



**WATER
RIVERVIEW PARK AND ZOO**

**CONSTRUCTION
SPECIFICATIONS**

January 2024

LIST OF REVISION NOTICE DATES

Rev. #	Rev. Date	COMMENTS
15	Jan. 2024	Added Sampling Responsibility Table to Section 3.8.3 Bacteriological Sampling and Testing Relocated Cathodic Protection to Section 2.5 Removed A3080 and Replaced with A3121 Merged Cement Mortar Lining (CML), Cured in Place Pipe (CIPP) Construction requirements, and payment specifications in Section 4.0
14	March 2023	Clarified payment terms for several items Revised Connection to Existing Requirements – Section 2.3.20 Revised Section 3.0 Quality Assurance and Testing Revised Hydrostatic Testing Requirements for New Watermain – Section 3.7
13	Jan. 2022	Combined all Sections under one (1) document All Sections have been renumbered Temporary By-pass and Watermain Testing and Commissioning – Third Party testing has been added to Section 3.0 Cathodic Protection is now governed by OPSS.MUNI 442
12	June 2020	Removed Section 7.0 Water Works Standard Drawings. It is now a separate document. Removed Section 8.0 Approved Manufacturers' Products for the Peterborough Water System. It is now a separate document.
11	April 2020	Section 1.4 – MOE updated to MECP Revised Section 6.1.2 – poly services 25-75 mm Revised Sections 6.1.3.14, 6.1.5.3, 6.1.5.14, 6.1.5.19
10	May 2019	Revised Section 6.1.3 Materials (6.1.3.1, 6.1.3.13, 6.1.3.14) Revised Section 6.1.5 Installation (6.1.5.20, 6.1.5.26, Added 6.1.5.32, renumbered remainder of Section 6.1.5) Moved Sections 6.1.5.37 to 6.1.5.45 (Temp by-pass) to new Section 6.12 Revised Section 7.0 (Deleted A2371; Revised A1997, A3005, A3073 & B1779; Added A3004, A3080, A3081, A3085) Revised Section 8.0
9	July 2018	Added Sections 6.1.5.37 to 6.1.5.45 (Temporary by-pass watermain) Revised Section 7.0 (Revised A1997, Added A3080, Deleted A3004) Revised Section 8.0
8	Feb. 2018	Revised Section 1.4 Revised Section 4.3.4 Revised Section 6.1.2.1 Flushing Stations Revised Section 6.1.2.1 Water Services Revised Section 7.0 (Revised A3073; Added A3005, A3006) Revised Section 8.0

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PUC 1.0 GENERAL

PUG Services Corp. (PUGSC) shall act as the Peterborough Utilities Commission's agent regarding matters related to the water distribution system.

1.1 WATERMAIN CONSTRUCTION SIGNS

Where required, PUC shall supply 6' (1.8 m) x 4' (1.2 m) watermain construction signs. The Contractor shall install and remove these signs in locations designated by the Engineer. The installation shall be by free standing method utilizing sandbags or excavated in place or buried method using 4" (100 mm) x 4" posts. Installation method to be determined by the Engineer.

1.2 DEPRESSURIZED WATERMAIN HAZARD

The depressurization of the watermain shall be controlled by the Contractor. When the Contractor requires a watermain to be depressurized, PUC cannot guarantee a full shut down of the valve(s). Therefore, the Contractor shall verify the depressurization of the pipe by providing an open point, to atmosphere. The open point to atmosphere shall be in place for the duration of the shutdown.

A request for watermain isolation shall be made by the Contractor, in writing, to the Contract Administrator at least forty-eight (48) hours prior to the required watermain isolation. System Maps with Hydrant and Valve IDs will be provided by PUC to the Contractor at the Construction Start-up Meeting. An example of the request can be found below.

Please set up the following valve request for Thursday April 27, 2023. This request is to complete cut and capping at Brock St west construction limits to install water main by-pass feed.

Valve Request – 7:00 AM – OFF

V5621 - Brock V5622 – Brock V1316 – Stewart V1318 – Stewart V8787 – Stewart V8786 – Rubidge Back shut for hydrant pressure verifications

Please verify pressure by bleeding off hydrant – H0549B – Southwest corner Stewart and Bethune.

Valve Request – 5:00 PM – ON

All above valve open except
V5621 – Remains Shut
V5622 – Remains Shut

All notices will be provided to affected residents and businesses Monday April 24, 2023.

The Valve Operating Report shall be signed by the Contractor and PUC's Operator at the time of the valve operation and confirmation of the shut-down.

1.3 PAYMENT

Payment for work completed will be assumed to be included in the unit prices provided. No extra claim shall be considered.

1.4 REFERENCES

All **standard drawings** related to the construction of watermain in the City of Peterborough, the Contractor shall reference “PUC Water Construction Drawings” available at:

www.peterboroughutilities.ca/en/services/construction-standards.aspx

For a list of **Approved Products** related to the construction of watermain in the City of Peterborough, the Contractor shall reference “PUC Approved Manufacturers’ Products for the Peterborough Water System” available at:

www.peterboroughutilities.ca/en/services/construction-standards.aspx

For all specifications related to the construction of City of Peterborough Infrastructure (Sanitary Sewer, Storm Sewer, Roadways), the Contractor shall reference “Supplemental General Conditions and Standard Specifications” available at:

https://www.peterborough.ca/en/city-hall/bids-and-tenders.aspx?_mid_=26267

PUC 2.0 CONSTRUCTION

2.1 MATERIALS

The Contractor shall notify the PUC staff of material delivered to the site. The Contractor shall provide the Contract Administrator with a List of Materials to be used from the supplier, allow PUC staff access to the delivered material for review, and confirm adherence to the current approved product list. All items deemed unsuitable for installation shall be removed from the site immediately.

All water contacting materials used in construction and operation of drinking water systems shall meet all applicable quality standards set by AWWA and shall meet the latest edition of the consumer safety standards NSF/ANSI Standard 60 and Standard 61. NSF/ANSI Standard 61 products are to be products manufactured after July 1, 2012, and be 'lead-free' as defined by that Standard (≤ 5 ppb leached; $\leq 0.25\%$ by weight).

A complete current list of approved products and their manufacturers, makes and models can be found at:

www.peterboroughutilities.ca/en/services/construction-standards.aspx

2.2 BEDDING REQUIREMENTS

2.2.1 Ductile Iron and Concrete Pressure Pipe

Pipes shall be bedded in accordance with the details shown on the drawings or as ordered by the Engineer. Bedding material shall be granular, concrete or crushed stone where indicated, as specified or where directed by the Engineer.

The minimum bedding requirements for cement-lined ductile iron and concrete pressure pipe shall be Class C (ordinary bedding) consisting of laying the pipe on a careful excavated flat bottom trench and backfilling with clean, organic free, carefully selected excavated material. The bottom of the trench shall be excavated in such a manner that the barrel of the pipe shall have a bearing for its full length. The pipe shall be entirely surrounded by carefully selected excavated material, free from organic materials, lumps, stones, stumps, etc. This material shall be carefully placed in maximum of 300 mm lifts around this pipe to fill the voids and thoroughly compacted to 98% maximum dry Standard Proctor density.

Where the native site material may be injurious to the pipe coating, the pipe shall be bedded on and encompassed by a minimum of 150 mm (6") of a granular backfill material.

Where polyethylene encasement is used, bedding shall be a minimum of Class 'B' unless the existing material is stone free and can be effectively placed and compacted without damaging the polyethylene encasement.

2.2.2 PVC

Pipes shall be bedded in accordance with the details shown on the drawings or as directed by the Engineer.

The minimum bedding requirements for polyvinyl chloride pipe shall conform to the following PUC Standard Drawing A1769 unless amended in Contract Documents:

- i) Granular "A" bedding under the pipe to minimum 150 mm in depth and up to the pipe springline, compacted to 100% maximum dry Standard Proctor density;
- ii) Sand or Granular "A" from springline to 300 mm above crown of the pipe compacted by a mechanical vibratory plate tamper to 100% maximum dry Standard Proctor density in 150 mm lifts;
- iii) Balance of approved backfill shall contain no stones which are more than 200 mm in diameter and shall be spread in uniform layers of 300 mm compacted to 98% maximum dry Standard Proctor density. Rolling equipment should not be used until a minimum of 1.0 metres of backfill material has been placed over the top of the pipe. If a hydro hammer is to be used to compact the backfill, a minimum of 1.5 metres of cover is required;
- iv) Subgrade consists of Granular 'A' and Granular 'B' compacted to 100% maximum dry Standard Proctor density in 150 mm lifts; or as specified in the contract documents.
- v) Trench width shall be the same as for ductile iron which is shown in the trench reinstatement profiles of the manufacturer's recommendations for installation.
- vi) When using trench boxes or moveable sheeting, care shall be given not to disturb the pipe location or compacted backfill material up to springline of pipe.

2.3 WATER SERVICE BEDDING

All water service pipes shall be bedded and covered with screened sand to a minimum of 100 mm surrounding the pipe and compacted to 100% of Standard Proctor density.

2.3.1 *Crushed Stone Bedding*

Where directed by the Engineer, crushed stone shall be used for additional bedding under pipes for refilling the bottom of the trench where additional excavation has been made, due to unsatisfactory foundation conditions.

Crushed clear stone (19 mm) bedding, where required, shall be placed and wrapped in non-woven geotextile filter fabric, in the trench to form a bed for the pipe and shall be consolidated to a firm condition. After the stone is placed, the pipe shall be bedded as per bedding requirements for the type of pipe. See City of Peterborough Drawing CPD410.02.

2.3.2 *Backfill*

The excavations and trenches shall be backfilled with specified backfill materials. Approved backfill materials shall be compacted to City of Peterborough specifications as per CP 501.01 Compaction. Excavations which are located within the City of Peterborough, on arterial roadways, or as directed by the Contract Administrator, shall be backfilled with unshrinkable fill as per CP 314.03 Unshrinkable Backfill from 300 mm above the watermain up to subgrade and left to set unless otherwise specified in the contract documents. The requirement for unshrinkable fill backfill shall be identified in the Contract Documents.

2.4 INSTALLATION

2.4.1 *General*

All materials shall be supplied, delivered, stockpiled and distributed at the site by the Contractor. Pipe, fittings, valves, hydrants and accessories shall be loaded by lifting with appropriate equipment so as to avoid shock or damage, as recommended by the manufacturer of the material. Under no circumstances shall such materials be dropped.

Keep material safe and clean at stockpile location.

Stored pipe shall, at all times, be supported on sand bags or other nonabrasive support placed under the end of the pipe. Bags shall be of sufficient size to prevent contact of the pipe coating with the ground or any obstruction. Rolling the pipe on coated surface will not be permitted.

In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pipe shall be handled so that the pipe, pipe coating or pipe lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor to the satisfaction of the Engineer.

The pipe shall be handled, hauled and placed, using wide slings and padded cradles of canvas, leather or other suitable material so designed and constructed as to prevent damage to the pipe or pipe coating. The use of bare metal cables, chains, hooks or other equipment which might damage the pipe or pipe coating will not be permitted.

2.4.2 Plugging Pipe

An easily removable water-tight stopper shall be inserted in the end of every pipe as it is being laid so as to prevent entry of foreign materials, contaminated trench water, rodents, etc.

During all phases of the pipe laying operation, the watermain pipe in the trench shall be protected with a watertight plug or stopper. At the close of each day's work or when work ceases for any reason, special care shall be taken to protect the stopper so that it cannot be inadvertently removed.

2.4.3 Cleaning Pipes and Wiping Joints

Each pipe shall be kept clean at all times and care shall be taken by the Contractor to prevent any materials or debris from entering the pipe while stored at the site, during and after laying operations. The end of the pipe shall be plugged each time the laying operations are suspended and preventative measures in this connection shall be such as will meet the approval of the Engineer.

All pressure pipe, before being lowered into the trench shall be thoroughly cleaned of all materials which may have accumulated inside the pipe or in the joints. All pipes and castings shall be carefully swept and cleaned and all spigots and sockets shall be wiped so they are clean and dry. No joint shall be made unless these are perfectly dry and clean. Pipe shall be carefully examined for cracks and flaws and no defective pipe or fittings shall be used in the work. All open branches and ends of the pipe shall be plugged at night and at lunch breaks. A proper plug shall always be kept in front of the pipe to prevent any foreign substance from entering the pipe.

The Contractor shall ensure that each pipe and casting is clean and perfect in all respects and has no foreign substance in it when laid; they shall be held responsible for any neglect in this respect, as well as for any damage done to the pipe or other articles or material, until the completion of the contract, and from any damage of whatever nature, caused by their operations or neglect.

Initial disinfection of the pipe, as described in PUC Section 3.0 "Quality Assurance, shall be performed just prior to pipe installation.

Pipe shall be laid and all joints made in a manner approved by the Engineer and as recommended by the manufacturer of the material. All tees, bends, etc., shall be

securely braced or stayed by the Contractor against draw or blow out and the Contractor shall be liable for any damage or repairs arising from any draw or blow out, etc, occurring in the main they are laying, has laid or to which they are making connections. The means of providing electrical conductivity shall be installed as recommended by the manufacturer of the pipe.

2.4.4 Laying and Jointing – Ductile Iron Pipe

Pipes shall be handled carefully by approved methods so as to avoid damage to the pipes, either by transit, unloading, storage or moving to the final location and placing. Pipe bedding and backfill shall be in accordance with PUC Standard Drawing A1769.

Special care shall be taken to ensure that the pipes are well bedded as per specification on a solid foundation and any defects due to settlement shall be made good by the Contractor at their own cost and expense. The bottom of the trench shall be shaped to ensure the surface of the pipes have an even bearing throughout their entire length, without causing strain on the spigot.

Mechanical joints or their equivalent shall be made by the Contractor to the satisfaction of and under the supervision of the Engineer. All bolts, nuts, couplings, rubber rings and connecting pieces must be thoroughly cleaned and the ends of the connecting pieces coated with pipe soap, as supplied by the manufacturer, (the use of cup grease or machine oil is not permitted) so that the rubber rings will fit tightly and correctly in place when the couplings are bolted together.

At each joint, the spigot shall be centrally located in the bell. The surface with which the rubber gasket comes in contact shall be thoroughly cleaned to remove any loose rust or foreign material. The gasket may be rinsed in soapy water prior to being placed on the pipe end. The bolts shall be lubricated and the nuts shall be tightened alternately so that the gland is brought up evenly toward the pipe flange. The nuts shall be tightened in three or more stages and the final tightening shall be done by ratchet wrenches of the torque limiting type with indicators to apply a torque on each bolt of approximately 100 Newton-metres.

If any gaskets are damaged or gland rings broken, due to improper jointing procedures, they shall be replaced at the Contractor's expense.

"Tyton" joints shall be made in accordance with the pipe manufacturer's instructions. The Contractor shall assemble all joints carefully, as follows:

- a) Clean bell, spigot and gasket. Flex the gasket and place in bell with bulb entering first.
 - b) Locate the gasket groove on its retaining bead. Bed gasket heel firmly in seat.
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- c) Ensure gasket seats snugly around whole circumference. Remove bulges that might interfere with proper entry of spigot end. In large diameters, this may be assisted by forming a second loop in the gasket, opposite the first. Press loops flat one after the other.
- d) Apply thin film of lubricant to surface of gasket which will come in contact with entering spigot. Lubricate outside surface of spigot for about 25.4 mm (1") from the end.
- e) Align spigot end of pipe being jointed. Carefully enter spigot into bell until it just makes contact with the gasket.
- f) Complete entry of spigot into bell by pushing against bell end of entering pipe with a crowbar or a spade, until the second painted strip is approximately flush with bell face.

When the pipe is cut in the field, the cut end shall be conditioned as recommended by the manufacturer by filing or grinding a small taper at about 30° to remove any sharp, rough edges which might otherwise injure the gasket.

The pipe and fittings shall be supplied with suitable means of providing electrical current conductivity. The method used to obtain electrical continuity shall be as per the pipe manufacturer's recommendation.

Where serrated bronze wedges are used, the Contractor shall install three at each pipe joint. The method of producing electrical continuity shall be approved by the Engineer.

All phases of construction shall be in accordance with the current standards recommended by the pipe manufacturer, except as otherwise specified.

2.4.5 Laying and Jointing – Concrete Pressure Pipe

The Contractor shall install pipe to the manufacturer's specifications and as indicated by the manufacturer's approved shop drawings. The Contractor shall submit shop drawings to the Engineer for approval and shall not deviate from the drawings unless previously approved by the Engineer.

Joint deflection shall not exceed the manufacturer's allowable in any circumstance.

Special care shall be taken to ensure that the pipes are well bedded on a solid foundation and any defects due to settlement shall be made good by the Contractor at their own cost and expense. The bottom of the trench shall be shaped as detailed to ensure the surface of the pipes having an even bearing throughout their whole length.

Joints shall be prepared by the Contractor in accordance with the pipe manufacturer's requirements.

2.4.6 Laying and Jointing – PVC Pipe

The Contractor shall use proper handling procedures for PVC pipe and chains or cables shall not be used in lifting pipe. Special care in pipe handling shall be employed during freezing temperatures. Bedding and backfill shall be in accordance with PUC Standard Drawing A1769.

The trench bottom shall be prepared to provide firm, stable support throughout the full length of the pipe, as per specification, with no stones exceeding 20 mm in diameter present. Bell holes shall be provided to properly achieve this support. The Contractor shall keep the trench width at the pipe level to the minimum to achieve proper compaction adjacent to the pipe. Where possible, pipes shall be laid with bell ends facing the direction of laying. Pipe lengths shall not be deflected in excess of manufacturer's recommendations.

For a bell and spigot joint, the pipes shall be joined to the depth indicated on the pipe or to manufacturer's requirements. The gasket shall be carefully fit into the bell groove and the spigot shall be lubricated using manufacturer supplied lubricant suitable for use in potable water applications. The Contractor shall ensure that the bell, spigot and gasket are clean and free of imperfections.

A wooden block shall be used when levering the pipe. The Contractor shall not pry directly against the PVC pipe. Mechanical equipment shall only be used for joint construction when recommended by the manufacturer and approved by the Engineer.

When pipe is field cut a bevel of approximately 15 degrees shall be put on the spigot end.

2.4.7 Polyethylene Encasement for Ductile Iron Pipe

The Contractor shall install polyethylene encasement as specified. Polyethylene encasement shall be in accordance with ANSI/AWWA C105/A21.5-93. Installation shall conform to either Method "A" or "B" as outlined in this section.

The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material but is not intended to be a completely air and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed.

a) Method "A"

1. Cut polyethylene tube to a length approximately 610 mm longer than that of the pipe section.
2. Slip the tube around the pipe, centre it to provide a 305 mm overlap on each adjacent pipe section. Bunch it accordion-fashion (lengthwise) until it clears the pipe ends.
3. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at the joints to facilitate installation of the polyethylene tube.
4. After assembling the pipe joint, make the overlap of the polyethylene tube. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new pipe section and secure the overlap. Pull the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Secure the overlap in place. Take up the slack (widthwise) to make a snug, but not tight, fit around the circumference of the pipe along the barrel of the pipe, securing the fold at quarter points with appropriate ties, a minimum of four (4) per 5.5 metre length.
5. Repair any rips, punctures, or other damage to the polyethylene with adhesive tape or with a short length of polyethylene tube to be cut open, wrapped around the pipe, and secured in place. Proceed with installation of the next section of pipe in the same manner.

b) Method "B"

1. Cut the polyethylene tube to a length approximately 300 mm shorter than that of the pipe section. Slip the tube around the pipe; centre it to provide 150 mm of bare pipe at each end. Make polyethylene snug around the circumference, but not tight; secure ends as described for Method "A".
 2. Before making up a joint, slip a 1.0 metre length of polyethylene tube over the end of the preceding pipe section bunching it (lengthwise) accordion-fashion. After completing the joint, pull the 1.0 metre length of polyethylene over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least 300 mm.
 3. Make snug around the circumference and secure each end as described for Method "A".
 4. Repair any rips, punctures or other damage to the polyethylene as described for Method "A".
-

c) Pipe-Shaped Appurtenances

Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in the same manner as the pipe.

d) Odd-Shaped Appurtenances

When valves, tees, crosses, and other odd-shaped pieces cannot be wrapped practically in a tube, wrap with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Make seam by bringing the edges together, folding over twice and taping down.

Make snug around the circumference and overlap at joints as described in Method "A". Tape polyethylene securely in place at valve stem and other penetrations.

e) Openings in Encasement

Provide openings for branches, service taps, blow-offs, air valves and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as any other damaged areas in the polyethylene with tape.

f) Junctions between Wrapped and Unwrapped Pipe

Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least 600 mm. Secure the end with several turns of tape around the circumference of the pipe.

g) Backfill for Polyethylene-Wrapped Pipe

Use the same backfill material as that specified for pipe without polyethylene wrapping, exercising care to prevent damage to the polyethylene wrapping when placing the backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage polyethylene.

2.4.8 Tracer Wire

Tracer wire shall be installed on all plastic pipe installed, including all plastic services and hydrant leads.

The wire is to be laid along with the pipe in the trench and strapped to the top of the pipe with tape (Denso tape or equal) at intervals not exceeding 3.0 metres. The wire is

to be brought to the surface at all hydrants through a 12 mm polyethylene or PVC pipe strapped to the outside of the hydrants and at all mainline valve boxes. The tracer wire shall be connected to the hydrant boot and ground flange as per PUC Standard Drawing A2729 or A2976. A continuous length of wire is to be used between surface points. The wire shall be taped to the outside of the valve box so as not to interfere with the operation of the valves. If the valve box does not have a pre-manufactured hole drilled in the top for tracer wire access, then a groove shall be cut in the top of the valve box just under the lid to enter the tracer wire. Any wire joints made at tees etc., shall be made with Marr connectors, brass split-bolt connectors or solder and then wrapped with insulating tape to inhibit corrosion of the wire. Cad weld to fittings and DI pipe ends. Spray coat all exposed connections. Connect tracer wire under valve bolt nut. Do not remove epoxy coating.

Tracer wire used in conjunction with non-metallic water services (25 mm to 50 mm) shall be connected to the electrical grounding tail nut tracer wire terminal on the main stop and be accessible at the lid of the service box as per PUC Standard Drawing A2820.

Upon completion of the watermain and water services the tracer wire shall be tested for continuity by an independent consultant (approved by the PUC) at the Contractor's expense. The Contractor shall provide the Engineer with a continuity report. Any indication of a break in continuity shall be repaired at the Contractor's expense.

2.4.9 Changes in Line or Grade

Changes in line or grade of 11.25 degrees or more shall be made with specially fabricated bends. Deflections of less than 11.25 degrees shall be made by pipe joint deflections. Pipes shall not be deflected either vertically or horizontally in excess of that recommended by the manufacturer.

2.4.10 Valves

All valves shall be furnished with mechanical joints or flanged ends. The valves and connecting piping shall be accurately aligned and supported to prevent subsequent movement and strain at the joints. All valve installations are to include all required fittings, couplings, valve box assemblies. All materials to be supplied and installed by the Contractor.

All bolts, nuts, couplings, rubber rings and connecting pieces shall be new and thoroughly cleaned. The valves shall be supported on the blocks as shown on the drawings. Contractor shall be paid under contract item.

2.4.11 Air Relief Valves and Other Appurtenances

The Contractor shall install air relief valves and all other small appurtenances and jointing materials as detailed on the drawings or as required by the specifications.

2.4.12 Hydrants

The Contractor shall install fire hydrants of the type and at the locations where shown on the drawings or as directed by the Engineer on a 150 mm diameter lead of pipe material similar to the main. The hydrants shall be valved with a 150 mm gate valve and box, as specified. Hydrants are to be installed in accordance with PUC Standard Drawings A2729 and A2976. The hydrant barrel installed below grade is to have a 6 mil polyethylene encasement surrounding it.

The work shall include all material including stone and concrete, excavation, backfilling, and all labour necessary to install the hydrant, valve, valve box, branch connecting pipe, concrete thrust blocks or restrained joints from tee to hydrant, all as specified herein. The hydrant shall be securely supported to prevent drawing off from the pipe, by blocking solidly between the hydrant and solid earth with concrete.

The hydrant shall be installed to a grade that the breakaway is 75 mm to 225 mm above the final surrounding grade. The Contractor shall install any hydrant and isolation valve box extensions required.

2.4.13 Service Connections

The Contractor shall install water services as indicated on the drawings or directed by the Engineer. The work shall include all excavating, bedding, pipe-laying, backfilling, compacting, installation of materials, anode supply and installation, etc., necessary to construct complete water service connections from the main to the property line. Water services shall be installed in accordance with PUC Standard Drawing A2820 or A2865. As per pipe manufacturer's recommendations, all water service taps to be wet-tapped regardless of material.

The Contractor, unless otherwise directed by the Engineer, shall pressure (wet) tap the watermain to receive the main stop at a point opposite the horizontal center line of the main. Sufficient slack (a "horizontal gooseneck" of at least one (1) metre in length) shall be left in the service pipe to allow for any settlement of the backfilling material. Joints between the fittings and pipe shall be made watertight.

PVC pipe tapping shall be a pressure tap with line valves only cracked open to maintain line pressure but reduce the flow of water should a problem arise. All services installed on PVC pipe shall use a saddle designed for the application and a safety blanket shall be used during the tapping operation.

Care shall be taken to ensure the curb stop valve boxes are set vertical with the tops level with the ground. All services shall be laid at a depth of 1800 mm below the proposed ground surface unless otherwise directed. Refer to PUC Standard Drawing A2732 for anode connection detail.

Unions will not be permitted in new water services from main to property, without approval of the Engineer.

Contact the Water Division of Peterborough Utilities for requirements specific to the service extension from property line to and into the house, including water meter requirements and the activation or shut-off of a service.

Water service shut-offs at the property line are the property of the Commission and shall be operated only by PUC employees. The Public Utilities Act specifically forbids the turning on or off of water service shut-offs without the approval of the PUC, except in the case of accident or for the protection of the building to prevent flooding.

2.4.14 Exposed Metal Surfaces

Any exposed metal surfaces not embedded in concrete or wrapped with polyethylene shall be painted with two (2) finishing coats of No. 1756 Black Mastic, from Sterling Varnish. The application rate with two (2) coats shall be twenty (20) mils. The mastic shall be applied only to clean dry surfaces with temperatures of 45°F (7.2°C) or over and the Contractor shall warm areas to be painted if required. Suitable ventilation of the area shall be provided. During winter conditions, a comparable low temperature mastic shall be used.

2.4.15 Thrust Blocks / Restrained Joints

Concrete thrust blocks or approved restrained joints shall be required behind all bends 11.25 degrees and over, tees, hydrants, plugs, etc. The concrete shall be installed in such a way, that the concrete is placed behind the bends, etc., but not around or overtop of the glands, nuts, and bolts. A polyethylene bond breaker shall be placed between the thrust block and fitting/hydrant, etc. The concrete shall be placed to transfer the thrust to solid undisturbed ground adjacent to the bend.

The surface area for the thrust blocks against solid undisturbed ground for the various piping shall be as follows:

Thrust Block Areas in Square Metres (Soil Bearing Pressure 50 kN/m ²)				
	150 mm	200 mm	300 mm	400 mm
Behind Hydrant	0.50 m ²	0.50 m ²	0.50 m ²	0.50 m ²
"T" or Plug	0.50 m ²	0.86 m ²	1.83 m ²	3.18 m ²
90° Bend	0.760 m ²	1.214 m ²	2.502 m ²	3.18 m ²
11.25° Bend Horizontal	0.097 m ²	0.168 m ²	0.358 m ²	-----
22.5° Bend Horizontal	0.194 m ²	0.335 m ²	0.716 m ²	0.716 m ²
45° Bend Horizontal	0.382 m ²	0.656 m ²	1.400 m ²	-----

All connections, caps, bends, etc., which are liable to "draw" or blow out, shall be securely stayed with concrete, as directed, to the satisfaction of the Engineer, and without any extra remuneration to the Contractor. The Contractor shall be liable for any damage caused by the drawings or blowing off of any such connection, caps, or bends or for any damage caused by blow outs, etc., of any pipe with which they are making the connection.

Restrained joints in lieu of concrete thrust blocks for hydrants and fittings will be permitted. When utilizing restrained joint devices, the watermain joints shall also be restrained (two (2) joints either side of fitting being restrained). The Contractor is responsible for all associated costs.

2.4.16 Victaulic and Dresser Couplings

Victaulic and Dresser couplings, if required and approved by the Engineer, shall be supplied by the Contractor and installed in accordance with manufacturer's specifications.

The pipes shall be cleaned and dried and the rubber gaskets shall be lubricated with lubricants approved by the manufacturer. The coupling shall be carefully assembled. The bolts shall be tightened using a torsion wrench of the correct torsion as recommended by the manufacturer of the couplings. The Contractor is responsible for all associated costs.

2.4.17 Mechanical Joint Retaining Glands

Where mechanical joint retaining glands are required on the watermain, the Contractor shall supply and install the retaining gland rings in place of the regular gland rings. The Contractor is responsible for all associated costs.

2.4.18 Tie-Rods, Steel Straps, etc.

Where tie rods, steel straps, anchor rods and steel beams are required, as shown on the plans, or required by the specifications, the Contractor shall supply and install the tie rods, threaded as required, complete with nuts and shall supply and install the necessary steel straps, anchoring rods and steel beams required for thrust blocks. All materials to be stainless steel, unless approved otherwise by PUC's Engineer. The Contractor is responsible for all associated costs.

2.4.19 Connection to Existing Watermain

The connections to the existing watermain shall not be made until the new watermain, or a section thereof has been swabbed, pressure tested, flushed, disinfected, and sampled to the satisfaction of the PUC Engineer or designate as per Section 3.0 "Quality Assurance and Testing" and PUC Standard Drawings A3085 or A3121.

All costs associated with steps and procedures required for acceptance of the new watermain, as well as temporary and permanent connections to existing watermains shall be borne by the Contractor.

All work including, but not limited to, swabbing, flushing, disinfection, bacteriological sampling and leakage testing must be witnessed by a PUC MECP Licensed staff member.

Prior to the commencement of testing, all hydrants must be installed to the flange final grade elevation, as per approved design. Any hydrant adjustments required after the water system is commissioned must be completed under the direct supervision of PUC Distribution Staff.

Once all required bacteriological sample results have passed, PUC has issued a Letter of Acceptance, the connection to the existing watermain shall be performed.

A sump, minimum 300 mm depth, shall be excavated in the trench bottom, and filled with clear stone, to provide a location to collect and pump water.

Watermains shall be cut back to remove any temporary taps. The Contractor shall disinfect the connection watermain pipe as outlined below and shall, using all means possible, dewater the watermains and trench in a controlled manner as to not allow backflow of water into the watermains.

If trench water, dirt or debris has entered the watermain during the final connection, the watermain shall be aggressively flushed and additional bacteriological samples may be taken as directed by the Inspector and/or PUC Distribution Staff, at the Contractor's expense.

The Contractor will not be permitted to connect to the existing watermain if the final connection is greater than one pipe length or 6 metres.

Connections greater than 6m in length require PUC approval. If a need is demonstrated and approved by the PUC, connections greater than 6m in length are to be performed as per MECP Watermain Disinfection Procedure Section 1.1.4.2.

When the connection length is one pipe length or less, the new pipe, fittings and valves required for the connection shall be swabbed and/or sprayed with a minimum 1% to maximum 5% solution of NSF certified chlorine, as per MECP guidelines, immediately prior to being installed. In addition, the existing watermain being connected to shall be cleaned, in the immediate area of the connection, and spray disinfected with the same solution.

All temporary caps (if required) shall be kept in place during the installation procedure until immediately prior to making the connection.

The existing watermain in the immediate area of the connection, as well as the newly required fittings and valves, shall be cleaned and spray-disinfected with a minimum 1% to a maximum 5% solution of NSF certified chlorine immediately prior to connection.

When the connection of the new watermain is being made to an existing ferrous watermain, a 14.5 kg magnesium anode shall be installed on the ferrous watermain within 1.5 m of the point of connection to the new watermain and a tracer wire connection shall be cad-welded to the existing ferrous watermain. Solid sleeve type couplings shall be used to assemble the final connection and shall be prevented from moving along the pipe by installation of mechanical restrainers of each side of the solid sleeve.

All connections are to include the required fittings, couplings, and material to connect to existing watermain. The Contractor is responsible for the costs of all required material to complete the connection and shall be paid under the contract item.

All open ends of sections of existing watermains that are to be abandoned in place after the connection is made shall be plugged and filled with grout as per City of Peterborough specification CP510.12.

2.4.20 Connection to New Water Services 100mm and Greater

As per MECP Watermain Disinfection Procedure, water services 100mm and greater shall be considered as watermains. Therefore, all requirements of Section 2.4.19 "Connection to Existing Watermain" apply to the Public and Private portions of new service connections 100mm and greater. PUC allows the exemption of Section 3.6 "Final Swabbing" and Section 3.7 "Hydrostatic Testing" on the private portion of water services; however, developers are responsible for meeting all requirements of building code and building permit.

2.4.21 Locate Works for Tie-Ins

The Contractor shall be responsible, as part of the cost of the excavation and installation of the various works, to locate and uncover all existing utilities including existing watermains that they are to tie into, sufficiently in advance of the actual tie-in so that the alignment or grade of the new pipe being laid can be altered if necessary, or other arrangements made, to accommodate the existing in place piping.

2.4.22 Customer Notification of Water Interruptions

All customers supplied by mains to be shut down shall be notified by the Contractor prior to the interruption of the water supply. Where the Contractor is allowed to have the water turned off in existing mains to make connections, they shall notify the Fire

Department and the customers in the affected area at least forty-eight (48) hours in advance of the water interruption and indicate the anticipated duration of the shut-off. The Contractor is responsible for all associated costs. The operation of the existing valves to shut off and/or charge watermains shall be carried out by PUC Water Department personnel.

2.4.23 Leakage from Existing Mains

The Contractor shall not hold PUC liable for leakage from existing mains or services. Where a leak is found on existing watermain infrastructure, PUC shall take appropriate action to limit the disruption to the contract.

2.4.24 Chlorination Lines

The Contractor shall provide the necessary chlorination lines to perform chlorination works conformance with PUC and MECP requirements. The Contractor shall remove the mainstop and plug the pipe orifice with a brass plug once the bacteriological results meet specification and there is no further need for the line. The Contractor is responsible for all associated costs.

2.4.25 Short Duration Water Shutdowns

Short duration water shutdowns, where proper notice has been given, and authorized by PUC, are acceptable where there are no major objections from the affected parties. Short duration water shutdown shall not extend beyond a ten (10) hour period.

2.4.26 Temporary Bleeder Lines

Where temporary dead-ends are created on existing watermains due to valve closures or otherwise, the Contractor shall excavate and install a temporary 20 mm bleeder line as directed by the Inspector or Contract Administrator to maintain water quality. The Contractor is responsible for all associated costs.

2.4.27 Bacteriological Sampling Line

The Contractor shall provide necessary bacteriological sampling lines as specified in PUC Section 3.0 "Quality Assurance and Testing". The Contractor shall remove the mainstop and plug the pipe orifice once the bacteriological results meet specification and there is no further need for the line. The Contractor is responsible for all associated costs.

2.4.28 20 mm Chlorination / By-pass Test Point

The Contractor shall supply and install chlorination/by-pass test points complete with a reduced pressure zone (RPZ) double check backflow preventer at all tie-in locations or as directed by the Engineer. The work shall include all excavation bedding, pipe laying, backfilling, compaction, installation of materials necessary for a

complete installation. The by-pass arrangement shall be installed in accordance with PUC Standard Drawing A3085 or A3121. During freezing conditions, the by-pass shall be properly protected and insulated. The use of double curb stops may be required at the discretion of the Engineer. Once the bacteriological results meet specification, the by-pass shall be removed, and the pipe orifice plugged. The Contractor shall provide the Engineer with certification of testing of the back flow preventers prior to commissioning this by-pass arrangement. The Contractor is responsible for all associated costs.

2.4.29 Water Quality Sampling Station

The Contractor shall install water sampling stations as indicated on the drawings or as directed by the Engineer. The work shall include all excavation, bedding, pipe laying, backfilling, compacting and installation of materials necessary for a complete installation. Sampling stations shall be a water quality sample station as per PUC Approved Manufacturer's products List. Contact PUC Engineering department for details. All watermain taps shall be as per Section 2.3.19. Payment shall be made under the contract item.

2.4.30 Insulation

The Contractor shall supply and install insulation on all watermain at tie in locations with less than 1.8 m of cover. The work shall include all excavation, bedding, high density rigid polyurethane foam half shell insulation complete with an outer urethane skin, backfilling, compaction and installation of materials necessary for a complete installation. The insulation shall be installed in accordance with PUC Standard Drawing A3006 or A3111 (requires PUC approval). Payment shall be made under the contract item.

2.5 CATHODIC PROTECTION OF WATERMAINS

OPSS.MUNI 442 (latest version) shall apply, except as amended Herein.

2.5.1 PUC Drawings

available at: www.peterboroughutilities.ca/en/services/construction-standards.aspx

- a) A2732 – Cathodic Protection / Bonding Cable / Tracer Wire for Non-Metallic Watermains:
- b) A2733 – Cathodic Protection for Valves & Fittings on Non-Metallic Pipe

2.5.2 *Payment*

The Contractor shall include all costs associated with the supply and installation of anodes and other cathodic protection devices under the relevant associated contract item. Extra payment for cathodic protection will not be considered by the PUC.

PUC 3.0 QUALITY ASSURANCE AND TESTING

3.1 COMMISSIONING PLAN

Pressure testing, chlorination, and bacteriological sampling as well as continuity testing of tracer wire shall be completed by an MECP Licensed Contractor and witnessed by the PUC Inspector. All flushing and disinfecting operations shall be in accordance with the MECP Watermain Disinfection Procedure, except as amended here within. A minimum of one (1) week in advance of starting these processes, the Contractor shall submit to the Inspector for review prior to submitting to PUC for approval a plan detailing:

- Temporary by-pass connections including a backflow preventor
- Source water location
- Swabbing locations and routing (within R.O.W only)
- Hydrostatic testing plan, leakage calculations as per OPSS 441.07 (within R.O.W. only)
- Chlorination and bacteriological sample locations with unique identifier
- Plan for disposal of super chlorinated solution
- Connection locations. Note all connections are to be less than 6m total length, to be overseen by certified operator
- Final connection methods (as per MECP Watermain Disinfection Procedure Section 1.1.4)
- Pipe sizes and total quantities
- A drawing depicting all required information

3.2 CONNECTIONS TO EXISTING ACTIVATED WATERMAINS

PUC Water Department MECP licensed operators shall, unless otherwise agreed to in writing, carry out the tapping of all existing watermains at the expense of the Contractor. This includes the actual tapping of the tapping sleeves and valves and the tapping for additional water services or watermains in active service. The Contractor will, however, be required to provide the materials and to excavate, backfill, compact, etc., and carry out all other work required in connection with the installation, except for the actual operation of the tapping machine itself (i.e. the Contractor is to clean and prepare the pipe and put the tapping sleeve and valve in place, ready for tapping). The tapping shall be carried out at the Contractor's expense for private developments.

The Contractor shall make arrangements for the tapping with the Water Department Superintendent at least seventy-two (72) hours in advance of the time they propose to carry out the tapping of the watermain.

3.3 WATERMAIN VALVE OPERATION

Once the new water system has been installed, pressure tested, disinfected, flushed, passed bacteriological testing and put into active service, the Contractor **shall not operate** existing or newly activated watermain valves, hydrants and services.

If the Contractor requires a valve shut-off or turned on, which will affect the status of the watermains or hydrants that are charged, they shall request the PUC Water Department personnel to operate the water system. The Contractor shall make arrangements forty-eight (48) hours in advance of the pre-planned work with the PUC Water Department personnel. In the case of emergencies, the nature and extent of the emergency will govern the notification to customers. In all cases, the customers should be informed of the situation and given some information as to when they can expect service to be restored. At present, there is no charge by the PUC Water Department for this service during regular working hours, but PUC summer hour schedule may affect the availability of licensed operators.

3.4 USE OF WATER AND HYDRANTS

Treated water for construction purposes shall be furnished under the provisions of this clause from the nearest appropriate hydrant. Water required for cleaning, testing, and chlorination purposes may be obtained free of charge from the Commission waterworks system. All water used shall be drawn only at times and in a manner approved by the Engineer.

Contractors will be allowed to obtain water from the fire hydrants provided they supply themselves with a reducer, a control valve, and an approved and tested reduced pressure zone backflow prevention device, which must be operated for this purpose. The valves must be maintained in perfect working order the whole time the work is under construction. If at any time during the construction of the work the Engineer finds that the control valves are out of order and cannot be operated so as to turn on and off, they must immediately close the hydrant valve, and keep it closed until the control valves have been repaired or a new valve in good order substituted.

A PUC Water Department licensed operator shall open the main valve of the hydrant in the morning and close it at night, removing the reducer from the hydrant at the same time. **At no time** shall the Contractor or their employees be allowed to open and shut the hydrant valve. Any infringement of this rule shall render the Contractor liable to charges being laid to the full extent of the law, as well as potential actions by the Ministry of the Environment.

Where the Contractor desires to use water from a Commission hydrant, they must first obtain a written permit from the Engineer.

3.5 INITIAL SWABBING AND DISINFECTION

When the water pipe is installed, it shall be as free as possible of all foreign matter. The interior of the pipe shall be cleaned and swabbed with bactericidal solution, approved by the Engineer, immediately prior to laying. A 0.1% chlorine solution (1000 mg/L) shall be used for swabbing the pipe.

Swabbing shall be carried out using a suitable foam swab at least 300 mm long and at least 50 mm larger in diameter than the diameter of the watermain. Care shall be taken to keep the swab free of exterior contamination by providing a proper support arrangement while the swab is not in use. The Contractor is responsible for all associated costs.

3.6 FINAL SWABBING

The entire pipeline shall be swabbed after installation, filling and water service tapping, in accordance with the latest revision of AWWA C651. The Contractor shall determine the swabbing protocol prior to pipe construction and it shall be approved by the Engineer. The swabs shall be loaded upon completion of the main. Where the distance is greater than 300m, multiple swabs shall be loaded into the main. The foam swabs shall have a density between 1.33 and 1.44 lbs/ft³ and be sized at least 50 mm (2") greater than the inside diameter of the largest sized pipe being cleaned. The swabs shall be passed through the entire length of the completed pipeline as well as a minimum of one swab passed through each hydrant lead, with a potable water feed, at a rate not exceeding 0.5 metres per second (1.5 ft/s). The Contractor is responsible for all associated costs.

3.7 HYDROSTATIC TESTING

3.7.1 Pressure Test

After the pipe has been laid and backfilled and all services, hydrants, blow-offs, have been installed, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1034 kPa (150 psi) pressure at the point of testing. New watermains shall be pressure tested in sections of approximately 300 metres and between appropriately located valves and hydrants. Testing of any length greater than 300 metres is subject to PUC's approval.

Pressure tests shall:

1. Not be less than 1034 kPa (150 psi).
2. Not exceed pipe or thrust restraints design pressures.
3. Be of at least two (2) hour duration.

Where any section of pipe is provided with concrete anchorage, the hydrostatic pressure tests shall not be made until at least five (5) days have elapsed after the

concrete was installed. If high-early-strength cement is used in the concrete, the hydrostatic tests shall not be made until at least two (2) days have elapsed.

The Contractor shall test the new watermain, in isolation from any existing mains and shall supply the filling supply hose and an approved and tested 50mm backflow prevention device for use from a hydrant water supply point.

Each section of pipe shall be slowly filled with water, allowing the air to escape. After the pipe has been filled with water at normal system pressure, it shall be left at normal system pressure for a period of at least twenty-four (24) hours prior to carrying out of the pressure and leakage tests. The specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The testing equipment comprised of the pump, storage tank, pressure gauge, relief valve, check valve and pipe connection and all necessary apparatus shall be furnished by the Contractor, who shall carry out the tests at their expense. The Engineer reserves the right to check the Contractor's pressure gauge against a suitable test gauge.

The Contractor shall provide and install the necessary piping to connect to the main.

Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks so that the air can be expelled as the line is filled with water. After the air has been expelled, the corporation cocks shall be closed and the test pressure applied.

The water supplied for these tests shall be potable water and all containers used to handle it must be clean and sterilized before use.

During the pressure test, the surface of the watermain trenches shall be checked for visible leaks and any obvious leaks should be fixed before the leakage test is made.

Any cracked or defective pipe, fittings, valves, or hydrants discovered in consequence of this pressure shall be removed and replaced by the Contractor with sound material and the test shall be repeated until satisfactory to the Engineer. The Contractor is responsible for all associated costs of the pressure test.

3.7.2 Leakage Test

After the pipe has been laid and backfilled and all services, hydrants, blow-offs, etc., have been installed, all newly laid pipe or valved sections thereof, shall be leakage tested in sections of approximately 300 meters between appropriately located valves and hydrants. If the Contractor wishes to test larger sections, they will require PUC approval. The system to be tested will be allowed a maximum allowable leakage equal to that of 300m despite additional length.

The Contractor shall provide the engineer with allowable leakage calculations, notify the Engineer at least forty-eight (48) hours prior to the execution of the leakage tests. Testing shall be carried out during the PUC's regular working hours.

The leakage test may be conducted with the pressure test or after the pressure test has been satisfactorily completed.

The leakage test shall be applied for a minimum period of two (2) hours and during the test, the pipe shall be subjected to a test pressure of 1034 kPa (150 psi).

Leakage shall be defined as the quantity of water measured in litres that must be supplied into the newly laid pipe to maintain 1034 (150 psi) test pressure within 35 kPa (5 psi) after the air in the pipeline has been expelled and the pipe has been filled with water. The allowable leakage is as per OPSS MUNI 441 defined by the formula:

The allowable leakage is 0.082 litres per millimetre of pipe diameter per kilometre of pipe for the 2-hour test period.

For High Density Polyethylene (HDPE) pipe the test section is not to include any other materials. A three to four (3-4) hour deformation period, maintaining 150psi, will be required immediately prior to the hydrostatic testing.

During the leakage test, the amount of water pumped into the main shall be measured by the reduction in volume in the storage tank or by a water meter. Readings shall be taken by the Engineer at 30-minute intervals over a period of two (2) hours.

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0014 L/mm/hr (0.0078 gal/hr/in) of nominal valve size shall be allowed. No allowable leakage shall be allowed for closed resilient seated gate valves.

When hydrants are in the test section, the test shall be made against the closed hydrant. Acceptance shall be determined on the basis of allowable leakage.

If the actual leakage for the 2-hour period exceeds calculated allowable leakage, the Contractor shall, at their own expense, locate and repair the defective joints, retest, etc., until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage. The Contractor is responsible for all costs associated with the leakage test.

3.8 FLUSHING AND DISINFECTION OF NEW WATERMAINS

When the Contractor has completed the installation of the watermains and has carried out satisfactorily, the specified pressure and leakage tests thereon, the Contractor shall thoroughly flush and disinfect the system in sections of

approximately 500 metres and between the valves or plugs in a manner approved by the Engineer, at their own expense, as follows:

3.8.1 Initial Flushing

The main shall be thoroughly flushed prior to disinfection at a flushing velocity of not less than 0.75 m/s (2.5 ft/s). The rate of flow required to produce this velocity in various diameters of watermain is shown on the following table:

REQUIRED OPENINGS TO FLUSH PIPELINES (275 KPA – (40 PSI) RESIDUAL PRESSURE					
Pipe Size (mm)	Flow Required to Produce 0.75 m/s (2.5 fps) Velocity Litres/Second	Cubic Metres/ Minute	Orifice Size (mm)	Hydrant Outlet Nozzles	
				Number	Size (mm)
100 (4")	7 (100 USGPM)	0.38	24 (15/16")	1	62.5 (2 1/2")
150 (6")	14 (220 USGPM)	0.83	35 (1 3/8")	1	62.5 (2 1/2")
200 (8")	25 (390 USGPM)	1.48	48 (1 7/8")	1	62.5 (2 1/2")
250 (10")	39 (610 USGPM)	2.31	59 (2 2/16")	1	62.5 (2 1/2")
300 (12")	56 (880 USGPM)	3.33	71 (2 13/16")	1	62.5 (2 1/2")
350 (14")	76 (1200 USGPM)	4.54	83 (3 1/4")	2	62.5 (2 1/2")
400 (16")	99 (1565 USGPM)	5.92	92 (3 5/8")	2	62.5 (2 1/2")
600 (24")	222 (3515 USGPM)	13.30	141 (5 5/8")	1	62.5 (2 1/2")
				1	100.0 (4")

The flushing shall be carried out in accordance with a procedure approved by or as stipulated by the Engineer. At the discretion of the Engineer, the flushing may be permitted or required to be carried out in stages as parts of the system are completed.

Disposal of flushing water shall be such as to cause the least disruption to the area surrounding the point of flushing. Suitable hose for appropriate discharge of water flushed from the hydrant shall be provided by the Contractor.

When the required initial flushing has been completed satisfactorily, the Contractor's subcontractor may proceed with chlorination of the system. The Contractor is responsible for all costs associated with flushing of the new main.

3.8.2 Chlorination

New watermain pipe shall be disinfected by the continuous feed method in accordance with the latest revision of AWWA Standard C651, Disinfecting Watermains and any MECP watermain disinfection procedures in effect.

The Contractor shall give the Engineer at least two (2) working days' notice of the date when they intend to commence the chlorination of the watermain and submit a plan showing all proposed sample locations.

The Contractor shall arrange for water from the existing system to flow at a measured rate into the newly laid pipeline. The Contractor shall then introduce chlorine at a measured rate. The two rates shall be proportioned so that the chlorine concentration in the water throughout the length of this pipe is maintained at not less than 25 mg/L and not more than 200 mg/L. The chlorine solution to be used shall be a concentrated solution of known strength. Powdered chlorine shall not be used. All surfaces shall be in contact for a period of at least 24 hours. Following the 24-hour period, the allowable chlorine drop shall be no more than 40% of the initial concentration to a maximum reduction of 50mg/L.

WATERMAIN DISINFECTION CONCENTRATION AND CONTACT DURATION FOR NEW, LINED WATERMAINS AND TEMPORARY WATERMAINS		
Contact Duration (hours)	Initial Disinfectant Concentration Range (ppm)	Maximum Allowable Decrease in Chlorine Concentration
24	25-200 ppm	40% of initial concentration to a maximum reduction of 50 mg/L

Failure to introduce and maintain a concentration within the limits stated above will require the watermain to be flushed and re-chlorinated.

The duration of the disinfection as well as the initial doses and remaining residual at the end of the contact time are to be recorded.

The taking of bacteriological samples and testing for chlorine residual shall be observed by the PUC Inspector.

At all locations where water is required to feed the newly installed watermain from the existing water distribution system, a chlorination and bacteriological test point by-pass shall be installed in accordance with PUC Standard Drawing A3085 or A3121.

All materials, equipment and labour shall be supplied by the Contractor at their expense, except the supply of water from an existing hydrant required to carry out the commissioning of the watermain.

a) Disposal of Super-Chlorinated Water

Flushing shall be carried out by discharging the super-chlorinated water to a suitable sanitary sewer.

The Contractor shall provide for the safe disposal of all super-chlorinated water used for testing, flushing, or disinfection. The Contractor shall note that if approval is given to discharge to a watercourse or storm system, the chlorine residual shall be 0 mg/l.

Methods employed for disposal of all super-chlorinated water shall be approved by the Engineer.

Permission to discharge to the sanitary sewer must be obtained from the City of Peterborough Environmental Protection Division. The capacity of the sewer must be checked with the City of Peterborough Environmental Protection Division and the discharge flow rate kept under this value. The Contractor shall continuously monitor discharge into the sewers for surcharging or operational problems. The supply of all de-chlorination agents shall be the responsibility of the Contractor.

The Contractor shall be responsible for satisfactory disposal of all water used in flushing, including problems associated with sewer system or premises connected to the sewers. Flushing shall be continued until the water tests at no more than 1.5 mg/L total chlorine residual and the turbidity does not exceed 1.0 NTU in the newly installed watermain.

3.8.3 Bacteriological Sampling and Testing

Following flushing, bacteriological sampling shall be carried out in accordance with a procedure as approved by the Engineer. A copy of the Standard Operating Procedure may be obtained from PUC.

The watermain shall not be considered disinfected nor be put into service until three (3) successive tests meeting the bacteriological requirements of the Ontario Drinking Water Standards, Objectives and Guidelines and the section titled "Water Quality Parameters" on the following page have been obtained. All bacteriological samples shall be tested by a CAEAL accredited testing agency.

The Contractor is responsible for contacting the PUC Water Department a minimum of twenty-four (24) hours prior to when staff are required to operate a water supply valve, and/ or witness the taking of samples for testing and for lab analysis. At present, there is no charge for this service during PUC's normal working hours. Appropriate charges may apply for valve operation after normal working hours.

(Please note the PUC Water Department may be on summer hours, which may affect the availability of staff.)

The Contractor or Consultant responsibilities during the bacteriological sampling process vary on different project types. Reference the table below for detail, contact PUC Water Department if further clarification is required.

Project Type, S.O.P No.	Bottles Provided and Labelled by	PUC Provided Chain of Custody Completed by	Samples to be Acquired and Labelled by	Samples to be Delivered to Laboratory by
Capital Project SOP-09-002	PUC Inspector	PUC Inspector	PUC Inspector	PUC Inspector
New Subdivision SOP-09-013	MECP Licensed Contractor	MECP Licensed Contractor	MECP Licensed Contractor	PUC Inspector or Licensed Operator
Private Side - Large Diameter Service SOP-09-200	MECP Licensed Contractor	MECP Licensed Contractor	MECP Licensed Contractor	PUC Inspector or Licensed Operator
Public Side - Large Diameter Service (over 6m) SOP-09-200	PUC Inspector or Licensed Operator	PUC Inspector or Licensed Operator	PUC Inspector or Licensed Operator	PUC Inspector or Licensed Operator

3.8.4 Sampling Bottles

Sterile bacteriological bottles can be obtained from the City of Peterborough CAEAL accredited, Environmental Protection Division laboratory at no charge and shall contain sodium thiosulfate in them, so as to neutralize the chlorine in the water sample. These bottles shall not be rinsed out. All sample bottles shall have a white adhesive Avery label indicating specific site of sample, date and sample number which corresponds to the information on the Chain of Custody form.

3.8.5 Sampling Locations

The locations for sampling points shall be provided by the Contractor and be such as to provide a sample point at the first available approved outlet within a maximum of 50m, one (1) additional test location for each additional 300 metre section of new watermain, and a test location on each dead ends longer than 6m. A minimum of one (1) test location for watermains less than 200 metres in total length, two (2) test locations for watermains between 200 metres and 400 metres in total length are required.

All bacteriological test locations shall be either copper or poly chlorination lines extending from the end of the water service or a specially tapped bacteriological test station on the hydrant branch. The bacteriological test line shall be a minimum of 1200 mm above the existing ground so as to ensure the end of the line does not

become contaminated. Hydrant ports are not acceptable locations for bacteriological sampling due to the existence of unplugged drain holes and the potential for bacteriological contamination.

On the existing source watermain a chlorination/by-pass test point, as per PUC Standard Drawing A3085 or A3121 shall be installed to facilitate the sampling of the existing water system's free chlorine and turbidity levels to ensure that the water quality conditions throughout the new watermain are consistent with the system water upstream of the new watermain for Day 1 of testing.

3.8.6 Water Quality Parameters

Any samples that are not witnessed by the PUC inspector shall be rejected and re-sampling shall be completed.

Three (3) consecutive sample sets at each of the designated sampling locations, shall be taken at least twenty-four (24) hours apart (one at time of flushing and one (1) every 24 hours for two (2) days after the flushing - 0, 24, 48 hours).

All bacteriological samples taken require free chlorine residual to be documented. Sample sets taken on Day 1 **only** shall include turbidity test samples. The same sampling locations are to be used for all three (3) sets of tests. A two-day sampling procedure is acceptable for the installation of temporary by-pass watermain.

The chlorine and turbidity samples must meet the following conditions, prior to the start of bacteriological testing:

- a) Free chlorine must be greater than 0.20 mg/l
- b) Free chlorine must NOT exceed 2.0 mg/l and be deemed to be consistent with system water upstream of the new watermain.
- c) Turbidity objective is less than or equal to 1.0 NTU. Any permitted exceedance must be approved by PUC's Water Utility Engineer.

Any samples that do not meet these standards shall be rejected and re-sampling shall be completed at the Contractor's expense.

All bacteriological samples must meet the Ontario Drinking Water Quality Standards (Amended O. Reg. 169/03) as follows:

- a) Total Coliform must be 'Not Detectable',
- b) E-coli must be 'Not Detectable',

Furthermore, general background bacteriological samples must meet the following limits:

- a) Heterotrophic Plate Count (HPC) must be < 500 CFU/1mL
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Any samples that do not meet these standards shall require the watermain system to be flushed, re-chlorinated and re-sampled and shall be completed at the Contractor's expense.

The bacteriological results shall be sent from the CAEAL approved testing laboratory to the Engineer for review and acceptance prior to activating the water distribution system. The Engineer will issue a letter, which will acknowledge the receipt of water quality test results and whether the watermain installation has met the requirements of Ontario Drinking Water Standards (ODWS).

After the water quality results have been deemed acceptable by the PUC, the Contractor shall remove all test lines within three (3) working days after the receipt of the acceptance letter. All new system valves and hydrants shall be verified for proper operation by the Contractor and witnessed by PUC prior to activating the system. The system will then be final flushed by the Contractor under the supervision of PUC Water Works personnel and put into service.

The flushing shall be carried out in accordance with a procedure approved by or as stipulated by the Engineer. At the discretion of the Engineer, the flushing may be permitted or required to be carried out in stages as parts of the system are completed.

Disposal of flushing water shall be such as to cause the least disruption to the area surrounding the point of flushing. Suitable hose and hydrant control valve for appropriate discharge of water flushed from the hydrant shall be provided by the Contractor. The Contractor is responsible for all costs associated with the Disinfection of New Watermain.

3.8.7 Flushing and Re-Disinfecting Tested Watermains

Where new watermains, after installation and initial successful testing, incurs little or no water usage, and water quality testing indicates that the water is not meeting current Ontario Drinking Water Standards; the Engineer may require the Contractor to flush and re-disinfect the watermains at their expense. As well, the Contractor would be required to provide potable water to all customers in the affected area at their expense.

The Contractor shall flush the new watermains in a satisfactory manner and the Contractor will be responsible for satisfactory disposal of all water used in flushing.

PUC 4.0 CONSTRUCTION (CIPP AND CML)

4.1 General

4.1.1 Labour, Equipment and Materials

The Contractor shall, unless specified otherwise, furnish all materials, equipment, tools, and labour, necessary to do the work required under this specification and unload, haul, and distribute all pipe, castings, fittings, valves, valve boxes, hydrants, and accessories, etc.

All construction practices, materials and commissioning identified in PUC Section 4.0 "Construction (CIPP and CML) to conform to PUC Sections 1.0 "General", Section 2.0 "Construction" and Section 3.0 "Quality Assurance and Testing" where applicable.

4.1.2 Operation of Valves

The operation of all valves in connection with cleaning and lining watermains shall be done by PUC Water Department personnel or an MECP certified operator authorized by the PUC to operate valves. Contractor shall control and verify watermain depressurization, submit request for watermain isolation as per PUC Section 1.0 "General".

4.1.3 Cutting of Pipe

Pipes shall be cut by power operated pipe cutting machines, or other approved method, creating an unfractured cut, substantially perpendicular to the pipes' axis. No additional payment shall be made for this work.

4.1.4 Anodes

Anodes shall be placed at all locations where any existing watermain is exposed and at the specified locations for new watermain construction. A minimum one (1) 14.5 kg. magnesium anode shall be installed at each entry point to the existing metallic watermain. One (1) 5.4kg zinc anode shall be placed on each iron fitting, valve where non-metallic pipe is used. Hydrants require one (1) 10.9kg zinc anode. All anodes and material required for a complete installation shall be supplied by the Contractor. Work shall be done as per PUC Section 2.5 "Cathodic Protection of Watermains".

4.1.5 Repair of Pipe and Valves

Not less than twenty-four (24) hours after the placement of the lining, the openings in the watermain shall be closed up using new pipe and approved couplings. New pipe, fittings, bends, valves, and valve boxes shall be as per PUC Section 2.0 "Construction".

4.1.6 Valves and Appurtenances

Any valves, corporation cocks or other appurtenances which have been damaged due to the cleaning and lining operation shall be replaced at the Contractor's expense. No additional payment shall be made for this work.

4.1.7 Protection of Lining

Should the lining be damaged as a result of negligence of the Contractor or reveal evidence of defective work or materials prior to the completion of the Contract, such damaged or defective portions shall be removed and replaced at the Contractor's expense.

4.1.8 Return of Main to Service

After all tests have been approved and the PUC Engineer has issued a Letter of Acceptance the watermain shall be flushed out, final connections performed as per PUC Section 3.0 "Quality Assurance and Testing", service connections restored, excavations backfilled, the main returned to service and the temporary service lines removed.

4.2 UNIT PRICE STANDARD SPECIFICATIONS

4.2.1 Traffic Control

CP 200.0 shall apply except as amended and extended herein.

The lump sum price for this item shall be full compensation for the supply of all labour, equipment, and materials necessary to meet the traffic management restrictions and requirements set forth in the Contract and in accordance with Sections 27, 28, 29 & 30 of the City of Peterborough Supplemental General Conditions.

The Contractor shall ensure that the condition and use of the road allowance is not impaired by cutting, excavation or restoration within such road allowances. All debris and stockpiled material produced by or required for the performance of the Work and equipment required in the performance of the Work shall be placed by the Contractor in a location approved by the Engineer or his Designate that will not interfere with or obstruct pedestrian or vehicular traffic.

4.2.2 Environmental Considerations

CP 805.01 shall apply except as amended and extended herein.

The unit price bid identified in the schedule of unit prices shall be full compensation for all labor, equipment and materials required to develop, implement, and maintain the sediment and erosion control program to the satisfaction of the Contract Administrator and any other governing agency, including the scheduling and carrying out of construction operations in accordance with the requirements.

4.2.3 Mobilization and Demobilization

The Contract price shall include all costs related to moving onto the site, setting up of work trailers and removing all construction related items/materials once the contract has been completed. Also included are all restoration costs associated with any staging and/or construction laydown area. The lump sum price shall cover other costs incidental to the contract for which there is not a specific item, including but not limited to items detailed below:

- a) Maintaining and updating project schedule;
 - b) Site preparation for work;
 - c) Costs of all necessary approvals and permits as applicable;
 - d) Cost of constructing a laydown area in a location acceptable to Contract Administrator;
 - e) All costs associated with utility locates protection or temporary relocation and reinstallation of utilities, as applicable and not specified in other areas of the contract;
 - f) Installation and removal of temporary barricades, hoarding, snow fencing and other protection required;
 - g) Protection of trees not designated for removals;
 - h) Layout of work;
 - i) Cost of supplying and maintenance of adequate sanitary facilities;
 - j) Costs associated with submission of shop drawings, product submissions and all other submissions;
 - k) Maintaining and reinstatement of existing road signs, mailboxes, etc.;
 - l) Maintaining the site in a clean and orderly manner;
 - m) Cost of advertising of Substantial Completion in the Daily Commercial News;
 - n) Cost of reinstating to original conditions the Contractor's lay down area;
 - o) All costs of any incidental work not specifically mentioned in the Contract Documents but required by virtue of the work;
 - p) All costs associated with environmental protection measures except as specifically mentioned for other Items of work; and
 - q) Careful removal and reinstallation of Highway Signs and commercial and information signs within limits of roadway reconstruction. This work needs to
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be coordinated with Contractor's own traffic management plan. Following completion of work all existing signs need to be reinstalled in new locations as necessary for compliance with OTM and Traffic Highway Act.

4.2.4 Legal and Insurance

The Contract price shall include all costs associated with obtaining the required Insurance, Bonding, and all other legal requirements as per the General Provisions.

4.2.5 Removal of Excess Soils

Requirements of O. Reg. 406/19 and OPSS. MUNI 180, November 2021 shall apply except as amended and extended herein.

The lump sum price of this item is to be full compensation for the supply of all labour equipment, materials, and documentation necessary for the disposal of all surplus/unsuitable materials. The Contractor will be responsible for monitoring the amount of excess soil as defined as defined under O. Reg 406/19 that leaves the site and providing records to the PUC. All removal of soils meeting Table 2.1: Full Depth Excess Soil Quality Standards in a Potable Ground Water Situation Standards under O.Reg. 406/19, as well as all Salt-Impacted Excess Soil, are to be covered under the provisions of this lump sum item.

The unit price identified shall include compensation for obtaining an appropriate reuse site, submitting to the Contract Administrator a Form OPSS 180-1 signed by Property Owner within two (2) weeks of the contract award date as well as submitting a form OPSS 180-3 immediately after excavation is completed. Also included in the unit price is the supply of all equipment labour and materials necessary for transporting excavated material, disposal of all surplus and/or unsuitable material, as well as any stockpiling and/or double handling of excavated material to be used as backfill.

Any sampling of excavated materials required to satisfy the Reuse Site Property Owner will be solely borne by the Contractor. The Contractor shall not be entitled to claims associated with testing regime changes (i.e.: more or less frequent sampling/testing, sampling/testing methods, etc.) increased costs, or delays.

The Contract Administrator will conduct Quality Assurance sampling and testing only if unsuitable soils are encountered. When waiting for sampling results, the Contractor will be responsible for stockpiling of the material in a safe manner on the project site/area or in a location of their choice.

Excess Soil Hauling:

The tracking system is to be developed by the Contractor and approved by the Contract Administrator prior to removing any excess soil from the project area.

Hauling records must be submitted to the Contractor Administrator by the Contractor prior to Final Completion. Any digital hauling records should be made available to the Contract Administrator upon request. Hauling records are to be submitted to the Contract Administrator by the Contractor on a regular schedule of every 2 weeks or otherwise agreed upon at the pre-construction meeting to verify the accuracy of the records. The tracking system must include procedures or other methods to verify the accuracy of the information required to be tracked in respect of each load of excess soil that is to be removed from the project area.

At a minimum, the tracking system shall provide all requirements outlined in the Excess Soil Rules document, mainly:

1. The locations of the project area where the soil was excavated and/or stockpiled and the quality of the soil associated with these locations and stockpiles
 2. The quality of the load of excess soil being removed from the project area
 3. The location of the site at which the excess soil is to be finally placed or reused
 4. The date and time the excess soil left the project area
 5. The person responsible from the project area for overseeing the loading of the excess soil
 6. The name of the entity transporting the excess soil, the name of the driver of the vehicle and the number plates of the transport vehicle
 7. The date and time the excess soil was received at the site where excess soil has been deposited
 8. The contact information of the person who acknowledged receipt of the load of excess soil on behalf of the site where excess soil was deposited
 9. Confirmation that the vehicle that deposited the excess soil and the volume of soil received at the site is the same as that which left the project area.
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4.2.6 Plumbing Required for Temporary Servicing

OPSS MUNI 100 shall apply, except where amended below.

The Contractor shall retain a licensed plumber as identified on the Commission's Approved Plumber List for all work required to connect and maintain a temporary service to all affected residents/customers for the duration of the Contract. Upon removal of the temporary service, the licensed plumber shall reinstate the interior plumbing to the satisfaction of the property owner and the PUC.

Work included, but not limited to under this item, shall be the installation of a main shutoff, outside tap or removal of the water meter. The Contractor shall be responsible for customer notification, interactions, and scheduling of required repairs. All work shall be in accordance with the Ontario Building Code – Section 7.

The Contractor is required to receive approval from the PUC prior to performing any private plumbing repairs. The work is to be completed on a Time and Material basis. Unauthorized plumbing repairs will not receive consideration for payment.

For plumbing work completed during normal working hours (8:00am to 5:00pm), the Contractor shall not claim for general supervision, administration and management time spent on the Work. For plumbing work completed outside normal working hours, the Contractor shall be entitled to claim for a foreman and vehicle equal to the hours claimed by the plumbing sub-Contractor.

Payment shall be upon receipt of monthly time and material documentation.

4.2.7 Cleaning and Lining of Watermains

The length of pipe cleaned and lined shall be measured horizontally. Materials and installation to conform to Section 6.0 "Cleaning and Cement Mortar Lining. Payment at the unit price shall be full compensation for carrying out the proposed work. Unit price payment for cleaning and lining of watermains shall include the Contractor's supply of all labour equipment, materials required for the maintenance of Traffic Access, Sawcutting, Excavation, Access Pits, Steel Plates, Backfilling/ Imported granular and Restoration Within the Municipal Right of Way (items a to I below) are to be included in the unit cost of cleaning and lining as minimum requirements:

a) Sawcutting

The edge of the surface of all excavations, except for those made in sodded areas, shall be cut by the Contractor in straight lines using a saw to leave a clean, straight edge. All such excavations shall have vertical walls only. Excavation wall support systems shall be provided by the Contractor and shall conform to requirements of the Province of Ontario's Occupational Health and Safety Act (RSO 1990, CO1, as amended) and Regulations made

hereunder. Such excavations shall not extend beyond the specified limits of the cut.

b) Access Pit/Additional Sawcutting

All care is to be taken by the Contractor to ensure that the undermining of adjacent pavement is minimized. Where such pavement is undermined by construction activities or from other causes, the Contractor shall cut such pavement and backfill and reinstate the undermined areas in accordance with these Specifications. In accordance with Regulations for Construction Projects (Ontario Regulation 218/91, as amended) bracing, shoring and/or sheeting shall be used by the Contractor to support the sides of the excavation and to prevent any movement that could damage any services, adjacent pavements, or other works. Such excavation support systems shall be removed as backfilling proceeds to eliminate voids between the fill and the adjacent soils. Loose or wet soil at the bottom of the excavation, shall be removed by the Contractor prior to bedding and service installation. The Contractor shall be solely responsible for and shall bear the costs and expenses for the appropriate restoration of all services encountered.

c) Access Pits

The Contractor is to supply all labour equipment and materials necessary for the excavation, construction, maintenance, and removal, backfilling, compaction, restoration and disposal of surplus material of all access pits. All excavated material shall be removed by the Contractor from the Place of the Work and immediately disposed of at the Contractor's expense to the satisfaction of the Engineer or his Designate. When possible, existing valve and fitting locations shall be used as access pit locations. Access pit locations shall be approved by the Contract Administrator prior to construction. When an access pit is in close proximity to a closed live watermain valve, the active thrust force of the valve shall be addressed to prevent dislocation and ensure safe working conditions.

d) Steel Plates

Access pits excavated in high traffic volume streets, or where a 3.5m wide lane cannot be maintained, or as deemed necessary by the Contract Administrator shall be covered with steel plates, having a bearing surface at least 300mm wide all around and recessed into the existing asphalt by the plate thickness, until resurfacing has been completed. The steel plates may be removed during the workday at locations where entry is required and shall be replaced at the end of the day. When plates are removed for work, proper traffic barricades shall be erected for protection of the public. Plates shall be minimum 25mm thick. Plates shall be placed such that they do not vibrate or

knock when traffic passes over them and such that they will not be moved by passing traffic.

e) Cleaning of Watermains

i) Method of Cleaning

All rust, tubercles, deposits, loose or deteriorated remains of original coating and other foreign materials, shall be removed from the inside of the pipe and valves by water-propelled cleaning devices, scrapers, or other approved methods. The Contractor shall pass the cleaning device through the main as many times as is necessary to obtain results satisfactory to the Engineer.

Sand boxes of adequate size with compartments or other suitable and approved means shall be provided to function as settling tanks for the retention of solids removed during cleaning, flushing, and pumping operations.

ii) Disposal of Cleaning Water

All water from cleaning operations shall be pumped to the nearest approved sanitary sewer. Approval to discharge to the sanitary sewer must be obtained from the City of Peterborough Environmental Protection Division. The capacity of the sewer must be checked with the City of Peterborough Environmental Protection Division and the discharge flow rate kept under this value. The Contractor shall continuously monitor discharge into the sewers for surcharging or operational problems.

The Contractor shall be responsible for satisfactory disposal of all water used in cleaning operations, including problems associated with sewer system or premises connected to the sewers. The City of Peterborough Environmental Protection Division is to be notified twenty-four (24) hours in advance of discharge of cleaning water to the sanitary system.

iii) Bulkheads on Open Pipe Ends

After the pipe has been cleaned and until it has been reconnected, the Contractor shall close all pipes using a mechanical joint plug or cap anytime there is no work being performed on the pipe. The bulkhead shall be capable of preventing water from entering or exiting the pipe and shall be equipped with a relief valve.

f) Temporary Restoration

The Contractor shall follow closely after their watermain cleaning and lining operation with cleanup and restoration work. Ten (10) calendar days after the water services have been reverted back to operate from the lined main, all

excess material shall be removed off the site and all disturbed areas shall be restored as specified, failing which the Commission shall have the required work carried out by others at the Contractor's expense.

All excavations within the right-of-way including Municipal Road, curb and sidewalk shall be temporarily restored with 50 mm cold mix. No separate or additional payment shall be made for this restoration.

Any areas requiring temporary cold mix restoration beyond those noted in this section, and determined necessary by the Engineer, shall be paid under the Provisional Items if included, or by force account if no Provisional Item exists.

The subgrade granular shall be as per current City of Peterborough specifications.

The Contractor shall temporarily reinstate cuts within the right-of-way by placing a minimum of 50 mm cold mix over the Granular 'A' compacted to the levels of the existing surface. Final restoration of all road cuts, Municipal sidewalks and curbs shall be completed by the City of Peterborough Public Works.

g) Permanent Restoration – Cuts in Sodded Boulevards

The Contractor shall permanently reinstate cuts in existing sodded boulevards as per City of Peterborough Specifications. The installation of topsoil and sod are to conform to City of Peterborough CP 802.01 and CP 803.01.

h) Permanent Restoration – Cuts in Paved Boulevards

The City of Peterborough Public Works shall permanently reinstate cuts in boulevards or driveway aprons paved with asphalt or concrete.

i) Restoration – Asphalt and Curb in the Public Right of Way

For the purpose of Watermain Lining Contracts, the following restoration works: asphalt, curb and sidewalk, are to be supplied and carried out by the City of Peterborough Public works.

j) Paving Stones

The Contractor shall remove all paving stones in the area of his excavations by hand, handling with care to avoid chipping, and shall store such lock stones in a secured acceptable location where the lock stones shall be placed neatly by the Contractor as directed by the Engineer or his designate.

The Contractor shall reinstate the stone area with compacted granular material to the level of the existing stones. The Contractor shall be solely responsible for and shall bear the costs and expenses for the maintenance of such temporary reinstatements until the date of payment. The Contractor shall permanently and completely restore all areas of disturbed stone to its original condition or better and to the satisfaction of the Engineer or his designate.

Notwithstanding the foregoing, the Contractor shall restore all disturbed areas to a condition equal to or better than the state of such areas prior to the commencement of the Work and to the satisfaction of the Engineer or his designate and the City of Peterborough.

k) Subgrade/Backfill

The Contractor shall supply all labour equipment, materials required to backfill all cuts, access pits as per PUC Standard Drawing A1769 unless otherwise specified. All granular designs and compaction are to conform to the City of Peterborough Specifications.

l) Closing of Pipe

Contractor to supply of all labour equipment and materials necessary for the closing of the watermain at all required access points not covered under a specific item.

4.2.8 Mainline Valve Installation / Removal

The unit price shall be full compensation for the supply of all labour, equipment, and materials necessary for the replacement of main line valves.

The watermain line valves shall be removed by the Contractor prior to lining. Contractor shall excavate, remove existing valve and/or concrete chamber (where specified), install new valve, valve box, and any valve box extensions required, bedding, backfilling, compacting, dewatering, disposal of excess material, cathodic protection and restoration as specified.

New valves, couplings, and other materials, to be supplied and installed by the Contractor. Work shall be done as per PUC Section 2.0 "Construction".

4.2.9 Replacement of Fittings

The unit price shall be full compensation for the supply of all labour, equipment, and materials necessary for the installation/ replacement of fittings as identified in the contract drawings. Contractor shall excavate, remove existing fitting, install new fitting, and required couplings, bedding, backfilling, compacting, dewatering, disposal

of excess material, cathodic protection and restoration as specified. All work shall be done in conformance with PUC Section 2.0 "Construction".

4.2.10 Hydrant Installation / Replacement

The unit price shall be full compensation for the supply of all labour, equipment, and materials necessary for the installation/ replacement of hydrants.

The new hydrants or hydrants identified for replacement shall be supplied and installed by the Contractor. Installation and removals shall include all material including stone and concrete, excavation, backfilling, and all labour necessary to install the hydrant, valve, valve box, branch connecting pipe, concrete thrust blocks or restrained joints from tee to hydrant. Installation to be as per PUC Standard Drawing A2729 or A2976. Lump sum price to include dewatering, backfilling, compaction, restoration, and disposal of surplus material.

All work shall be done in conformance with PUC Section 2.0 "Construction".

4.2.11 Unshrinkable Fill

The unit price shall be full compensation for the supply of all labour, equipment, and materials necessary for the supply and placement of unshrinkable fill as specified in the contract documents.

Unshrinkable fill is to be used to backfill access pits within the pavement limits of arterial Roads. Arterial Roads are to be identified in the contract documents. Contractor is required to provide watermain bedding as per PUC Construction Specifications, PUC Standard Drawing A1769. Unshrinkable fill is to be used from 300mm above the watermain to the asphalt subgrade materials. All unshrinkable backfill shall be standard 28-day with maximum strength of 0.4 MPa as per CP314.03.

4.2.12 Physical Separation, Commissioning of Watermains

The lump sum price identified in the schedule of unit pricing shall be full compensation for all labour, equipment and materials required for the provision of Physical Separation at all connection points to the active drinking water system, as well as commissioning requirements: flushing, disinfection, and bacteriological testing, sample points as per PUC Section 3.0 "Quality Assurance and Testing."

Physical Separation is to be maintained at all connection points to the active drinking water system as per the Contractor's individual approach to the project. As individual approaches may vary, PUC does not guarantee that all required physical separation locations are shown on contract drawings. Excavation, installation, supply of all necessary material as per PUC A3118, A3119, bedding, compaction, disposal of excess material, backfilling and restoration as specified. After all tests have been approved, the main shall be flushed out, service connections restored,

excavations backfilled, the main returned to service and the temporary service lines removed. Lump sum price to include dewatering, backfilling, compaction, restoration, and disposal of surplus material. All work shall be done in conformance with PUC Section 2.0 "Construction".

4.2.13 Installation and Removal of Construction Signs

Unit price payment shall include the supply of all labour equipment, materials required for the installation of watermain construction signs. The Contractor shall install and remove these signs in locations designated by the Engineer. PUC shall supply 6' (1.8 m) x 4' (1.2 m) sign. The Contractor is responsible for picking up the signs from PUC Water Distribution garage, timing to be coordinated with the PUC Inspector. The installation shall be by free standing method provided by the Contractor utilizing sandbags or excavated in place or buried method using 4" (100 mm) x 4" posts.

4.2.14 Post Lining CCTV

Payment at the unit price shall be full compensation for carrying out the proposed work. Unit price payment shall include the supply of all labour equipment, materials required for the performance of Post Lining CCTV recording of the entire length of the watermain as per PUC Section 6.4 "Quality Assurance". Re-inspection of an unacceptably lined pipe after correction shall be at no additional cost to the Owner.

4.2.15 Excavate and Remove Lead Joints

The unit price shall be full compensation for the supply of all labour, equipment, and materials necessary for the removal of lead joints as identified during the cleaning or CCTV process. Contractor shall excavate, remove existing lead joint, install new PVC watermain, and required couplings, bedding, backfilling, compacting, dewatering, disposal of excess material, cathodic protection and restoration as specified. All work shall be done in conformance with PUC Section 2.0 "Construction".

4.2.16 Additional Openings / Obstructions

The unit price shall include the supply of all labour, equipment, and materials necessary for the excavation of additional openings if required due to bends, reducers, or changes in alignment or for any other reason, including backfilling, compaction, restoration, and disposal of surplus material.

Obstructions in the watermain which prohibit the passage of cleaning and/or lining equipment shall be removed by the Contractor. Bends, valves, reducers, and any other possible obstructions shown on the drawing shall be included in the Contractor's unit price to clean and cement-mortar line the pipe. No additional payment shall be made for items shown on the drawing. Where openings are required due to obstructions not shown on the drawings the Contractor shall

excavate and cut such additional openings and shall be paid under the Provisional Items for additional openings.

The Contractor shall locate and remove obstructions, if any, in the pipeline that impedes the passage of cleaning or lining equipment or materials. Obstructions shall include, but may not be limited to:

- a) Bends, reducers, offsets or other such fittings not indicated by the drawings.
- b) Over-poured lead joints.
- c) Out-of-round or defective joints.
- d) Protruding lateral or service connections.

The presence of an obstruction shall be demonstrated to the Engineer at the site of each obstruction. Removal of such obstructions shall be authorized by the Engineer.

4.2.17 Clearing Blocked Water Services

Payment at the unit price shall be full compensation for the supply of all labour, equipment, and materials necessary to clear water services and reconnect to the watermain, where the Contractor is denied access to buildings to blow back services or where in the opinion of the Engineer, the restriction was not a result of the cleaning and lining operation. Where it is determined the blocked service is a result of the Contractor's operation, there will be no payment for "excavate to clear blocked services" and the costs of permanent restoration shall be payable by the Contractor.

4.2.18 Excavate and remove Concrete Road Base Under Asphalt

Payment at the unit price shall be full compensation for the supply of all labour, equipment, and materials necessary to excavate and remove including disposal of concrete road base encountered under asphalt.

4.2.19 Utility Poles

Work in accordance with OPSS. MUNI 491 except as amended below.

The unit price identified for this item shall include supporting and protecting utility poles and overhead utility lines as necessary during installation of underground services required by this Contract and as approved by the Contract Administrator and Utility Providers. The Contractor shall be responsible for assessing if a utility pole is required to be removed or held as part of the work to be performed. If required, the pole hold shall be in conformance with the Utility Owner's requirements. The cost and coordination of the required staffing, equipment, and approvals to remove or support a utility pole (if required) are to be covered under the appropriate unit price. The Peterborough Utilities shall not be held responsible for, including but not limited to; additional costs, timelines, delays, claims, coordination, where support of utility poles is required.

Where the Contractor, without specific direction from the Engineer, removes or replaces poles that are not considered necessary as part of the work, costs of this work shall be at the Contractor's own expense.

Failure of the Engineer to instruct the Contractor to remove or replace poles or posts in no way relieves the Contractor of the responsibility of providing adequate support for poles.

Only after other shoring and excavation methods have been exhausted will supporting and protection of utility poles be considered.

The method of support shall be approved by the Utility Provider and the Contract Administrator prior to placing any supports on any utility poles. The Contractor is responsible for determining the most suitable and safest means of supporting the utility poles and additional support of the utility poles due to any activity or inactivity by the Contractor will not be considered for additional payment. Payment shall be made under this item.

Measurement for payment – each pole supported shall be considered one unit for payment regardless of the number of days or mobilizations required to complete the work.

Basis of Payment – Payment at the Contract unit price shall be full compensation for all labour, equipment, and material to do the work.

PUC 5.0 CLEANING AND STRUCTURAL LINING (CIPP)

5.1 SCOPE OF WORK

This specification covers the requirements for cleaning and cured-in-place-pipe (CIPP) structural lining of the watermain and furnishing all labour, equipment and material for the following operations: installing a temporary by-pass line and maintaining temporary services during construction, installing temporary flushing/chlorination/test lines, traffic control, cutting the pavement, excavation, shoring, cutting the pipes, maintenance of physical separation between watermain being rehabilitated and active drinking water system, dewatering, replacement of identified valves and hydrants, cleaning the pipe, disposal of water and waste products from cleaning operations, installations, curing and protection of the lining, hand work and back flushing of hydrants, clearing of services, backfilling of excavation, permanent restoration of the municipal street, curb and gutter, municipal walks, permanent repairs to boulevards and private drives, cleanup of the site, cathodic protection as per OPSS.MUNI 442 (latest version), Section 3.0 "Quality Assurance and Testing", video inspection and reporting, pipe section sampling, disinfection and returning main to service and all other incidental work and expenses.

The requirements of OPSS.MUNI 460 (latest version) shall apply, except as amended herein.

5.2 MATERIALS

5.2.1 Cured-in-Place Structural Lining

a) Materials

The liner shall be comprised of two (2) layers of woven glass reinforced and polyester fabric, fully wetted with proprietary epoxy resin of the quality mandated by the supplier of the system. The inner polyester fabric layer shall be coated with a water-tight polyurethane layer. All materials shall be new and manufactured within four (4) months of installation. The installed liner system shall be certified approved by the National Sanitation Foundation for use in potable water systems.

The Contractor shall submit upon award of contract the manufacturer's technical data for the CIPP product containing complete information on:

1. Material composition, physical properties, and dimensions of the product to be used;
 2. Independent test data shall be provided to substantiate the CIPP material strength and modulus used in the design. Structural details of the proposed watermain liner in sufficient detail to enable confirmation
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by the Contract Administrator that the design will meet the design requirements outlined below. Include sufficient detail pertaining to the tight fit of the CIPP liner to the existing watermain that clearly indicates how the completed CIPP liner will not have any gap or annular space between the liner and the existing pipe.

3. A certified original copy complete with supporting literature from the resin manufacturer of the infrared Spectrograph of the catalyzed resin mixture proposed for the Contract.
4. Recommendations for transporting, handling and storage;
5. Repair of product damaged during installation;
6. Installation and connection details;
7. Inversion pressures; and
8. Product curing procedures listing the curing temperature and duration, including cool down time for the product.

The Contractor shall submit upon award of contract contingency plans for:

1. Improper placement of the CIPP;
2. Damage to the host pipe; and
3. CIPP's failure to achieve structural integrity.

b) Liner Design

The engineering design shall be in accordance with ASTM1216 with the following criteria:

- a) CIPP design shall assume fully deteriorated condition of the original pipe.
 - b) CIPP design shall assume no bonding to the original pipe wall.
 - c) Design life of 50 years or greater.
 - d) Safety factor of 2 on external load and internal pressure.
 - e) Groundwater depth is full soil depth, unless otherwise known.
 - f) Soil modulus of 4.8 Mpa, unless otherwise known.
 - g) Soil density of 1925 kg/m^3 , unless otherwise known.
 - h) Live load is Highway H2O of 110 Mpa.
 - i) Ovality no greater than 2 %.
 - j) Long-term flexural modulus.
 - k) Tube not to be stretched greater than 5% during installation.
 - l) Liner flexural modulus of 1,724 Mpa according to ASTM D790.
 - m) Liner flexural strength 31 Mpa according to ASTM D790.
 - n) Liner tensile strength 21 Mpa according to ASTM D638.
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- o) Liner 50-year creep reduction of 50%+ according to ASTM D2990.
- p) The finished liner shall be fully resistant to all chemicals and agents found in a municipal drinking water supply.
- q) The liner shall be NSF/ANSI 61 compliant, as shall any product in contact with the water supply.
- r) The tube shall be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit.
- s) The tube shall be marked at regular intervals not to exceed 1.5 m along its entire length, identifying the manufacturer's name or identifying symbol.
- t) The liner shall be capable of remote reinstatement of service connections (up to and including 50mm diameter services) from within the interior of the watermain and no further work shall be required to seal or otherwise connect the service connections for the liner to function for its design life.

The thickness of the liner shall be capable of providing full, unsupported structural capacity for the intended use. Calculations shall be submitted by the Contractor to the Engineer at least seven (7) days prior to installation, deriving the required liner thickness for specified watermain diameters with a maximum operating pressure of 700 kPa. Such calculations shall be performed in accordance with ASTM F1216 and ASTM F1743 and shall be stamped by a Professional Engineer, whose customary work is in design of water pipelines.

The Contractor shall verify that actual field conditions for any liner installation watermain section correspond with the liner design for that installation. The field conditions to be verified shall include deepest cover over top of the watermain and live load situation. Where the existing liner design is not appropriate for the field conditions, the Contractor shall adjust the liner design accordingly and the liner installed shall meet the requirements of the adjusted design. The adjusted liner design shall be submitted to the Contract Administrator for approval.

Where a liner design previously approved by the Contract Administrator is found needing adjustment due to determined actual field conditions, the Contractor shall advise the Contract Administrator within forty-eight (48) hours and wait for the Contract Administrator's instructions. Where the adjusted design results in a thicker liner to be installed, any additional cost involved shall be determined according to the Contract Price where applicable, and if Contract Price is not applicable, then price shall be negotiated with the Contract Administrator.

No liner shall be installed that does not meet the requirements for actual field conditions, including required liner thickness for actual field conditions.

5.3 INSTALLATION

5.3.1 Lining Thickness

The Contractor shall guarantee the minimum thickness of the lining around the entire circumference of the pipe. Lining not meeting the minimum thickness requirement, or falling outside the thickness tolerances, or otherwise not meeting these specifications shall be considered defective. Defective lining shall be removed in total from the entire pipe section if the resin has not reached its initial set. The Contractor may excavate additional test pits, at their own cost, to isolate the extent of defective lining. If the lining has reached initial set, the lining shall be repaired by the Contractor, at no additional cost, by the most practical method as determined by the Engineer.

5.3.2 Pre-lining Video and Service Corking

After completion of cleaning, the Contractor shall perform CCTV inspections of all pipes to be lined, using appropriate lighting and digitally record the inspections, which shall be submitted to the Engineer before lining will proceed. The inspection shall record the longitudinal and radial location and size of all services and laterals.

5.3.3 Corking

Prior to lining, a suitable plug of non-toxic material shall be inserted into each and every water service pipe where it enters into the main, to prevent the passage of lining resin into the water service pipe. Payment for all work to plug the existing water services prior to lining will be paid under the unit price bid for cleaning and lining.

5.3.4 Abandoned Service Taps

Service connections that have been identified by the Contract Administrator as no longer being required and to be abandoned, shall be plugged, lined through, and not drilled out prior to CCTV inspection.

5.3.5 Procedure

Immediately prior to installation, all water shall be removed from the pipe to be lined and steps taken to prevent further ingress of water. Liner fabric shall be 100% wetted, using the correct proprietary resin. The liner shall then be placed into position in the run to be lined, with sufficient protrusion at both ends. Immediately thereafter the liner shall be formed, by means of water or vapour pressure to achieve 100% contact with the host pipe. Thereafter, water or vapour pressure shall be maintained at constant pressure, without interruption, until initial cure of the liner is complete. Any failure of the installation equipment or personnel that will delay the liner installation at any point for longer than thirty (30) minutes shall be cause to abort the installation and, if possible, remove it.

5.3.6 Curing

After installation, the liner shall be cured for a minimum period of one (1) hour at 60 to 70 degrees Celsius at 5 psi or PUC approved alternative. Temperature and pressure gauges shall be provided at suitable points to allow monitoring of temperatures and pressures by the Engineer.

5.3.7 Trimming Liner

Once the final cure is achieved, the ends of the liner shall be trimmed flush with the ends of the lined pipe to provide a watertight seal.

5.3.8 Fit and Properties

The outside surface of the finished liner shall be in 100% contact with the inside surface of the host watermain and shall be completely bonded to the inside surface as required. 100 % contact means that there shall be no measurable or visible gap or annulus space between the liner and the watermain over the full circumference/perimeter and over the full length of the liner installation. The level of bonding shall correspond to the design and performance parameters for the liner as described above. The inside surface of the existing watermain is the surface after the watermain has been prepared for lining in accordance with the above noted cleaning and preparation requirements. Where any space or gap exists between the outside surface of the liner and the inside surface of the existing watermain the liner fit (and liner) will be considered deficient.

Where the required tight fit has not been achieved throughout the entire installation, the liner shall not be acceptable, and the liner shall be removed and replaced with a new liner that is a tight fit. If the forgoing removal and replacement is not possible then a new watermain shall be installed as approved by PUC.

Should the lining be damaged as a direct result of the Contractor's operation or reveal evidence of defective work or materials prior to the completion of the contract, such damaged or defective portions shall be removed and replaced (including restoration) at the Contractor's expense.

5.3.9 Finished Liner

The liner shall be free of any interior bulges, ribs, ripples, or other irregularities except where these irregularities correspond with irregularities in the existing watermain after cleaning and preparation in accordance with above noted design requirements. Where folds, ridges, ripples, and wrinkles are a direct result of obtaining the required tight fit, they shall be acceptable providing that the liner installed was correctly and properly sized for the existing watermain based on the inside diameter measurements made as required herein. Where such folds, ridges, ripples, and wrinkles are due to improper or incorrect sizing of the liner, they shall not be acceptable. The Contract Administrator shall be solely responsible for

acceptance of the finished liner. Any sections of liner deemed unacceptable as outlined above shall be removed and replaced with a new liner. If the foregoing removal and replacement is not possible, then a new watermain shall be installed. Either of these watermain replacements (including restoration) shall be done at the Contractor's expense and with the PUC's approval.

5.3.10 Liner Work at Edges

Edges of linings at openings or ends of lined sections shall be neatly finished. If the liner fails to make a watertight seal with the existing pipe, a seal shall be applied at this point. Sealing process shall use a material compatible with the liner pipe.

5.3.11 Guarantee

During the guarantee period, any portion of the lining found to have deteriorated or to have failed, shall be repaired by patching or by removal and replacement of the resin lining by the Contractor. Repairs or replacements shall be done at the sole expense of the Contractor.

5.3.12 Post Installation Sampling and Testing

Sampling and subsequent testing will be conducted in accordance with OPSS.PROV 460 (latest version) at the Engineer's discretion. Sampling and testing will only be conducted when the post lining video indicates a suspected lining deficiency.

5.3.13 Clearing Blocked Water Services

There will be no payment for "excavate to clear any blocked services" within the construction/lining limits and the costs of all restoration to complete this work (if required) shall be payable by the Contractor.

PUC 6.0 CLEANING AND CEMENT MORTAR LINING (CML)

6.1 SCOPE OF WORK

This specification covers the requirements for cleaning and cement mortar lining of the watermain and furnishing all labour, equipment and material for the following operations: installing a temporary by-pass line and maintaining temporary services during construction, installing temporary flushing/chlorination/test lines, traffic control, cutting the pavement, excavation, shoring, cutting the pipes, maintenance of physical separation between watermain being rehabilitated and active drinking water system, dewatering, replacement of identified valves and hydrants, cleaning the pipe, disposal of water and waste products from cleaning operations, placing the cement mortar lining, curing and protection of the lining, trowelling (if required), hand work and back flushing of hydrants, clearing of plugged services, backfilling of excavation, temporary restoration of municipal streets, curb and gutter, municipal walks, permanent repairs to boulevards and private drives, cleanup of the site, cathodic protection as per OPSS.MUNI 442 (latest version), flushing, disinfection and returning main to service and all other incidental work and expenses.

The requirements of OPSS.MUNI 462 (latest version) shall apply, except as amended herein.

6.2 MATERIALS

6.2.1 Cement Mortar for Lining

All cement mortar for the lining shall be proportioned by volume and shall be of the proper consistency to provide a dense, homogeneous lining which will hold itself firmly against the pipe surface. The cement and sand for the mortar lining shall be mixed in the proportions of one part cement to one and one quarter parts of screened sand by volume, the exact proportions to be determined by the characteristics of the sand available for the work. Unless specified otherwise, the Contractor may submit for the approval of the Commission to use a premixed mortar. Under no circumstances will the Contractor be permitted to use or introduce any chemical or additives of any kind unless written approval from the Commission has been obtained prior to its application.

6.2.2 Cement

- **Portland Cement**
Shall meet the requirements of A.S.T.M. designation C-150 as last revised.
 - **Natural Cement**
Shall meet the requirements of A.S.T.M. designation C-10 as last revised.
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6.2.3 Sand

Sand shall be washed and manufactured, having clean, hard, durable, uncoated grains, free from organic matter, shale, clay, lumps, coal, soft or flaky particles and other unsound or deleterious substances, and shall be delivered to the site in sealed bags. Sand shall be well-graded and shall pass a No. 16 mesh screen, with not more than 5% passing a No. 100 sieve.

6.2.4 Water

Water shall be potable, clean, and free from injurious ingredients.

6.2.5 Natural Cement

Natural cement may be used in the proportion of up to one (1) bag Natural cement to five (5) bags of Portland cement. No mortar which has attained its initial set shall be used.

6.2.6 Pozzolanic Material

Pozzolanic material shall consist of siliceous or a combination of siliceous and aluminous material in a finely divided form that in the presence of moisture will react with calcium hydroxide, at normal temperatures, to form compounds possessing cementing properties. Pozzolanic material shall meet the requirements of ASTM C618.

6.2.7 Admixtures

The Contractor may use admixtures, upon the approval of the Engineer, provided that its use does not have a deleterious effect on the potable water and that the use conforms to ASTM C494. The ratio of admixture to Portland cement shall not exceed that used in the qualification tests of ASTM C494.

6.2.8 Cement-Mortar Mixture

The mortar shall be mixed sufficiently to provide a homogeneous mixture with maximum plasticity. The slump upper limits shall conform with ANSI/AWWA C602- 00 requirements.

6.3 INSTALLATION

6.3.1 Thickness and Placement of Cement Mortar Lining

The Contractor shall ensure that the pipe is free of debris or accumulated water which shall be a detriment to the cement-mortar lining operation and final product.

The lining shall consist of one-course application of pre-mixed cement mortar 5 mm thick (+3.0 mm and -1.0 mm tolerance) and shall be placed by a machine propelling

the mortar against the wall of the pipe and long radius bends, by centrifugal force, without injurious rebound and with sufficient velocity to cause the mortar to be densely packed and to adhere in place. The travel of the machine and the rate of discharge of mortar shall be controlled so as to produce a uniform thickness of lining around the perimeter and along the length of pipe.

6.3.2 Trowelling

If requested by the Contract Administrator, the cement mortar lining machine shall be equipped with attachments for mechanically trowelling the mortar to produce a smooth surface finish and shall travel ahead of the lining, so that the freshly placed and trowelled mortar will not be touched until it has set. The design of the trowel attachment shall be such as to permit operations in pipes which may be out of round, as well as to permit trowelling through bends that deflect up to (and including) 22 ½ degrees. Mortar of improper consistency, that does not provide a dense, homogeneous lining which will hold itself firmly against the pipe surface, and all waste materials, spatter, etc., shall be removed from the pipe. Only mortar of suitable consistency and applied with sufficient velocity to adhere firmly to the surface of the pipe shall form the lining. The finished surface shall be smooth and shall not have a sand finish. If any section of the lining fails or shows evidence of failure or unusual irregularity, the faulty section of lining shall be removed to the extent indicated by the Engineer and the pipe re-cleaned and the lining replaced.

6.3.3 Hand Work

Edges of linings at openings or ends of lined sections shall be neatly finished. Edges shall be rounded or bevelled so as to avoid sharp angles or abrupt changes of sections, which may tend to cause failure of the lining or offer resistance to flow. Surfaces of cement mortar lining to which additional mortar is to be placed shall be moistened just before the mortar is applied.

Hand finishing work in a section of the pipeline shall be completed within twenty-four (24) hours after the machine application of the mortar lining to that particular section of the pipeline has been completed.

Immediately upon completion of the cement-mortar lining of a length of watermain, all openings in the main shall be closed to prevent circulation of air.

6.3.4 Service and Hydrant Connections to be Backflushed

When the lining has achieved sufficient set, all service and hydrant connections shall be backflushed by water or other approved method to remove any mortar deposited in them. No additional payment shall be made for this work.

6.3.5 Mortar to be Kept Damp

As soon as practicable thereafter, water shall be introduced into the mortar-lined section between bulkheads or valves, in order to maintain a moist atmosphere.

6.3.6 Mortar Consistency and Adherence

Mortar of improper consistency that does not provide a dense, homogeneous lining which will hold itself firmly against the pipe surface, and all waste materials, spatter, etc., shall be removed from the pipe. Only mortar of suitable consistency and applied with sufficient velocity to adhere firmly to the surface of the pipe, shall form the lining. The finished surface shall be smooth and shall not have a sand finish. If any section of the lining fails or shows evidence of failure or unusual irregularity, the faulty section of lining shall be removed to the extent indicated by the Engineer and the pipe re-cleaned and the lining replaced.

6.3.7 Cement-Mortar Lining Thickness

The Contractor shall guarantee the minimum thickness of the lining around the entire circumference of the pipe. Lining not meeting the minimum thickness requirement, or falling outside the thickness tolerances, or otherwise not meeting these specifications shall be considered defective. Defective lining shall be removed in total from the entire pipe section if the mortar has not reached its initial set. The Contractor may excavate additional test pits, at his own cost, to isolate the extent of defective lining. If the lining has reached initial set, the lining shall be repaired by the Contractor, at no additional cost, by the most practical method as determined by the Engineer.

6.3.8 Guarantee

During the guarantee period, any portion of the cement-mortar lining found to have deteriorated or to have failed, shall be repaired by patching or by removal and replacement of the cement-mortar lining by the Contractor. Repairs or replacements shall be done at the sole expense of the Contractor.

6.4 QUALITY ASSURANCE

6.4.1 CCTV Inspection

The unit price shall be full compensation for all labour, equipment, and materials required for CCTV Inspection as follows:

- a) After completion of lateral clearing, the Contractor shall perform CCTV inspection of all completed linings, using appropriate lighting with accurate distances recorded on 100% of the inspection, and digitally record the inspections. Defects that appear on the CCTV shall be made good by the Contractor at his sole cost, to the satisfaction of the Engineer.
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- b) The copy of each inspection shall be supplied to PUC no later than seventy-two (72) hours after the video and ultrasonic inspections are performed.
- c) The Contractor shall give PUC 24-hours' notice as to when the inspection is being performed so that a PUC representative is present during the actual operations to observe as the camera and the ultrasonic unit pass through the pipe.
- d) The report is to be submitted, labelled with the Contract No., Date of Inspection, List of Streets Inspected, Index No. for the digital recording and Report, and General Contractor's name. The report should consist of a table of contents, listing the streets inspected, start and end locations and count for the start of each inspection. The inspection reports for each length of watermain inspected should report as a minimum: street name, date of inspection, pipe type and size, start and end locations, length of pipe inspected, summary comments, disk, and file numbers. The summary comments should identify all distinguishing features of the watermain to include but not limited to service locations, condition of cement, bends, valves, ponding water, and poor visibility.
- e) All costs associated with the labour, equipment, and materials, including supply of digital recording medium, to carry out this work shall be included in the appropriate contract item.

6.4.2 Post-Cleaning / Pre-Lining – CIPP

After completion of cleaning, the Contractor shall perform CCTV inspection of the pipe to confirm satisfactory cleaning has been achieved.

All water shall be removed prior to inspection. The inspection shall be carried out in the presence of the Engineer or representative. The post-cleaning inspection does not require a recording.

6.4.3 Post-Lining

After completion of lateral clearing, the Contractor shall perform CCTV inspections of all completed linings, using appropriate lighting with accurate distances recorded on 100% of the inspection, and record the inspections on flash drives (USB drive). Defects that appear on the CCTV inspections shall be made good by the Contractor at his sole cost, to the satisfaction of the Engineer.

The report is to be submitted for post-lining inspection in pdf format on a flash drive. Each folder is to be labelled with the Contract No., Date of Inspection, List of Streets Inspected, Index No. for the flash drive and report, and general Contractor's name. The report should consist of a table of contents, listing the streets inspected, start and end location. The inspection reports for each length of watermain inspected should report as a minimum: street name, date of inspection., pipe type and size, start and end locations, length of pipe inspected, and summary comments. The summary comments should identify all distinguishing features of the watermain to

include but not limited to service locations, condition of cement, bends, valves, ponding water and poor visibility.

The copy shall be supplied to the PUC no later than seventy-two (72) hours after the video is performed.

6.4.4 Protection of Lining

The Contractor shall take adequate steps to protect the lining from damage after installation. Any damage to the lining due to the Contractor's negligence, shall be made good by the Contractor, to the Engineer's satisfaction, at the sole expense of the Contractor.

6.4.5 Test Pits

The unit cost shall be full compensation for the supply of all labour equipment and materials necessary for obtaining a test piece of lined watermain. The Contractor shall excavate test pits and remove a sample of watermain for the purpose of inspecting the work where directed by the Engineer.

The Contractor's work shall include excavation, cutting a 500 mm section of pipe from the newly lined watermain, replacing the section with a new piece of pipe and fittings, bedding, dewatering, compaction, disposal of excess material, cathodic protection, backfilling, and restoration as specified.

Where, in the opinion of the Engineer, the work is not satisfactory, he may require the Contractor to excavate additional test pits to verify the quality of the work on the section in question. All subsequent test pits on this section shall be at the Contractor's expense.

PUC 7.0 TEMPORARY WATERMAINS, SERVICES, HYDRANTS

The lump sum price identified in the schedule of unit pricing shall be full compensation for supply of all labour, equipment, and materials, necessary for the installation, commissioning, maintenance, and removal of a temporary watermain system as per PUC Section 7.0 "Temporary Watermain, Services and Hydrants".

7.1 TEMPORARY BY-PASS MAIN

OPSS. MUNI 493 November 2019 shall apply except as amended and extended herein.

The Contractor shall provide a temporary by-pass plan to the Engineer prior to construction.

The work shall include the supply of all labour, material and equipment required for the following operations - installing the temporary by-pass, temporary fire hydrants and connections, valves and check valves where required, swabbing of temporary by-pass, supply connections, chlorination, protection of the installation from damage, temporary flushing/bleeder lines at dead ends, temporary shut-off of private services by operation of curbs-stops or such other means as required, removal of temporary service connections and by-pass line and restoration of the site upon completion of the work.

Each run of by-pass pipeline shall terminate with a minimum 50 mm diameter terminal valve for flushing and chlorinating. Service connections shall not be attached to, or downstream from, this terminal valve. Chlorination of by-pass shall be as per PUC Section 3.0 "Quality Assurance and Testing".

Where the ends are at different pressure zones, a check valve shall also be installed. Valves shall be installed in the by-pass in the vicinity of existing main line valves on the line being cleaned and lined and also where 50 mm by-pass connects into 100 mm by-pass line or at such other locations as the Engineer may direct.

The location of all temporary by-pass pipeline shall be marked by setting bright orange, reflective traffic delineators along it at intervals not greater than 20 m.

Final swabbing: The entire by-pass pipeline shall be swabbed after installation and filling. The Contractor shall determine the swabbing protocol and provide to the engineer for approval. The swabs shall be strategically placed in the pipe at no more than 300 metre intervals to thoroughly swab the entire pipeline, not including hydrant branches, prior to disinfection.

The existing watermain shall not be removed from service until the installed by-pass has been approved by the Engineer in writing and all affected customers have been connected to the temporary by-pass system.

The Contractor shall maintain the temporary water service lines in safe and operative condition at all times and shall be responsible for the prevention of injury to

persons and damage to property. Safeguards shall be provided by the Contractor to the satisfaction of the Engineer, but such provisions shall not relieve the Contractor of full responsibility for the adequacy of protection. The by-pass pipeline system shall be adequate to withstand the internal pressures and external loading that is required of it without noticeable leakage. Continuous leakage of pipe, hose or fittings will not be permitted.

Upon commencement of installation of the by-pass system, the Contractor shall furnish to the Engineer the names and telephone numbers of personnel that have been designated to perform emergency repairs to the by-pass system. The Contractor shall respond to emergency repair calls within one (1) hour of being called.

At all times that the by-pass system is in operation, the Contractor shall maintain at least two (2) lengths of each size of by-pass pipe and two (2) service hoses which have been disinfected, sampled, approved, and kept sealed, for emergency use in case of breakage of pipes or hoses in service.

7.2 TEMPORARY BY-PASS WATERMAIN REPAIRS

Temporary water systems in service are part of the existing water distribution system. As such any repairs to this temporary system must be completed in accordance with the MECP regulations and Peterborough Utilities Commission guidelines and procedures.

During normal working hours the onsite inspector is to be informed immediately of any temporary watermain breaks so that the inspector can supervise the repairs and perform the required water quality testing after the repair.

For after hour call-outs, the Contractor's representative is to assess the situation. If the temporary watermain is broken to the state that the system needs to be shut down to complete the repairs, contact the PUC Water Department personnel on call to oversee the repairs and perform the required testing. This can be done by calling 705-748-9300 and the answering service will dispatch the on-call representative. Advise the on-site inspector the next morning so the inspector can follow up with the on-call operator.

If there is potential for flooding and damage to neighbouring properties or a safety hazard, the flow in the watermain may be reduced by partially closing a valve BUT some flow must be maintained at all times, if at all possible or practical. Contractor should discuss reducing the flow or total shutdown with the on-site inspector or on-call operator prior to taking any action if at all possible.

7.3 TEMPORARY SERVICE CONNECTIONS

All work on the temporary service mains and temporary property services shall be done by the Contractor. A record of curb stops in mains being cleaned and cement-lined under the Contract, if not attached hereto, shall be available to the Contractor from the PUC records but in the event that the records are incomplete, it

shall be the responsibility of the Contractor to provide an adequate supply of water to all properties affected by mains under this Contract. All work on service connections shall be done only by proper authority of the Engineer. Full liability for all service connection work on any premises shall be assumed by the Contractor.

Where temporary hose is used for individual property connections and temporary watermain, it shall conform to the NSF 61 standard and minimum 20 mm ID, designed for a working pressure of 860 kPa, free from defects in material and workmanship. Each residential consumer shall have its own temporary water service connection to the by-pass pipeline and a connection to the private plumbing via a 20 mm double-valved wye with garden hose thread.

Temporary service hoses, where practical, shall be cut to an appropriate length so as not to have excess hose coiled at the curb line causing potential trip hazards.

In order to ensure that service hoses are disinfected the Contractor will be required to pour liquid chlorine/water solution in one end of the hose and allowed to travel slowly through the hose. Hose ends are to be dipped in a chlorine/water solution prior to connecting to a house.

The Contractor shall be aware that the majority of curb stops in Peterborough are of the "stop and drain" design, therefore the Contractor or homeowner must also close services using the inside house valve. If the Contractor operates the inside shut-off, a visual inspection for any signs of leaking is mandatory. **Homeowner is to be advised to also check periodically for drips or leaks to avoid possible water damage.**

The pipe, hose and all other materials which are to be furnished by the Contractor for use in conjunction with the temporary service pipe and temporary connections to property services and branches shall be approved by the Engineer, and shall be fully adequate to withstand the pressures and all other conditions of use and shall be of a material which does not impart any taste or odour to the water. The pipe and fittings shall provide adequate water tightness and care shall be exercised throughout the installation of any temporary pipe and service fittings to avoid any possible contamination of any Commission main or property services or contamination of the temporary service pipe proper.

The Contractor will be permitted to reuse temporary by-pass service connections previously disinfected without re-disinfecting provided that precautions are taken, to avoid the potential for contamination, that include immediately capping each end of the temporary by-pass service prior to storage and reuse; and storing the temporary service lines in a manner that will lessen the likelihood of contamination.

Prior to the reconnection of the previously disinfected temporary service connection, the connection ends of the service pipe must be submerged in a 5% sodium hypochlorite solution. The service pipe must then be flushed, the outside hose bib and "Y" connector sprayed with a 5% sodium hypochlorite solution before final hook up of the temporary service pipe to provide service.

During freezing, stormy, or inclement weather, no work shall be done except that which is incidental to cleaning or lining, unless otherwise directed by the Engineer. No by-pass service pipe or property service connections shall be installed during freezing or inclement weather and pipes already in use shall be removed or drained and services restored when so directed by the Engineer. Removal and re- installation of such pipes or services shall be done at the Contractor's expense.

7.4 MOUNDING AND BURYING BY-PASS

The Contractor shall be required, at his own expense, to mound over the by-pass pipe with asphalt or other acceptable material, wherever it crosses a driveway in order to prevent injury of damage to vehicular or pedestrian traffic. Such lights and barricades as may be required shall be furnished and maintained by the Contractor. In general, the temporary service pipe shall be laid where it causes the least obstruction and is least liable to be damaged.

At all street crossings, the Contractor shall recess the by-pass pipeline into the pavement such that its highest point is flush with the pavement surface. When by-pass pipeline crosses a wheelchair ramp or sidewalk and there is less than a 1.2 m wide unobstructed passageway, the Contractor shall install the pipeline in a recessed trench or shall provide a pre-manufactured serviceable ramp at a slope not greater than 1:12.

Wherever by-pass pipelines pass across driveways, they shall be ramped over using either compacted cold-patch asphalt or rubber ramps. Loose granular material will not be permitted. Ramp slopes shall not be steeper than 1:4.

7.5 TEMPORARY FIRE HYDRANTS

Where required, the Contractor shall furnish, install, and maintain temporary fire hydrants. Temporary hydrants shall be fed by 100 mm diameter by-pass pipeline continuously from the feed point. Temporary hydrants shall have single 62 mm diameter nozzles, with male threads 5 threads per 25 mm. Each hydrant shall have a minimum 100 mm operating valve. They shall be set close to existing hydrant locations so that the Fire Department will have no difficulty connecting a fire hose to them and where they will cause least hazard to pedestrian and vehicular traffic. The Contractor shall submit a sketch of the temporary hydrant that he intends to use with the submission of his by-pass plan. Temporary hydrants shall be tested by the Contractor prior to the by-pass system being put into operation. Temporary hydrants shall be protected by barricades and maintained in an upright position at all times. Permanent existing hydrants that are put out of service shall be bagged and clearly marked with "hydrant out of service" tag or lettering.

7.6 FLUSHING, DISINFECTION AND BACTERIOLOGICAL TESTING OF TEMPORARY BY-PASS

It is required that flushing, disinfecting and bacteriological testing of the by-pass line and all temporary service connections be completed prior to their use. Disinfection and bacteriological testing of the by-pass system shall be performed by the

Contractor in a manner consistent with PUC Section 3.0 "Quality Assurance and Testing" and as approved by the Engineer.

The temporary service connections shall be valved near the point of connection to the by-pass and also to the private plumbing system so that both the by-pass line and temporary services may be chlorinated except for the final connection.

7.7 CHLORINATION OF TEMPORARY WATER SERVICE HOSES

In order to ensure that service hoses are disinfected the Contractor will be required to pour liquid chlorine/water solution in one end of the hose and allowed to travel slowly through the hose. Hose ends are to be dipped in a chlorine/water solution prior to connecting to a house.

7.8 CONNECTION TO HYDRANTS

All temporary by-pass service attachments to fire hydrants shall be equipped with a reduced pressure zone backflow preventor and shall be made in such a manner that if it becomes necessary, they can be easily removed so that the hydrant can be used for firefighting purposes. The Contractor shall provide the Engineer with certification of testing of the backflow preventors prior to commissioning the temporary system.

7.9 OBSTRUCTIONS IN SERVICES

Should any services be restricted or stopped due to the entrance of loosened foreign materials, it shall be the Contractor's responsibility and sole expense to remove such obstructions in a manner approved by the Engineer.

7.10 EXCAVATING TO CLEAR WATER SERVICES

The Contractor shall provide all labour, materials, tools, and equipment for cutting pavement, excavating, and removing restrictions in main stops or services or replacing the main stop as ordered by the Engineer reconnecting the service, backfilling the excavation and repairs to the surface. Refer to PUC Section 2.0 "Construction".

7.11 SHUT-OFF OF PROPERTY SERVICES

The Contractor shall make all shut-offs of property services and shall furnish water for the temporary by-pass service from a hydrant or other temporary source.

7.12 REMOVAL OF BY-PASS AND TEMPORARY SERVICES

Upon restoration to service of a section of watermain, the Contractor shall remove any corresponding section of temporary by-pass service pipe and temporary property service connections and shall satisfactorily restore the permanent property connections and leave streets, sidewalks, and adjacent property in a neat and orderly condition.

7.13 PAYMENT

Payment at the contract price for temporary watermain, water service and hydrants shall include the supply, installation, commissioning, and maintenance of a temporary water system during construction including the installation of temporary flushing and chlorination test lines.

7.13.1 Payment Breakdown

40%Installed – Charged / No leaks – not commissioned
 50% Commissioned – Hook-ups not complete
 70% Customer hook-ups in progress
 85% In Service – Watermain Shutdown
 100% ...Watermain in service, by-pass removed, Cleanup / Restoration Complete

7.14 EXCAVATE AND CONNECT TEMPORARY IN-PIT SERVICE CONNECTION >50 MM

The lump sum price identified in the schedule of unit pricing shall be full compensation for all labour, equipment and materials required for each specific large in-pit connection. The Contractor is to perform excavation of the access pit, commission and install adequate temporary servicing - minimum 100 mm feed and connection to the existing water services identified on the contract drawings greater than 50 mm. The Contractor shall be responsible for customer notification, interactions, and scheduling. Lump sum price to include dewatering, backfilling, compaction, restoration, and disposal of surplus material.

PUC 8.0 HYDRANT FLOW TESTING, LEAK DETECTION AND PAINTING

8.1 SCOPE OF WORK

This specification covers the requirements for flow testing, leak detection, painting, and colour coding of fire hydrants.

8.2 MATERIALS

8.2.1 Paint – General

The paint system used shall be as listed in the chart below and supplied from the indicated manufacturers.

PAINT TYPE	PAINT COLOUR	COLOUR CODE	SUPPLIER
Primer	Zinc Phosphate	E61AL0008	Sherwin Williams
Primer (newly installed)	White Air Dry	B50WZ4 Kem Bond HS	Sherwin Williams
Topcoat	Primrose Yellow	H60YK2006	Sherwin Williams
Colour Code	Safety Blue	H60LK2051	Sherwin Williams
Colour Code	Safety Green	H60GK2033	Sherwin Williams
Colour Code	Safety Orange	Rust-oleum 956	Acklands Grainger
Colour Code	Safety Red	Glid-Guard 4320	Glidden

Hydrant barrels shall be painted yellow. The Contractor shall supply one (1) litre of each colour (blue, green, orange & red) to the PUC prior to beginning colour coding.

8.2.2 Approved Paint Suppliers

- Sherwin Williams** 130 Van Kirk Drive, Brampton ON L7A 1B1
Phone: 800-268-5613 or 905-846-0740
Fax: 905-846-5140
- Acklands Grainger** 90 West Beaver Creek Rd, Richmond Hill ON L4B 1E7
Phone: 905-731-5555
- Glidden ICI Paint Centre** 139 George St N, Peterborough ON K9J 3G6
Phone: 705-741-0015

8.2.3 Paint – Primer

Primer used for the blasted hydrants shall be quick drying rust inhibitor zinc chromate primer, compatible with the topcoat being used and recommended by the paint manufacturer. The newly installed hydrants shall have a coating of white primer applied prior to the zinc chromate primer. See PUC Section 8.4.3 “Hydrant Painting”.

8.2.4 Paint – Topcoat

The paint shall be a self-priming, rust-inhibitor type enamel as listed in the Acceptable Paint Colour Code Chart in PUC Section 8.2.1 “Paint – General”.

The paint shall have a variable drying time of ten (10) minutes to one (1) hour at temperatures of 5°C to 40°C with ideal temperature of 20° C, allowing for a twenty (20) minute drying time. Hydrants are not to be painted when the temperature is less than 5°C or greater than 40°C.

8.2.5 Paint – Colour Coding

The paint to be used is listed in the Acceptable Paint Colour Code Chart in PUC Section 8.2.1 “Paint – General”.

8.3 EQUIPMENT

8.3.1 Sand Blasting Equipment

Sand blasting will be the method used to achieve proper paint and rust removal. Please review the current edition of the Ontario Government Environmental Protection Act Regulation 346. All aspects of this regulation must be adhered to during the hydrant blasting operation.

A suitable shield **MUST** be used in conjunction with this operation to protect against injury of people or property in the vicinity.

8.3.2 Sounding Equipment

All material and equipment used for the sounding of fire hydrants shall be approved by the Engineer. The equipment shall consist of a direct contact microphone with electronic amplification and the capability of listening for any detectable leaks on the hydrants and water mains within 33 metres of hydrant connection.

8.3.3 Paint Brushes

The Contractor shall use "one coat quality" brushes, designed for quality application of the paint used.

8.4 CONSTRUCTION

8.4.1 Notification of Work

The Contractor is required to notify the media, in writing, forty-eight (48) hours in advance of flow testing identifying the general area, dates and times that the flow testing is proposed to be carried out by placing a minimum 75 mm x 125 mm advertisement in the Peterborough Examiner and Peterborough This Week. This advertisement must be approved by the Engineer prior to its publication in the media. The Contractor will then provide the PUC with a daily routing list indicating the areas of work (including the specific hydrant numbers) and the PUC will in turn notify the Water Treatment Plant.

8.4.2 Hydrant Preparation for Painting

Hydrants to be painted but not sandblasted shall be washed and cleaned of all dirt, grease, oil, and other foreign matter which will affect the coatings performance. The hydrant is then to be rinsed off with fresh water. Any loose or flaking paint shall be removed by scraping, power wire brushing and power grinding to create a feathered effect back to the existing paint to allow proper adherence of the new coat of paint. The surface shall be prepared for painting as recommended by the paint manufacturer. Bare metal surfaces shall be spot primed in accordance with paint manufacturer's recommendations. The Contractor shall clear sufficient grass, weeds, etc. around the hydrant to within 25 mm of ground level so that it can be painted properly.

8.4.3 Hydrant Painting

The Contractor shall exercise care and caution in painting the various hydrants and avoid spattering abutting facilities such as fences, hedges, sidewalks, curbs, asphalt driveways, etc., with paint. The clean-up of such spattering shall be carried out by the Contractor at their expense, to the satisfaction of the PUC. The Contractor shall ensure that all hydrant port caps are replaced **securely** after the paint has had sufficient time to dry.

Special care shall be taken to protect the top of the spindle with masking tape during painting so that neither the spindle nor the area around the spindle where it passes through the bonnet are painted. The paint shall be carefully applied in accordance with the manufacturer's directions. Brushes and equipment shall be cleaned with the appropriate solvent.

8.4.4 Paint Schedule

The following paint schedule shall apply unless otherwise specified:

Sand Blasted Hydrant	1 coat	zinc chromate primer (cut by 10% with a xylene reducer)
	1 coat	zinc chromate primer (to be applied 24 hours after first coat of primer)
	1 coat	yellow topcoat on non-colour coded areas
	2 coats	coloured topcoat for colour coding of hydrant
Non-blasted Hydrant	1 coat	yellow topcoat on non-colour coded areas
	2 coats	coloured topcoat for colour coding of hydrant
Newly Installed Hydrant	1 coat	white (barrier) primer
	1 coat	zinc chromate primer
	1 coat	yellow topcoat on non-colour coded areas
	2 coats	coloured topcoat for colour coding of hydrant

8.4.5 Paint Coating Minimum Thicknesses

The coatings shall be applied to the following minimum dry film thicknesses (per coat):

Primer	1.5 mils
Topcoat (when re-coating over existing topcoats)	1.5 mils
Topcoat (when coating over primer)	2.0 mils

8.4.6 Sand Blast

An appropriate metal shield must be used to protect the surrounding area during the sand blasting operation. Where spray equipment is used, it shall preferably be airless spray in order to cut down over spray. In **ALL** cases, a shield to protect against over spray **MUST** be used.

During the sounding operations, the Contractor shall also grade the condition of the hydrants, verify requested hydrant information, and identify hydrants with coating in poor shape and with excessive paint buildup, and prepare a list of hydrants for

blasting. The Engineer shall review and approve the hydrants for blasting and may indicate additional hydrants requiring blasting. The Contractor shall, where required, clean and remove rust and existing build-up of paint on hydrants using a high-pressure sand blast. The first coat of zinc chromate primer will be applied immediately after blasting.

Sand blasting shall be carried out in a manner that does not endanger the public.

After sandblasting the entire hydrant, the primer shall be applied and the hydrant painted, including colour coding, within seventy-two (72) hours. The Contractor shall notify the PUC once the blasted hydrant has had the first coat of zinc chromate primer applied before proceeding with the second coat of zinc chromate primer, yellow topcoat, and colour coding.

The sand material resulting from this operation shall promptly be cleaned up after the operation is completed.

8.4.7 Sounding

The Contractor shall sound each hydrant that is to be painted. If sound is detected these hydrants are to be revisited during "Off" hours (in the late evening or early morning when there is less extraneous noise) to confirm the sound. These "confirmation" visits may be carried out after all hydrants have been sounded. The sounding shall be performed before the hydrant is painted and all results, including any noise that is heard, shall be recorded on a Hydrant Sounding Report in Excel format. (See example in Contract Drawing Index) The completed Reports are to be forwarded to the Engineer prior to payment for this operation.

The Contractor shall provide all material and equipment necessary to sound each hydrant to be painted in this contract.

The Contractor shall provide the Engineer with written proof that the personnel carrying out the hydrant sounding have been trained by a competent representative of the equipment manufacturer in the use of the leak detection equipment.

The leak detection equipment shall be tested for proper operation, both immediately prior to and after use, to confirm that it is operating as intended throughout its full range of capabilities.

During the sounding operation the Contractor shall also compile a list of any hydrants that have bushes, flowers, etc. growing around them which hinder the painting of that hydrant. The PUC shall then make arrangements to have the property owner trim the bushes, etc. before the painting Contractor completes the painting of this hydrant. The Contractor shall NOT trim private hedges or flowers.

8.4.8 Flow Testing

Hydrants shall be flow tested with a Pitot gauge acceptable to Fire Underwriters Association and the PUC. The colour coding of the hydrants shall be based on the technical information received from these flow tests.

Flow testing shall be carried out in an organized basis throughout the identified quadrant of the city. The Contractor shall arrange to notify the media forty-eight (48) hours in advance of the flow testing in the area of the city they propose to carry out testing and advise of any last-minute changes. The PUC will then notify the Water Treatment Plant on a daily basis. The Contractor must also submit a proposed routing list of hydrants, their order of flowing and proposed residual hydrants to be used prior to flowing for review and approval by the Engineer.

All pressure gauges shall be calibrated both before and after field tests to ensure consistency of measurements. Calibration shall be done by an outside source other than the Contractor and written results shall be given to the Engineer to reflect these tests. If gauges become damaged during the testing process, then any replacement gauges shall also be calibrated before being used and those results given to the PUC. Hydrants shall be colour coded in accordance with the current Edition of the NFPA 291 "Fire Flow Testing and Marking of Fire Hydrants".

This code requires:

The bonnet, bonnet flange and nozzle caps of hydrants are to be painted according to specific flows as follows:

- Class AA - BLUE - flow capacity of 1500 US gpm or greater at 20 psi
- Class A - GREEN - flow capacity 1000 to 1499 USgpm at 20 psi
- Class B - ORANGE - flow capacity 500 to 999 USgpm at 20 psi
- Class C - RED - flow capacity less than 500 USgpm at 20 psi

Hydrants shall be flow tested on the basis of any changes in the size of the main feeding the hydrant. If the pressure drop between static and residual pressure is less than 10 P.S.I., then an additional flow of that hydrant may be required. The Engineer shall be notified of any flowed hydrants that fit this criteria.

The flow testing data shall be recorded according to flows obtained per hydrant, size of main feeding hydrant and hydrant location. Hydrant flow test data shall be submitted in the Water Supply Analysis Report (Excel format) to the PUC on a daily basis and the PUC personnel shall indicate to the Contractor the colour to code each hydrant.

All Contractor personnel involved in flow testing of the hydrants shall have extensive experience in and be familiar with the mechanics of a water distribution system. All hydrants to be flowed are to be opened and closed very slowly in order to minimize the chance of damage to the existing PUC's Water Supply System. **BOTH** the flow

and residual hydrants are to be properly flushed until the water is clear prior to conducting the Flow Test. If any irregularities with regard to water colour or available pressure are present the Engineer is to be notified of this immediately. After completing the flow test the Contractor must continue to flush the flow hydrant until the water is clear. Appropriate discharge flow diffusers are to be used when flowing hydrants in order to prevent any damage to boulevards, sidewalks, driveways, lawns, asphalt, etc. Tarps may also be required to minimize damage to the surrounding area. Two (2) 2-1/2" ball valves (complete with safety lock devices) shall be attached to the diffuser cones during flowing to be used as an emergency shut down mechanism if required.

Before flow testing commences, adequate arrangements shall be made with the Engineering and Waterworks Department of the PUC listing personnel involved, location of test and times of flow tests. The initial flow tests are to be conducted with PUC personnel on site to clarify the acceptable specifications and operation of the hydrants.

8.4.9 Hydrant Nozzles

Hydrant nozzles vary in their discharge characteristics and caution should be employed when using such outlets. They may be used for checking flows when no large nozzles are available, but the volumes must be corrected by multiplying the volume flowed by the multiplication factor shown below depending on the configuration of the hydrant nozzle. Note: The flow rate is multiplied by the factor and not the coefficient, since the flow rate is based on the coefficient of 0.90.

8.4.10 Colour Coding Hydrants

The Engineer shall determine hydrant colour coding from results of flow testing submitted by the Contractor. The Contractor shall colour code the hydrants as directed by the Engineer.

8.4.11 Public Convenience and Safety

Wherever and whenever any work is closed, suspended, or stopped, all materials of every description must be gathered up from the streets, sidewalks and boulevards and removed therefrom.

The Contractor shall carry out his operations in such a manner that there will be a minimum of inconvenience to the people on the various streets. When necessary, sufficient warning and information signs shall be placed so that the public are informed of the work in progress.

8.4.12 Complaints

The Contractor shall expeditiously investigate all reasonable complaints of their operations and be agreeable to take positive steps to correct unsuitable aspects of their operations.

At any time, when a nuisance to householders arises, whether during working hours or after working hours, the Contractor shall immediately take the appropriate measures. If they fail to do so, it may be done by the PUC or ordered done by others at the Contractor's cost and expense.

All complaints whether directly received by the Contractor or received by them via the Inspector or any Municipal Official, shall be promptly dealt with and the Contractor shall take all such remedial action, so as to prevent further complaints on the same matter.

The Contractor shall, as soon as conveniently possible, advise the Engineer of any complaints or claims on damage of private property, directly received by their representative or anyone of their forces. They shall also advise the Engineer as quickly as possible of the action taken by them in the case of complaints and by his Insurance Company on claimed property damage and of the outcome of the rectification or settlement.

8.4.13 Damage

The whole work and every portion and detail thereof shall, during construction, be protected by the Contractor from damage and put and left by the Contractor in good and satisfactory condition, finished in all respects and, at the time, must be fully up to the requirements of the specifications in every particular; all surplus and refuse material and rubbish removed from the vicinity of the works, the premises left in a neat and tidy condition, all damages to adjacent property, pavements, foot-walks, boulevards and sodding, or other things, injured or interfered with by the Contractor or their personnel, made good, and every other requirement of the Contractor complied with.

8.4.14 Private Property

Most of the newer hydrants are located 0.3 m from centre of the hydrant to the property line and the Contractor is advised that neither they nor the PUC personnel have any right to trespass on private property to carry out this work. This fact should be kept in mind in carrying out any trimming of grass and weeds around the base of the hydrant. The Contractor shall NOT trim private hedges or flowers.

The Contractor shall obtain permission to trespass on private property and shall be responsible for any damage resulting from the work either on the public property or private property.

8.5 QUALITY ASSURANCE

8.5.1 Film Thickness

A "test area" consisting of ten (10) hydrants shall be identified by the PUC and the Contractor shall be required to complete painting of hydrants in this area to the total satisfaction of the PUC's Inspector before continuing on with any other painting work.

The Engineer may test the dry film thickness of the applied coating. If the thickness of the coating does not meet specifications, the Contractor shall apply additional coats, at no additional cost to the PUC, until the dry film thickness meets the specified thickness.

8.6 PAYMENT

8.6.1 General

Payment shall be full compensation for the work specified and shall be measured per hydrant. All payment shall include completion of specified written documentation in its entirety. The Contractor shall support his invoice for payment with a list of the hydrants, by hydrant location and PUC identification number that were painted, flowed, blasted, or sounded during the month in question.

8.6.2 Hydrant Flow Testing

Payment shall be full compensation for all labour, material, and equipment to flow test the hydrant as specified, including safety protection, clean-up, and completion of required documentation. Payment shall be made under contract item.

8.6.3 Hydrant Sounding

Payment shall be full compensation for all labour, material, and equipment to sound the hydrant for leaks, as specified (including revisiting hydrants where noises are initially detected - see Section 8.4.7), using a technician trained in leak detection. Payment shall include completion of required written documentation and be made under contract item.

The same unit price shall apply to additional hydrant sounding required by the PUC for hydrants grouped more than ten (10) in an area.

8.6.4 Hydrant Preparation for Painting (Non-blasted)

Payment shall be full compensation for all labour, material, and equipment to prepare the hydrant for painting, as specified and recommended by the paint manufacturer. Payment shall be made under contract item.

8.6.5 Hydrant Sand Blasting

Payment shall be full compensation for all labour, material, and equipment to sand blast the entire hydrant to remove existing paint and rust in preparation for primer application. Payment shall also include supply and installation of the coloured primer coats as specified in the Contract and recommended by the paint manufacturer. Payment shall be made under contract item.

8.6.6 Hydrant Colour Coding (Non-Blasted, Blasted & Newly Installed)

Payment shall be full compensation for all labour, material, and equipment to paint the hydrant bonnet, bonnet flange, hose nozzle caps and pumper nozzle cap with two (2) coats of the appropriate colour as determined by flow testing results and as indicated by the Engineer. Payment shall be made under contract item.

8.6.7 Hydrant Painting (Non-blasted)

Payment shall be full compensation for all labour, material, and equipment to paint non-colour-coded sections of the hydrant with one (1) yellow topcoat above the ground level as specified. Payment shall be made under contract item.

8.6.8 Hydrant Painting (Blasted)

Payment shall be full compensation for all labour, material, and equipment to paint non-colour-coded sections of the hydrant with two (2) coats of zinc chromate primer and one (1) coat of yellow topcoat above the ground level as specified. Payment shall be made under contract item.

8.6.9 Hydrant Painting (Newly Installed)

Payment shall be full compensation for all labour, material, and equipment to paint non-colour-coded sections of the hydrant with one (1) coat of white primer, one (1) coat of zinc chromate primer and one (1) coat of yellow topcoat above the ground level as specified. Payment shall be made under contract item.
