Attachment C
Addendum No. 2
Item 2-4.

SECTION 02511

CLEANING AND CEMENT-MORTAR LINING WATER MAIN

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Removal and disposal of sections of existing pipe cut out for internal access to existing pipe.

2. Internal cleaning of existing 60-inch diameter steel water main by self-conveyed mechanical methods.

3. Cement-mortar lining of existing 60-inch diameter steel water main by self-conveyed mechanical methods.

4. Cement-mortar lining of lock-bar and riveted joints with hand application as required to create smooth transitions.

5. Prevention of cement mortar from entering valves, air valves, manholes and connections affected by the lining operation.

6. Televised inspections of cleaned and rehabilitated water main.

7. Obstructions.

8. Leaking valves.

B. Related Sections:

1. Section 01065 – Project Safety and Health Specifications

2. Section 01300 – Submittals

3. Section 01380 – Construction Video Recording and Photographs

4. Section 01500 – Temporary Controls

5. Section 01540 – Safety and Protection of Property

6. Section 01590 – Temporary Field Facilities

7. Section 02200 – Earthwork

8. Section 02240 – Excavation Dewatering

9. Section 02514 – Ductile Iron Pipe

10. Section 02515 – Steel Pipe

11. Section 02516 – Valves and Appurtenances

12. Section 02675 – Disinfection of Water Mains

13. Section 02704 – Pipeline Pressure and Leakage Testing

1.02 REFERENCES:

A. AWWA C602-17 - Cement-Mortar Lining of Water Pipelines in Place – 4-inch and Larger

1.03 SYSTEM DESCRIPTION:

A. Where indicated on the Drawings, clean and cement-mortar line the interior of the existing steel pipe.

B. The term rehabilitation includes cleaning, cement mortar lining, and replacement of appurtenances with the associated pipeline and as defined herein.

1.04 SUBMITTALS:

Submit the following information to the Authority for review in accordance with Section 01300 - Submittals:

A. Record of Experience of Proposed Foreman:

1. See Paragraph 1.05.A.

B Product Data:

1. Detailed information regarding materials, proportions, and strength test results of cement-mortar proposed for lining water mains at least seven (7) days before cement-mortar is to be used for lining pipeline.

C. Shop Drawings: Submit Shop Drawings of all Work under this Section to the Authority for approval.

D. Detailed Information Regarding:

1. Equipment, methods, disinfection and flushing, testing, and operations schedules proposed for cleaning and lining work.

2. Locations for all access openings for cleaning and lining prior to construction and after having reviewed these locations in the field.

E. Samples:

1. In accordance with AWWA C602.

2. The Contractor shall take, make, cure, store, pack and ship all samples of cement-mortar used for lining.

3. Samples of cement-mortar to be used for lining by the Contractor will be used by the Authority as one standard of comparison.

4. If samples fail to meet AWWA C602 requirements, all additional sampling and sample testing shall be performed by the Contractor at no additional cost to the Authority until samples meet AWWA requirements and with the approval of the Authority.

F. Televised Inspection DVDs:

1. Submit in accordance with paragraph 1.05 C.

1.05 QUALITY ASSURANCE:

A. ***Cleaning and Cement-Mortar Lining Qualifications:***

1. Responsible and eligible bidders shall have the following experience and qualified personnel to perform the work.

a. The Contractor's foreman, or the Cleaning and Cement-Mortar Lining foreman shall have at least three (3) years' experience within the last ten (10) years cleaning and cement-mortar lining work on large diameter pipe (36-inch diameter and larger).

B. The Contractor shall not interfere with operations and maintenance of adjacent potable water distribution systems supplied by the Authority.

C. The Authority and the Contractor shall use the televised inspection to inspect the cleaned pipe prior to mortar lining. The Authority's inspection of the pipeline is required before cement-mortar lining of the pipeline sections may begin.

1. The Contractor shall televise and record the interior of all pipelines to be rehabilitated at the following times:

a. Following cleaning of pipeline: The Authority and the Contractor shall use the televised inspection to assist in the inspection for satisfactory cleaning, look for defects in pipeline, and determine if other repair measures should be completed prior to lining or whether replacement is required.

b. Following application of cement mortar lining: The Authority and the Contractor shall use the televised inspection to assist in the inspection for satisfactory application of cement mortar lining.

2. The Contractor shall provide two (2) copies of all television inspection video in DVD format to the Authority within five (5) days of television inspection.

   a. Televised inspections shall be of high-definition quality and include pipeline stationing and labels.

D. Welding

1. All welding shall be performed in accordance with the welding requirements of AWWA Standard C206.

E. Cement-Mortar Lining:

1. Lining to be a uniform coating with the following minimum thicknesses:

Lining Type	Minimum Lining Thickness
Cement-Mortar in Existing 60-inch Pipe	1-inch

2. Lining of the 60-inch pipe shall be done in multiple passes. The maximum thickness of any pass shall be ½-inch. Initial passes shall be sprayed. The final pass shall be troweled.

3. The minimum cement-mortar lining thickness over protruding rivets and lock-bar seems shall be ¼-inch.

4. Ensure that cement-mortar lining is properly cured after it is placed (Twenty-four (24) hours minimum curing time as indicated in AWWA C602). Protect surfaces from damage during curing period.

5. The Authority and the Contractor shall inspect the cement-mortar lining by viewing the televised inspection after the curing period for satisfactory application of the lining. The Authority's approval is required for acceptance, after cement-mortar lining work is completed for the pipeline sections.

F. The Contractor shall take, make, cure, store, pack, ship and test all samples of cement-mortar used to ensure quality control during the lining work.

G. The Contractor shall submit qualifications materials. Keep qualification documentation up to date and any changes to personnel over the duration of the project shall be submitted for approval.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. All excavated materials and equipment to be incorporated in the Work shall be placed so as not to injure any part of the Work or existing facilities and so that free access can be had at all times to all parts of the Work and to all public utility installations in the vicinity of the Work. Materials and

equipment shall be kept neatly piled and compactly stored in such locations to avoid inconvenience to public travel and adjoining owners, tenants and occupants.

1.07 PROJECT/SITE CONDITIONS:

A. Environmental Requirements:

1. Do not perform Work during weather conditions that could negatively impact the quality of work or provide unsafe working conditions.

B. Existing Conditions:

1. Drawings show approximate location of known existing structures along route of pipeline. Additional structures may exist along utility route.

2. Existing pavement and base pavements shall be cut no larger than necessary to provide working space for access pits and installation of appurtenances.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Cement for Mortar:

1. Portland cement shall be single brand of American-made, Type I or II in accordance with AWWA C602.

2. Pozzolanic materials in accordance with AWWA C602.

3. Admixtures shall be used only with specific approval of the Authority and in accordance with AWWA C602.

4. Fly ash shall not be used.

B. Water for Mortar:

1. Water from the City of Waltham or other potable source acceptable to the Authority.

C. Sand for Mortar:

1. Sand shall be inert granular material having hard, strong, durable grains product from hard crystalline rock and shall be in accordance with AWWA C602.

D. Cement-Mortar Mix Strength:

1. Cement-mortar for lining shall have the following minimum compressive strength in twenty-eight (28) days, based on a minimum of three (3) test specimens: Individual minimum 4,000 psi; Average minimum 5,000 psi.

F. Pipe, Fittings, and Valves:

1. Pipe ends with possible cracks or other damage caused by the Contractor shall be replaced at no additional cost to the Authority.

2. Pipe, fittings, and valves shall conform to Sections 02515 – Steel Pipe and 02516 – Valves and Appurtenances.

3. Closure of pipe access shall be suitable for the system pressure without leakage.

2.02 EQUIPMENT:

A. Equipment for cleaning, applying and troweling cement-mortar in pipe and for curing cement-mortar lining shall be in good condition and capable of obtaining the required results.

B. The television camera used for the inspection shall be 360 degree tilt-type specifically designed and constructed for such inspection. Lighting for the camera shall allow a clear picture of the entire pipe barrel. The camera shall be operative in 100% humidity conditions and waterproof. The camera, television monitor and other components of the video system shall be capable of producing a minimum 600 line resolution video picture. Picture quality and definition shall be to the satisfaction of the Authority and if unsatisfactory, equipment shall be removed, and no payment shall be made for unsatisfactory inspection.

2.03 MIXES:

A. In accordance with AWWA C602.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Access openings shall be located where necessary for satisfactory cleaning and lining except for locations that are indicated on Drawings as “NO ACCESS PIT”.

B. After the existing pipe has been exposed, remove sections of sufficient length to permit cleaning and lining. Removal of top portion of pipe is also acceptable for access.

C. Access pits shall be dewatered in accordance with Section 02240 – Excavation Dewatering to prevent inflow of water or water and soil into access pits.

D. Each access pit shall be of adequate size to accommodate the pipe, other materials and equipment and to provide sufficient working space. The access pits shall be excavated, dewatered, sheeted and supported in accordance with Section 02200 – Earthwork and Section 02161 – Earth Retention.

E. The locations of the cleaning and lining access pits are subject to the following restrictions:

1. Access pits shall be located at least 20 feet from existing trees and outside the drip line. Access pits within 30 feet of existing trees shall be sheeted.

2. Access pits will not be located in areas indicated as "NO ACCESS PIT."

F. Cut pipe with power-operated saw and prevent damage to existing pipe to remain. All cuts to be straight and true.

G. Cutting pipe by hammer and chisel or by wheel type cutters will not be permitted.

H. Prevent dirt, debris, groundwater or foreign matter from entering pipeline, except for materials needed for cleaning and lining.

I. The Contractor shall secure the pipe opening when work is not performed to prevent debris and animals from entering pipe.

J. Install adequate blocking to prevent pipe movement at locations where sections of pipe have been cut out adjacent to valves on pipe under pressure. Blind flange to contain leakage at system pressure can be used affixed to isolation valve if access pit permits.

K. Valves removed to permit access shall be replaced except as indicated on the Drawings.

L. Pipe sections damaged by cutting operations to be replaced at no additional cost to the Authority.

M. Closure of pipeline access to be capable of withstanding system pressure specified without leakage as specified in Section 02704 - Pipeline Pressure and Leakage Testing.

3.02 INSTALLATION:

A. Cleaning Pipeline:

1. In accordance with AWWA C602 by means of scraping apparatus. Remove all rust, tubercules, deposits, old coatings, oil, grease, dirt, debris, and other foreign materials to produce a surface suitable for application of cement-mortar lining. Several passages of cleaning apparatus, in both directions, or completion with hand cleaning tools may be required to produce specified results particularly at locations adjacent to the lock-bar and rivet heads.

2. Scraping apparatus shall be moved through pipeline by power winch or motorized buggy for section to be cleaned. Fluid-propelled devices shall not be allowed for pipe cleaning.

3. Cleaning shall include removal of any loose, deteriorated, or delaminated internal coatings such as coal tar enamel to ensure proper adhesion of the cement-mortar lining. Complete removal to bare metal is not required; however, the surface must be sound and suitable for bonding.

4. Provide clean interior metal surfaces in the water main ready to receive the cement-mortar lining. Leave nothing on pipe surfaces which in any way, or at any time,

may be harmful to the cement-mortar lining or prevent the lining from bonding properly to pipe wall.

5. Cleaned interior of the pipe shall be free of sharp projection that would affect thickness of lining and all matter detrimental to lining.

6. Cleaning debris shall not interfere with operation of air valves, laterals, valves and other water main appurtenances.

7. Remove debris from inside of pipe and dispose of in legal manner. The Contractor shall comply with all State and Federal laws and regulations regarding the disposal of the debris.

8. At point where debris is flushed or removed from pipe, provide a containment and settling area. Sediment, other unsatisfactory material and flushing water shall not enter into drains, sewers, waterways or onto private property.

9. Immediately following each debris removal or flushing operation, clean street and other affected areas in accordance with Section 01046 – Control of Work.

10. Prevent entry of dirt, debris, groundwater or other foreign matter into pipeline except materials needed for cleaning and lining of pipe.

11. Upon completion of cleaning operations for each section of pipeline, televise interior for visual inspection of the cleaned pipeline section.

12. Advise the Authority of any evidence encountered during cleaning indicating repair or replacement may be required before pipeline section is lined.

13. Assist the Authority in making inspection to determine acceptability of cleaning and need to repair or replace pipe.

B. Repair and Replacement:

1. Pipe, fittings, valves damaged by the Contractor's work methods or negligence shall be repaired or replaced at no additional cost to the Authority.

C. Cement-Mortar Lining:

1. Perform work in accordance with AWWA C602.

2. Proceed within one (1) week after pipeline is cleaned and the Authority has approved pipeline to be lined.

3. Mix for sufficient time to obtain maximum plasticity. Use mortar for lining before initial set takes place. For 36-inch pipe and larger, lining shall be installed in two (2) passes. The first pass shall be untroweled and allowed to cure prior to application of second pass lining. Final lining shall be troweled in accordance with AWWA C602. Where gaps occur, trowel patching should be completed using hand tools to make lining continuous and smooth.

4. Prior to pipe lining with sprayed and troweled mechanical methods, cement-mortar shall be applied using hand tools at longitudinal lock-bar seems, and riveted joints to promote a smooth lining and uniform coverage.

5. Assure cement-mortar lining will not interfere with operations of air valves, laterals, service connections, valves and other appurtenances. Before lining is placed, openings in pipeline leading to air valves, blowoffs, manholes and appurtenances, as well as to laterals and connections from pipeline, shall be temporarily covered or plugged with devices which can be removed without damaging cement-mortar lining.

6. Leaking Valves:

    a. The Authority shall operate valves to isolate sections of pipe for performance of Work. A tight shutdown of MWRA valves is not guaranteed. Contractor is required to handle a leakage rate of up to 200 gpm (gallons per minute) for each isolation valve and shall be prepared to provide line stoppage to make connections to existing water mains.

7. Cleaned and lined pipe shall not be pressurized or placed back in service until cement-mortar lining has been satisfactorily cured and not before seventy-two (72) hours have passed after completion of lining operations in pipeline section. Pipeline cannot be placed in service until TV inspection and compressive test results are obtained.

8. End of day clean up water and unused mixed mortar shall not be disposed of within 100 feet of a wetlands area or upon the ground surface.

D. Installation of New Valves:

1. In accordance with Section 02516 - Valves and Appurtenances.

E. Disinfection and Flushing:

1. Disinfect potable water lines including connections, valves, hydrant laterals using procedures and material conforming to the requirements set forth in Section 02675 - Disinfection of Water Mains.

3.03 APPLICATION:

A. Application:

1. Apply, finish, and cure cement-mortar lining in accordance with AWWA C602.

2. Repair Defective Lining:

    a. General:

        (1) Correct defects in manner acceptable to the Authority at no additional cost to the Authority.

(2) Repair defective areas by removal of defective lining and by reapplication of cement mortar lining encompassing full diameter of pipe.

(3) Replace defective areas encompassing full diameter of pipe by machine wherever practical.

3.04 FIELD QUALITY CONTROL:

A. Tests:

1. Inspect cement mortar lining thickness by drilling holes through the lining at regular intervals and recording the length of penetration by the drill bit.

a. Cement mortar lining shall be inspected for thickness at each access pit at 300 foot intervals.

b. At each inspection site, test the cement mortar lining at four (4) locations: at the crown of the pipe, at the pipe invert, and on each wall of the pipe at the springline.

2. When the inspection is complete for each site, fill drill holes with the cement mortar material and hand-finish the surface to a smooth, continuous expanse.

3. All tests required to ensure proper disinfection and flushing are performed by the MWRA Department of Laboratory Services. All results must be approved by the MWRA Water Quality Assurance Section or its designee prior to final acceptance of the Work.

B. Welder Qualifications and Testing:

1. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of ANSI/AWWA C206 or ANSI/AWWA C200, as applicable. All qualifications shall be in accordance with all-position pipe tests as defined in Section 5 of AWS D1.1.

2. The welder qualification testing for field welding shall be conducted at the project site. Results of previous qualification tests will not be accepted. The Contractor shall provide the services of an independent testing laboratory to perform the welder qualification. Copies of all test data and certifications shall be submitted to the Authority.

3.05 CLEANING:

A. All tools, equipment, rags and other materials not part of the pipe shall be removed. The interior of the pipe shall be cleaned thoroughly using a high pressure water jet, sweeping, scrubbing or equally effective means. All water, dirt, spalled concrete and foreign material accumulated in this cleaning operation shall be discharged from the pipe or otherwise removed prior to disinfection.

B. Disinfect main in accordance with Section 02675 - Disinfection of Water Mains.

3.06 PROTECTION:

A. Prevent contamination of contiguous potable water distribution system and services.

** END OF SECTION **

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