 3732 – selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays. If the cone also needs repair, the overhead areas shall be sandblasted to create a roughness for adhesion designated as CPS 3 by the International Concrete Repair Institute guideline 3732 – selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays. Surface shall be clean from dust.

5.3.3 Prior to application of sealant, all surfaces shall be being soaked with water. Surface must be saturated, but not dripping wet, prior to application of liner (see manufacturer's recommendations)

5.3.4 Lining material shall be applied in accordance with manufacturer instruction and under the appropriate application pressure. Water used for mixing material shall be fresh, clean potable water only.

5.3.5 The lining material shall have a finished, dry thickness greater than ½ inch thick on all surfaces.

5.3.6 Curing shall be in accordance with ASTM C309 and the manufacturer's recommendations. Moist curing shall

NOTE: concrete must be at least 28 days old with a compressive strength of 3500 psi prior to application of sealant. Temperatures must be above 40 F during application

DRAWING #1

Map of Sewer Line Segments to be Televised