
CONSTRUCTION AND MATERIALS SPECIFICATIONS MANUAL

REVISION # 4 – June 2013

NOTICE OF REVISION

Email Contact Information:

The City will only send notification of Manual revisions by email. If you would like to receive notifications of future revisions, send your email address to marco.cicconi@hamilton.ca

Access to Hamilton Standards:

This revision shall take effect on July 2, 2013. Each Manual holder is responsible for determining implementation dates and directions for use of these revisions. It is recommended that you retain superseded versions of specifications for future reference.

All specifications and drawings are available free of charge online at the City of Hamilton website at:

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Here you will find the latest versions of the published standards, archives of the previously published standards and Revision Information Sheets for currently published standards.

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Revisions to the Construction and Materials Specifications Manual:

Superseded / Cancelled (Remove)		Revised / New (Insert)		Comments
Document	Dated	Document	Dated	
Construction and Material Specification Manual Index	April 2012	Construction and Material Specification Manual Index	June 2013	Updated
Form 400, Specification for the Installation of Watermains	April 2011 / 2012	Form 400, Specification for the Installation of Watermains	June 2013	Form 400 and Appendix 400-A updated
Form 500, Specification for the Sewer Pipe Materials and CCTV Inspection	April 2011	Form 500, Specification for the Sewer Pipe Materials and CCTV Inspection	June 2013	Updated
Form 700, Specification for Portland Cement Concrete	June 2006	Form 700, Specification for Portland Cement Concrete	June 2013	Updated
Form 800, Specification for Hot Mix Asphalt	June 2006	Form 800, Specification for Hot Mix Asphalt	June 2013	Superpave mixes added
Approved Watermain Products List	January 2011	Approved Products List Section 1	June 2013	List updated and combined
Approved Sewer Products List	January 2011	Approved Products List - Section 2	June 2013	List updated and combined
Approved Street Lighting Products List	April 2012	Approved Products List – Section 3	June 2013	List updated and combined
-----	-----	Approved Street Lighting Products List – Section 4	June 2013	New list added
Standard Watermain Drawing Index	April 2011	Standard Watermain Drawing Index	June 2011	Updated
WM-201.01	November 2005	WM-201.01	June 2013	Updated

Revision Summaries:

These summaries are for information purposes and will highlight major or substantial changes only. Each revision and specification should be reviewed in its entirety.

Construction and Materials Specification Manual Index:

- References and specification dates updated.

Summary of Changes to Form 400 - Specification for the Installation of Watermains:

- Specification and standards references updated.
- All references to the restrained lengths in Sections 400.05.01, 400.07.01 and 400.23.02 revised to read “a minimum of 18m”. References to “3 full pipe lengths” removed.
- The following wording was added to Sections 400.05.01, 400.05.02 and 400.06:
“The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured “Tee”.”
- References in 400.07.01 to PVCO pipe removed.
- Section 400.12 Temporary Water Service By-Pass for Consumers – requirement for proposed by-pass configuration review added.
- Changes to Appendix 400-A summarized below:

Existing section 2.5, Disinfection of Watermains, 2nd paragraph – minimum residual chlorine levels after the high chlorine contact time have been revised from 10mg/L to 25mg/L:

The high chlorine concentration will be isolated in the system for a minimum of 24 hours and recorded on the “Watermain Disinfection, Pressure Testing and Acceptance form”. After the required contact time, the chlorine residual is to be taken at each sample location by the Specialist and recorded by the Construction Inspector. Flow required to take the chlorine residuals shall be provided through the temporary connection. If the chlorine residual is at or above 10mg/L the chlorine is ready to be discharged. In the event that the chlorine residual is less than 10mg/L, the chlorine in the system is to be discharged, and the system is to be rechlorinated. The Construction Inspector has the authority to require further swabbing if the residual is less than 10mg/L. Once this has been achieved, the watermain shall be flushed and sampled for appropriate chlorine residual levels. Minimum acceptable levels; Combined chlorine residual: 0.25mg/L and Free chlorine residual: 0.05mg/L.

- Existing section 2.7, Bacteriological Sampling, 1st paragraph - wording revised:

Existing wording: Before the watermain or temporary above ground by-pass system can be approved for connection to the existing water distribution system all water samples shall pass both the appropriate chlorine residual and bacteriological requirements as per City of Hamilton Environmental Laboratory testing procedures.

Revised wording:

Before the watermain, or temporary above ground by-pass system can be approved for connection to the existing water distribution system, two (2) consecutive rounds of water samples, taken 24 hours apart, shall pass the appropriate chlorine residual and bacteriological testing requirements as per the City of Hamilton Laboratory testing procedures. Prior to chlorine residual and bacteriological testing, all other testing and disinfection shall be completed and any super chlorinated water removed from all portions of the watermain system under consideration including hydrant leads, stubs, branches, services, etc.

- Existing section 2.8, Sampling Results, last paragraph - wording revised:

Existing wording:

If sample results are successful the system will be put into service once a certified copy of the form entitled “Watermain Disinfection, Pressure Testing and Acceptance” has been received and accepted. A single failed bacteriological parameter will constitute a failure of the entire sampling round. If sample results do not meet requirements the failed section must be flushed or re-disinfected, as directed by the Project Manager and re-sampled at sample locations determined by The City of Hamilton until all water samples pass both the appropriate chlorine residual and bacteriological requirements as per City of Hamilton Environmental Laboratory testing procedures.

Revised wording:

If sample results are successful the system will be put into service once a certified copy of the form entitled “Watermain Disinfection, Pressure Testing and Acceptance” has been received and accepted. A single failed bacteriological parameter will constitute a failure of the entire sampling round. If sample results do not meet requirements, the failed section must be flushed or re-disinfected, as directed by the Project Manager and re-sampled at sample locations. Sampling will continue until two (2) consecutive sets of water samples, taken 24 hours apart pass both the appropriate chlorine residual and bacteriological requirements as per the City of Hamilton Laboratory testing procedures.

Summary of Changes to Form 500 - Specification for Sewer Pipe Materials and CCTV Inspection:

- Specification references updated including references to Type HS cement.

Summary of Changes to Form 700 - Specification for Portland Cement Concrete:

- Specification references to Type GU (General Use) and HS (High Sulfate Resistant) cement updated.
- Table 700-1 - references to 30 MPa have been revised to 32 MPa.

Summary of Changes to Form 800 - Specification for Hot Mix Asphalt:

- Specification references updated.
- Section 800.02 - Specification for Superpave and Warm Mix added.
- List of approved Warm-Mix technologies added.
- Appendix 800-A Ministry of Transportation Laboratory Testing Method LS-318 – Practice for the Design of Superpave and Warm Mix asphalt added.

Summary of Revisions to the Approved Products List:

As of June 2013, all Approved Products Lists have been combined into one document. Each discipline will have its own section as follows:

- Section 1 – Approved Watermain Products List
- Section 2 – Approved Sewer Products List
- Section 3 – Approved Street Lighting Products List
- Section 4 – Approved Traffic Products List

Replacement divider tabs for binders are provided with paper copies of this revision only.

Summary of Revisions to the Approved Watermain Products List – Section 1:

- Specification and standards references updated.
- PetroWrap added to the Corrosion Protection category.
- Bionax PVCO pipe removed from the Approved Products List.
- Tapping sleeves – Specification references to size on size tapping configurations removed. This practice no longer permitted.
- Pipe restraint for ductile iron pipe - Stargrip Series 3000 and 3100 accepted size range increased up to and including 1200mm.

Summary of Revisions to the Approved Sewer Products List – Section 2:

- Specification references updated including references to Type HS cement.
- Manufacturer names for Saddles updated.

Approved Street Lighting Products List Section 3:

- Decorative Communication Light Pole (CLP) removed from the list.
- List expanded to include LED lighting and associated products.

Approved Traffic Signal Products List Section 4:

- New list added for products used for underground infrastructure related to traffic signal installations.

Summary of Revisions to the Standard Watermain Index and Drawings

- Index updated.
- WM-200.01 Bedding and backfill for concrete and PVC Watermains and Water Services – dimension F revised from D+700mm to D+675mm.

CONSTRUCTION AND MATERIAL SPECIFICATIONS MANUAL INDEX

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June 2006	Form 300 - General Construction Requirements
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June 2013	Form 400 - Specifications for the Installation of Watermains
June 2013	Form 500 - Specification for Sewer Pipe Materials
June 2006	Form 600- Specification for Granular Fill Materials
June 2013	Form 700 - Specification for Portland Cement
June 2013	Form 800 - Specification for Hot Mix Asphalt
June 2006	Form 900 - Specification for Standard Compaction Requirements
January 2011	Form 1000 - Amendments to OPSS and OPSD
	<u>Approved Products</u>
June 2013	Approved Product List
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**400 A PROCEDURE FOR THE DISINFECTION, TESTING AND CONNECTION
OF WATERMAINS**

.01 SCOPE**.01.01 General**

This Specification covers the requirements for the installation of ductile iron, polyvinyl chloride and concrete watermains. All watermains and water services shall be supplied and installed in accordance with OPSS 441 as amended by this specification.

.01.02 Work Included

The Contractor shall, unless specified otherwise, furnish all equipment, tools and labour necessary to do the work required under this contract and unload, haul and distribute all pipe, fittings, valves, hydrants and accessories. The Contractor shall also remove the pavement as stipulated; excavate the trenches and pits to the required dimensions; excavate the bell holes; construct and maintain all bridges for traffic control; sheet, brace and support the adjoining ground structure where necessary; handle all drainage or ground water; provide barricades, guards and warning lights; lay and test the pipe, fittings, valves, hydrants and accessories; backfill and consolidate trenches and pits; restore roadway surface, unless otherwise stipulated; remove and dispose of surplus excavated materials as directed; clean the site of the work; and maintain the street or other surface over trenches as specified.

.02 RESPONSIBILITY FOR MATERIAL**.02.01 Material Furnished by the Contractor**

Unless otherwise noted in the contract documents, the Contractor shall supply all materials required to complete the works. This will include but not be limited to:

The proposed watermain pipe(s) complete with all valves, connections, fittings, specials, thrust blocks, anchor blocks, tee's bends, sleeves, and all lowerings in accordance with the elevations and grades shown on the contract drawings.

Water for testing and disinfection will be supplied by the Contractor. Hydrant usage will require the necessary permit and meterage charges. The Contractor shall be responsible for the transportation of this water from source of supply to point of use.

The Contractor shall be responsible for all material furnished by them and shall replace all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labour required for the replacement of installed material discovered defective prior to the final acceptance of the work.

In addition to Form 200.04.06, all materials supplied by the Contractor shall be in accordance with the applicable current Approved Products List or contract specification. Any material used that is not approved or not appropriate shall be removed and replaced by the Contractor at no cost to the City.

.02.02 Material Furnished by the City

Where the contract documents or drawings indicate that the City will supply materials, the Contractor shall pick-up the required materials at the designated location and haul such materials to the site as required.

The Contractor's responsibility for material furnished by the City shall begin F.O.B. at the point of delivery to the Contractor. Materials already on the site shall become the Contractor's responsibility on the day of the execution of the Contract. The Contractor shall examine all material furnished by the City at the time and place of delivery to and shall reject all defective material.

.02.03 Safe Storage

The Contractor shall be responsible for the safe storage of material furnished by or to them, and accepted by them and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

.02.04 Replacement of Damaged Material

Any material furnished by the City that becomes damaged after acceptance by the Contractor shall be replaced by the Contractor.

.02.05 Disposition of Defective Material

Prior to acceptance of responsibility for safe storage by the Contractor under Section .02.03, any material furnished by the City found to be defective shall be set aside and removed from the site or the work by the City. All defective materials furnished by the Contractor shall be promptly removed by from the site.

.03 HANDLING OF MATERIAL**.03.01 Loading and Unloading**

All pipe fittings, pipe, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

.03.02 Transporting, Unloading, Storing and Handling Pipe

All pipe up to and including 600mm shall be delivered to the site with end covers and a tamper evident seals in accordance with OPSS 441.07.07.

.04 APPROVED WATERMAIN MATERIALS

All watermain pipe, fittings and other materials shall be as listed on the Approved Products List, as amended. Materials shall meet the current version of the applicable standards, including but not limited to CSA, ASTM, AWWA, NSF Standard 61 and OPSS.

Acceptable pipe materials are ductile iron, polyvinyl chloride and concrete pressure pipe.

OPSS 441.05.02 Ductile Iron Pipe - acceptable refer to 400.05

OPSS 441.05.03 Concrete Pressure Pipe Products - acceptable refer to 400.06

OPSS 441.05.04 Polyvinyl Chloride Pipe Products - acceptable refer to 400.07

OPSS 441.05.05 Polyethylene Pipe Products - not acceptable

OPSS 441.05.06 Steel Pipe Products - not acceptable.

OPSS 441.05.07 Copper Pipe – acceptable refer to 400.23.

OPSS 441.05.08 Composite Pipe - not acceptable.

.05 DUCTILE IRON PIPE WATERMAIN

All watermain materials shall be in accordance with AWWA C104, C105, C110, OPSS 441, this specification and be selected from the Approved Products List, latest version.

.05.01 Ductile Iron Pipe Watermain – 100mm to 300mm

Ductile iron pipe shall be Pressure Class 350, cement lined, tyton joint, for 300mm and smaller pipe as per OPSS 441.05.02 with cement lined fittings.

All pipe and mechanical joints of pipe shall be protected Polyethylene Encasement in accordance with this specification and the manufacturers recommendation. Field cut pipe shall be kept to a minimum.

Anchor blocks and joint restraint shall be used at all fittings in accordance with the City's standard drawings, contract documents and the following:

All fittings and valves shall be restrained for a minimum of 18m in each direction.

All fittings at dead ends shall be restrained for a minimum of 18m.

All fittings on all water services 100mm or greater shall be restrained for a minimum of 18m and shall extend to property line.

The connection of any proposed watermain or water service with a diameter

equal to that of the existing watermain shall only be made using a manufactured "Tee".

.05.01.01 Polyethylene Encasement of Ductile Iron Watermain

Polyethylene encasement shall be in accordance with ANSI/AWWA C105/A21.5 and the following:

- (i) Material to be Low Density, polyethylene film having a nominal thickness of 8 mil (.008 inch) in accordance with Section 4.1.1.3
- (ii) Installation Method "A" only to be used. (Poly-Tube with overlap - No sheets)
- (iii) Direct service connection tapping through Triple polyethylene adhesive tape & the polyethylene film is to be used for all service taps.
- (iv) Junctions between wrapped & existing unwrapped pipe - Polyethylene wrap is to cover the adjacent pipe for a distance of at least 0.9 m. Secure the end with sufficient circumferential turns of tape.
- (v) Attached service lines of dissimilar metals shall be wrapped with polyethylene or suitable dielectric tape for a minimum clear distance of 0.9 m away from the ductile iron pipe.

.05.02 Ductile Iron Pipe Watermain – 400mm and Larger

All ductile iron watermain shall be designed in accordance with the Trunk Watermain Design and Construction Parameters given in 400.08.

Pipe shall be Class 52, ductile iron cement lined, with Tyton and/or restrained Joints as per OPSS 441.05.02, with cement lined fittings. All pipe and mechanical joints of pipe shall be protected Polyethylene Encasement in accordance with this specification and the manufacturers recommendation. Field cut pipe shall be kept to a minimum.

Restrained Mechanical Joint for D.I. will be required at all fittings and for suitable length as recommended by the Supplier and shall be installed with strict accordance with the manufacturer's specifications and recommendations. Joints alone shall be capable of withstanding thrust up to 150 psi test pressure.

Anchor blocks and joint restraint shall be used at all fittings in accordance with the City's standard drawings and contract documents.

The maximum permissible joint deflection shall be less than or equal to 50% of the values recommended by the manufacturer.

Polyethylene encasement shall be in accordance with ANSI/AWWA C105/A21.5 and as described in subsection .05.01.01.

Closure pipe shall consist of Restrained Mechanical Joint Fittings and Solid Sleeve.

All dead ends on watermain shall be closed with cast iron plugs/caps or bulkheads that are adequately restrained for pressure testing and provided with a 50mm corporation main stop.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

.05.02.01 Submissions

The Contractor shall supply 2 copies of the following information to the Project Manager prior to installing any pipe:

- a) Letter confirming that the proposed pipe material, fittings and restraint are designed to operate as a complete system that meets all specified watermain design and operating parameters.
- b) Pipe layout drawings and schedules showing the location and type of all pipe, fittings, restrained lengths, valves, method of restraint, location and size of all anchor blocks;
- c) Drawings showing the proposed location of all valve chambers, including detailed dimensions and a listing of all internal components.
- d) Where the City has provided a stamped standard watermain valve chamber drawing, the Contractor shall construct all valve chambers in accordance with the approved standard drawing. Any variations to the approved drawing will require a revised stamped valve chamber drawing submission by the Contractor.
- e) All submissions shall be stamped by an Engineer licensed by Professional Engineers Ontario (PEO) to practice in the Province of Ontario.

.06 CONCRETE PRESSURE PIPE WATERMAIN (400mm and Larger)

All concrete watermain shall be in accordance with AWWA C301 and/or C303, OPSS 441, this specification and be selected from the Approved Products List, latest version. Non-cylinder pipe is not permitted.

400 mm concrete pressure pipe will only be permitted for short repair sections or where specifically approved for use by the City. All concrete watermain shall be designed in accordance with the Trunk Watermain Design and Construction Parameters given in 400.08.

Restrained Joint Concrete Pressure Pipe will be required at all fittings and for suitable length as recommended by the Manufacturer. Joints alone shall be capable of withstanding thrust up to 150 psi test pressure. Joint restraint shall be in accordance with the manufacturer's recommendations, welded joints will not be permitted.

Anchor blocks and joint restraint shall be used at all fittings in accordance with the City's standard drawings and contract documents

Tracer wire shall be installed on concrete pressure pipe shall be light coloured, plastic coated and strapped to the pipe at 6 m intervals and in accordance with 400.11.

Closure pipe shall consist of two lengths of pipe with a dresser coupling. The lengths of pipe shall be made to lengths measured in the pipe trench by the Contractor.

The maximum permissible joint deflection shall be less than or equal to 50% of the values recommended by the manufacturer.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

.06.01 Submissions

The Contractor shall supply 2 copies of the following information to the Project Manager prior to installing any pipe:

- a) Letter confirming that the proposed pipe material, fittings and restraint are designed to operate as a complete system that meets all specified watermain design and operating parameters.
- b) Pipe layout drawings and schedules showing the location and type of all pipe, fittings, restrained lengths, valves, method of restraint, location and size of all anchor blocks;
- c) Drawings showing the proposed location of all valve chambers, including detailed dimensions and a listing of all internal components.
- d) Where the City has provided a stamped standard watermain valve chamber drawing, the Contractor shall construct all valve chambers in accordance with the approved standard drawing. Any variations to the approved drawing will require a revised stamped valve chamber drawing submission by the Contractor.
- e) All submissions shall be stamped by an Engineer licensed by Professional Engineers Ontario (PEO) to practice in the Province of Ontario.

.07 POLYVINYL CHLORIDE (PVC) PIPE WATERMAIN

All PVC watermain shall be in accordance with OPSS 441, AWWA C605, C900, C905, C907, C909, this specification and be selected from the Approved Products List, latest version.

.07.01 Polyvinyl Chloride (PVC) Pipe – 100mm to 300mm

Pipe shall be in accordance with OPSS 441.05.04, and the following:

OPSS 441.05.04 Polyvinyl Chloride Plastic Pipe Products

PVC pipe in sizes 100 mm through 300 mm shall have cast iron outside diameters (CIOD) in all sizes. Pipe shall be jointed by means of integral elastomeric-gasket joints conforming to ASTM D3139.

Polyvinyl chloride pipe (PVC) pipe shall be Class 150, DR18 conforming to AWWA C900 and CSA B137.3;

Fittings for 100mm, 150mm and 200mm PVC pipe shall be injection molded PVC conforming to AWWA C907. Fittings for 250 mm and 300 mm shall be manufactured from segments of AWWA C900 PVC pipe, bonded together and over-wrapped with fibreglass-reinforced polyester to meet the requirements of CSA B137.3.

Anchor blocks and joint restraint shall be used at all fittings in accordance with the City's standard drawings, contract documents and the following:

All fittings and valves shall be restrained for a minimum of 18m in each direction.

All fittings at dead ends shall be restrained for a minimum of 18m.

All fittings on all water services 100mm or greater shall be restrained for a minimum of 18m and shall extend to property line.

Where metal fittings are used on PVC mains, protective coatings and cathodic protection must be provided to the satisfaction of the Project Manager.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

.07.01.01 Service Connection Fittings and Appurtenances – PVC Pipe

OPSS 441.05.12 Service Connection Fittings and Appurtenances

Add the following:

Service connections to 100, 150 and 200 PVC mains shall be made by using PVC molded tapped couplings, conforming to AWWA C907 and CSA B137.2.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

Where approved, service saddles shall be used on PVC watermain requiring a direct tap and shall be selected from the Approved Products List.

All proposed or replacement water services, 100mm or larger, shall be constructed using a pipe material that is the same as proposed watermain material.

.07.02 Polyvinyl Chloride (PVC) Pipe – 400mm to 750mm

All PVC watermain 400mm to 750mm shall be designed in accordance with the Trunk Watermain Design and Construction Parameters given in 400.08.

OPSS 441.05.04 Polyvinyl Chloride Plastic Pipe Products

Revised as follows:

PVC pipe in sizes 400mm to 750mm shall conform to AWWA C905 and shall be designed according to AWWA Manual M23: PVC Pipe-Design and Installation, 2nd Edition. All 400mm pipe shall be DR18. Joints alone shall be capable of withstanding thrust up to 150 psi test pressure.

Fittings for 400mm through 750mm PVC pipe shall be manufactured from segments of AWWA C905 PVC pipe, bonded together and over-wrapped with fiberglass-reinforced polyester to meet the requirements of CSA B137.3.

Joint restraint will be required at all fittings and for suitable lengths as recommended by the manufacturer. Joint restraint shall be installed accordance with the manufacturer's recommendations.

Anchor blocks and joint restraint shall be used at all fittings in accordance with the City's standard drawings and contract documents.

Where metal fittings are used on PVC mains, both corrosion protection and cathodic protection must be installed provided to the satisfaction of the Project Manager.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

.07.02.01 Submissions

The Contractor shall supply 2 copies of the following information to the Project Manager prior to installing any pipe:

- a) Letter confirming that the proposed pipe material, fittings and restraint are designed to operate as a complete system that meets all specified watermain design and operating parameters.
- b) Pipe layout drawings and schedules showing the location and type of all pipe, fittings, restrained lengths, valves, method of restraint, location and size of all anchor blocks;
- c) Drawings showing the proposed location of all valve chambers, including detailed dimensions and a listing of all internal components.
- d) Where the City has provided a stamped standard watermain valve chamber drawing, the Contractor shall construct all valve chambers in accordance with the approved standard drawing. Any variations to the approved drawing will require a revised stamped valve chamber drawing submission by the Contractor.
- e) All submissions shall be stamped by an Engineer licensed by Professional Engineers Ontario (PEO) to practice in the Province of Ontario.

.07.03 Installation of Pipes

OPSS 441.07.14 Installation of Pipes

Add the following:

Excavation and Preparation of Trench shall be completed in accordance with the manufacturers recommendations and AWWA C605.

.07.04 Jointing Polyvinyl Chloride (PVC) Pressure Pipe

OPSS 441.07.15.04 Jointing Polyvinyl Chloride Plastic Pressure Pipe

Add the following:

PVC pipe shall be laid in accordance with AWWA C605. Pipe deflection shall be in accordance with subsection .07.05 Changes in Line and Grade.

Bell and Spigot Joints

The pipe shall be jointed in accordance with AWWA C605 and the manufacturer's specifications. If elastomeric gaskets are supplied separately, they shall be inserted into the groove of the bell end of the pipe.

Lubricant for gaskets shall conform to pipe manufacturers recommendations and shall be NSF-61 approved. Clean the gasket, the bell, the groove area and the spigot area with a clean rag to remove any dirt or foreign material before assembling. Insert the gasket into the groove and seal it firmly. Apply lubricant, as provided by the manufacturer, to the beveled spigot end. Push the lubricated end past the gasket into the bell until the reference mark is even with the bell.

.07.05 Changes in Line and Grade

OPSS 441.07.17 Change in Line and Grade

Add the following:

All pipe joint deflections shall be less than or equal to 50% of the values recommended by the manufacturer. No deflection of the pipe barrel for changes in line or grade are permitted.

.07.06 Polyvinyl Chloride (PVC) Pipe - Cathodic Protection

The following are minimum requirements. Specific soil conditions may require changes to the cathodic protection system. The installation and placement of anodes and tracer wires shall be in accordance with OPSD 1109.011 and the following:

Cathodic protection shall be provided for all tracer wires on PVC watermain pipes. One (1) 5.4 kg zinc anode will be provided for every 1000 m tracer wire.

One (1) 5.4 kg zinc anode is to be installed on all copper service connections, by means of a service ground clamp, coated with T.C. Mastic or wrapped with "Scotchfill" electrical putty or approved equal. The anode is to be placed at least 1.0 m away from the water service and as deep as the service and within 1.0 m of the curb stop.

One (1) 10.8 kg zinc anode is to be installed on each hydrant. If PVC pipe is used between the hydrant tee or anchor tee and the hydrant boot, two (2) 10.8 kg zinc anodes shall be used.

One (1) 5.4 kg zinc anode is to be installed on every valve, and every metallic fitting connected to a PVC watermain. Fittings include bends, tees, crosses, sleeves, reducers, plugs, caps, joint restrainers and couplings.

One (1) 14.5 kg magnesium anode is to be connected to the first length of an existing metallic watermain pipe when connected to a new PVC watermain.

All sacrificial zinc anodes shall conform to ASTM B-418 Type II and shall be made of high grade electrolytic zinc, 99.99 % pure. Magnesium anodes shall conform to ASTM B-107-Type M1.

For all anodes connected to new pipe, fittings or to existing metallic watermains, a Cadwelder and CA-15 or equivalent cartridge shall be used. All thermite weld connections to be coated with T.C. Mastic (Tapecoat of Canada), Roybond 747 Primer and Royston "Handy Cap" or approved equal.

Contractors are advised that there is no specific pay item for Cathodic Protection, all costs shall be included in all other appropriate items.

.08 TRUNK WATERMAIN DESIGN AND OPERATING PARAMETERS – 400 mm AND LARGER

All trunk watermains shall be in accordance with the following requirements:

The pipe manufacturer shall calculate the joint restraint required based on the trench width, cover over the pipe, bedding and pressures indicated in this specification and on the contract drawings.

Watermains, fittings and restraint shall be designed and constructed for operation under the following parameters:

Design / Field Test Pressure	Working Pressure	Surge Pressure (Additional)	Additional External Loads
150 psi	100 psi	100 psi	Hwy. H-20 S16

- a) The factor of safety for pipe and fitting restraint shall be 2 times the design / field test pressure (300psi).
- b) Pipe joints alone shall be capable of withstanding 150 psi test pressure

- c) Trench Type 5 shall be used.
- d) Proposed joint restraint shall be able to accommodate all operating, test and surge pressures independent of anchor blocks.
- e) Anchor Blocks will be required in addition to joint restraint.
- f) All restrained joints shall be installed in strict accordance with the manufacturer's specifications and recommendations and shall include appropriate corrosion protection.
- g) Depth of bury shall be a maximum of 1.6m to top of pipe or less. Where drawings or documents indicate depth of bury less than 1.6m to top of pipe, that value will be used.

.09 VALVE CHAMBERS

.09.01 Chambers

Valve chambers shall be in accordance with OPSS 402, OPSS 1351, City standards and contract drawings. Chambers shall be capable of withstanding the required thrust forces and be selected from the Approved Products List.

Pre-cast chambers shall be supplied from a plant listed as Prequalified under the Plant Prequalification Program by the Ontario Concrete Pipe Association.

.09.02 Valve Chamber Piping

Chamber piping materials shall be ductile iron or concrete pressure pipe in accordance with the following:

.09.03 Ductile Iron

Ductile Iron Pipe shall be a minimum of Class 54, conform to AWWA C151 and be cement lined as per AWWA C104.

.09.04 Concrete Pressure Pipe

Prestressed Concrete Cylinder Pipe shall conform to AWWA C301.

.09.05 Chamber Fittings

Ductile Iron Fittings shall conform to AWWA C110.
Prestressed Concrete Cylinder Pipe shall conform to AWWA C301.

.09.06 Bolts

All nuts, bolts and washers shall be stainless steel. Bolt size, type and diameter shall be in accordance to AWWA C207. Bolt length shall be sufficient to accommodate flanges, gaskets and insulators. Protective coatings shall be applied to all nuts and bolts inside chambers.

.09.07 Design

All pipe and fittings shall be designed to the values given in the Trunk Watermain Design and Operating Parameters – 400 mm and Larger, subsection 400.08.

.09.08 Submittals

Contractor shall supply the following information before ordering or installing any chamber components:

- a) shop drawings, specifications and data sheets for all pipe specials;
- b) valve type, catalogue data, actuator type (with input and output torque ratings), principle dimensions, schedule of parts and materials and expected time of delivery;
- c) Layout drawings for all chamber pipe and internal components.

.10 VALVES

OPSS 441.05.09 Valves

All valves shall be selected from the Approved Products List or as specified in the contract documents.

OPSS 441.05.09.01 General

Revised as follows:

Valve types shall be in accordance with the following:

- a) All gate and butterfly valves installed within the boundaries of the former City of Hamilton are to be open right (clockwise), with the City's 25 mm standard operating nut WM-203.04.
- b) All gate and butterfly valves in the remainder of the new City are open left (counter clock-wise), with the City's 50mm operating nut.

The remainder of the new City of Hamilton shall be defined as the former municipalities of Ancaster, Dundas, Flamborough, Glanbrook and Stoney Creek.

- c) Track and roller option required for horizontal position valves.
- d) Bell end valves not acceptable.
- e) Fasteners including nuts, bolts and bolt studs shall be stainless steel.

.10.01 Gate Valves

OPSS 441.05.09.03 Gate Valves

Add the following:

Valves 75mm to 400 mm shall be ductile iron gate valves.

.10.02 Butterfly Valves

OPSS 441.05.09.04 Butterfly Valves

Add the following:

- a) Valves greater than 400 mm shall be butterfly valves selected from the Approved Products List.
- b) Torque ratings shall be as specified by the City. Contractor shall supply detailed actuator information upon request.
- c) Butterfly valves shall be installed so that the valve seat adjustment faces the spool piece side.

.10.03 Air Release and Vacuum Valves

OPSS 441.05.09.05 Air Release and Air/Vacuum Valve

Revised as follows:

Air release and air/vacuum valves shall be double acting type selected from the Approved Products List.

.11 TRACER WIRE AND CONDUCTIVITY TESTING

.11.01 Tracer Wire

Tracer wire shall be installed on all new installations of polyvinyl chloride and concrete pressure pipe including mains, branches and services. The wire shall be positioned along the top of the pipe and fastened at 6 metre intervals. Tracer wire shall be as listed on the Approved Products List.

The wire is to be installed between each valve and/or the end of the new watermain. Joints in the wire between valves shall be avoided. At each valve and hydrant secondary valve, the tracer wire loop shall be brought up the outside of the valve box and inserted into the tracer wire opening in the upper section. Insertion point shall be clear of the lid and use a protective grommet. Tracer wire shall be secured to the outside of the valve box near the top prior to backfilling. The tracer wire shall also be connected to the cathodic protection system as required.

Splices in tracer wire shall be done using a splice kit approved for use in direct bury underground use.

.11.02 Conductivity testing

The Contractor will be required to conduct all tracer wire conductivity testing to ensure that the tracer wire is installed correctly and intact. Testing shall be conducted by authorized personnel using approved testing equipment and shall be supervised by the Contract Inspector or Project Manager. No payments for watermain works shall be processed until tracer wire testing is completed and accepted by the City. All costs for conductivity tests shall be included in the watermain item. If the tracer wire is not electrically continuous from valve to valve, the contractor shall, at their expense, replace or repair the wire as required.

.12 TEMPORARY WATER SERVICE BY-PASS FOR CONSUMERS

Where called for or where needed, the Contractor shall provide, maintain and remove by-pass piping in accordance with OPSS 493, Appendix A attached to this specification and the following requirements.

12.01 Submissions

In order to evaluate the impact on the water network as a whole and the ability of the by-pass pipe to provide the volumes and flows required, the Contractor shall provide the proposed by-pass system layout proposal to the Project Manager for review and written approval. The Contractor shall not commence the installation of any by-pass materials in the absence of such written approval.

The Contractor will be required to revise the by-pass system and construction staging per the conditions provided in the written approval and shall provide revised drawings.

The Contractor shall have no basis for increased working time due to these requirements, revisions and/or conditions and all associated costs will be deemed to be included in the unit prices bid.

The Contractor shall supply 3 prints of the by-pass proposal a minimum of 3 weeks in advance of installation. Drawings of the system(s) being proposed shall be 1:500 metric scale (hard copy and PDF format) will be submitted to the Project Manager for approval. The Contractor shall provide By-pass Piping Submissions, for all phases of the bypass installation, in accordance with Form 400 and the following requirements.

- construction staging
- pipe sizes, manufacturer and material
- by-pass connection points/details
- back flow preventer size, location and manufacturer
- temporary hydrants connection points
- water services connection points

- horizontal location of the by-pass pipe in the road allowance
- locations and the materials used to ramp over the by-pass pipe
- locations where by-pass pipe is to be buried and the associated temporary restoration

.12.02 General Description

Temporary by-pass pipe, where required, shall be laid above ground to supply water to consumers connected to a pipeline while that pipeline is out of service. An approved back-flow preventer shall be used by the Contractor whenever connecting to a hydrant.

Temporary by-pass shall include hoses and the necessary outlet/fittings to each house service connection. The contractor shall maintain the temporary water lines in safe operating condition at all times. The Contractor shall be required to mound over the by-pass wherever it crosses a street, driveway, or sidewalk, in order to prevent injury to vehicular and pedestrian traffic. Lights and barricades shall be furnished and maintained by the Contractor when required by the Project Manager. When a replaced section of watermain is restored to service, the Contractor shall remove any corresponding temporary pipe and house service connection and shall leave the street, sidewalk and adjacent property in a neat and orderly condition.

.12.03 By-Pass Pipe and Materials

The size, pipe, hose and other materials furnished by the Contractor for the temporary service pipe and connections to house services/branches, shall be approved by the Project Manager and be fully adequate to withstand the indicated pressures and all other conditions of use. The pipe and fittings shall provide adequate water tightness and be disinfected prior to being put into service.

.12.04 Service of Water to Feed By-Pass

The Contractor shall furnish all above and below ground connections required to provide the necessary pressurized water to feed the temporary by-pass line. All connections shall be at reasonably close and convenient locations and hydrants will be used whenever available.

.12.05 Temporary Connection to Customer

The Contractor shall make all shut-offs of consumers services and the final connections from the by-pass pipe to the consumer using flexible hose. Special connections requiring excavation, cutting or tapping shall be made by the Contractor. The Contractor shall notify the customer concerning this operation in advance. When the pipeline has been replaced, the Contractor shall clean the service by back-flushing with air or water. Once the pipeline is returned to service, the Contractor shall restore the consumer to service and disconnect the hose from the consumer connection. Where admittance to the customer's premises is denied or impossible, by virtue of absence, the connection cannot be

cleared, it may be necessary to excavate and clear the service at the main. This shall be paid for on a unit price basis stated in the Form of Tender - Schedule of Quantities and Prices.

Where 100mm diameter Temporary Connections to the Consumers are called for, the length of the 100mm diameter piping required will be paid at the unit price for 100mm diameter Temporary By-Pass Piping. Cutting-in or tapping shall be provided by the Contractor and is included in the price bid.

All temporary service Connection materials shall conform to the NSF 61 standard. All hose used for individual property connections shall be minimum 20mm I.D., designed for a working pressure of 860 kPa and be free from defects in materials and workmanship.

The pipe, hose and all other materials supplied by the Contractor for temporary servicing shall be approved by the Project Manager. Materials shall be fully adequate to withstand the pressures and other conditions of use and shall be of material which does not impart any taste or odour to the water in accordance with NSF 61 Standard. 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 the possible pollution of any City main/property services or the contamination of the temporary service pipe. Flushing of the private service connections and chlorination of the by-pass line prior to their use will be required. The temporary service connection shall be valved near the point of connection to the by-pass and also to the private plumbing system so that, except for the final connection, the by-pass line and private services may be chlorinated.

During freezing, stormy or inclement weather, no work shall be done except that which is directed by the Project Manager. 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 directed by the Project Manager. Removal and re-installation of such pipes or services shall be done at the Contractor's expense.

Each home shall have its own temporary water service connection to the by-pass pipe and a connection to the private plumbing via a wye at an outside tap. The branching of wyes from a single spigot shall not be permitted; nor will connecting homes in series. An approved hose connection vacuum breaker (HCVB) shall be supplied on the open end of all wyes.

It shall be the responsibility of the Contractor to ensure an adequate water supply at all times. During the construction process, the Contractor is responsible for restoring a customer's water supply within two hours of notification from the Project Manager.

.12.06 Disinfection of Temporary Service Connections

Temporary service connections shall be chlorinated at the commencement of the contract works. Disconnection and relocation of service connections from one site to another within the contract works will not be subject to re-chlorination, unless otherwise directed by the Project Manager.

Where temporary service connections are disinfected in conjunction with the temporary by-pass watermain no physical connections to hose bibs will be permitted until after successful disinfection.

Where temporary by-pass service connections are disinfected offsite in a controlled environment, one set of samples shall be collected from every 350m of service hose connected in a series. One set of samples shall also be taken from source and at each end of any hose group connected in series, regardless of the total length. Where temporary by-pass service connections are disinfected in conjunction with the temporary by-pass water main additional samples must be taken at the end of any two (2) temporary by-pass service connections for every 350m of temporary by-pass watermain disinfection.

.13 EXCAVATION AND PREPARATION OF TRENCH

.13.01 General

The trench shall be excavated only so far in advance of pipe laying as permitted. Removals shall be in accordance with Form 300 – General Construction Requirements.

.13.02 Alignment and Grade

Refer to OPSS 441.07.14., 441.07.17

.13.03 Deviations Occasioned by Other Structures

Refer to OPSS 441.07.14, Form 200.02.05, 200.02.06 and 200.03.18.

.13.04 Pipe Bell Bedding

Bedding shall be shaped and compacted adequately support pipe barrel and bells as required.

.13.05 Excavation to Grade

Refer to OPSS 441.07.08 and 441.07.14.

.13.06 Excavation in Poor Soil

Where the bottom of the trench at the required pipe grade is found to be unstable or to include ashes, cinders, all types of refuse, vegetable or other organic material or large pieces or fragments of inorganic material which in the opinion of the Project Manager should be removed, the Contractor shall excavate and remove such unsuitable material to the width and depth required by the Project Manager. The Contractor shall be allowed extra compensation for this work provided for in Form 200.

.13.07 Excavation in Rock

Where excavation is made in rock or boulders, the trench shall be excavated to the width and depths that are required to provide for the granular bedding shown on plans.

In areas where the proposed watermain trench bottom varies from rock to earth, the Contractor shall taper the bottom of the earth trench over a two (2) metre length and supply, place and compact Granular "A" in this section to minimize any differential settlement between the two (2) bedding conditions.

.13.08 Special Foundation in Poor Soil

Where the bottom of the trench at subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Project Manager, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of piling, timbers or other materials, in accordance with plans prepared by the Project Manager. Extra compensation will be allowed for such additional work as per Form 200.

.13.09 Preparation of Trench Bottom

The bottom of the trench at pipe grade shall be finished to within 9mm of a straight line between pipe joints or batter boards and all tolerances shall be above the specified grade. It will only be permissible to disturb the finished surface over a distance of 450mm near the middle of each pipe for the withdrawal of slings or other lifting tackle.

.13.10 Preparation of Trench Bottom Below Grade

Where the trench has been excavated below pipe grade the Contractor shall place Granular "A" in 150mm layers to the required grade. Each layer shall be compacted by approved vibratory tampers to obtain 95% of the Standard Proctor Maximum Dry Density. The surface of the compacted granular material shall be finished to provide a continuous uniform support for the pipe at grade to the accuracy specified in subsection .13.10.

Unless otherwise specified, when the trench bottom has been excavated below the required pipe grade, the preparation of the trench bottom to pipe grade will be at the Contractor's expense. When the trench bottom is excavated below the pipe grade at the direction of the Project Manager, the preparation of the bottom of the trench to pipe grade will be allowed as extra compensation as provided for in Form 200.

.13.11 Care of Surface and Excavated Material for Reuse

Refer to Form 300.22.

.13.12 Piling Excavated Material

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Hydrants, valves, utilities

and drainage courses shall be left unobstructed and accessible until the work is completed.

.13.13 Interruption of Service, Shutting Down or Charging of Mains

OPSS 441.07.21 Shutting Down or Charging of Mains

Revised by the following:

No valves or other controls on the existing system shall be operated for any purpose by the Contractor. Only City employees will operate such valves, hydrants, blow-offs and curb stops. Refer to Form 300.20 Connecting to Existing Plant and Appendix A.

.14 BEDDING AND BACKFILL OF WATERMAINS

.14.01 General

OPSS 441.07.13, 441.07.14 and 401.07.10 are revised by the following:

Bedding and backfill shall be conducted in accordance with the depths and widths specified on the standard drawings and/or on the contract drawings. No type of slag including steel slag, blast furnace slag or nickel slag will be permitted for bedding or backfilling of watermains or water service trenches. All granular bedding and cover materials shall meet the requirements of Form 600.

.14.02 Bedding

Bedding shall be Granular material conforming to Form 600, placed in accordance with WM-200.01 and 200.02. Granular material shall extend to a minimum of 300 mm above the top of pipe. Bedding materials shall conform to Form 600 and shall be compacted in accordance with Form 900.

No type of slag including steel slag, blast furnace slag or nickel slag will be permitted for bedding of watermains.

.14.03 Backfill

Unless otherwise specified on the contract drawings or documents, trenches may be backfilled with select, approved native excavated earth materials from trenches. Where these materials are unavailable or deemed to be unsuitable, granular backfill will be used. Where granular backfill materials are used, they shall conform to Form 600 and shall be compacted in accordance with Form 900.

No type of slag including steel slag, blast furnace slag or nickel slag will be permitted for backfilling of watermain trenches.

The use of unshrinkable fill shall be employed where normal means cannot produce the required compaction of the material.

.14.04 Summary of Bedding and Backfill Materials

Bedding and backfill of watermains shall be in accordance with the following:

.14.04.01 Ductile Iron and Polyvinyl Chloride (PVC) Pipe Watermain

Bedding and cover - Granular "A"

Backfill - Select approved excavated native materials or Granular "A" or "B"

.14.04.02 Concrete Pressure Pipe Watermain

Bedding and cover - Granular "A" or "B"

Backfill - Select approved excavated native materials or Granular "A" or "B"

.14.04.03 Water Services

Bedding and cover – Granular D (crushed stone)

Backfill: approved excavated native materials or Granular "A" or "B"

.14.04.04 Hydrants

Bedding and cover - 19mm washed crushed stone

Backfill approved excavated native materials or Granular "A" or "B"

.15 LAYING

.15.01 Laying Pipe

At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a suitable watertight plug. Before filling main with water in freezing weather, exposed pipe and fittings shall be covered with straw, or other approved means shall be taken in order to prevent freezing.

Refer to also OPSS 441.07.14 and 441.07.15.

.15.02 Cutting Iron Pipe

The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe and in accordance with the manufacturer's recommendations.

The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed nor shall the cutting of pipe with hammer and chisel be allowed.

.15.03 Bell Ends to Face Direction of Laying

Refer to OPSS 441.07.14

.15.04 Unsuitable Conditions for Laying Pipe

Refer to OPSS 441.07.14

.16 JOINTING MECHANICAL-JOINT PIPE

.16.01 Assembling Joints

Refer to OPSS 441.07.15.

.16.02 Bolting of Joint

Refer to OPSS 441.07.15 and all nuts shall be tightened with a suitable torque-limiting wrench. The torque for various sizes of bolts shall be as follows:

SIZE Mm	RANGE OF TORQUE N·m
16	55-80
19	80-120
25	95-135
32	120-160

Nuts spaced 180° apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

.16.03 Permissible Deflection in Mechanical-Joint Pipe

Refer to Table 4.1 in Form 1000 – Amendments to Ontario Provincial Standards Volume 1, Division 4 - Drainage and Tunnels.

.17 JOINTING STEEL CYLINDER REINFORCED CONCRETE PIPE

Refer to OPSS 441.07.15 Jointing

.18 JOINTING TYTON-JOINT PIPE

.18.01 Cleaning and Assembling Joint

Refer to OPSS 441.07.15 Jointing

.18.02 Preparation of Spigot on Site

Where spigots require preparation on site, the outside of the spigot shall be filed to produce an angle of approximately 30 degrees.

.18.03 Electrical Conductors

"Lockwedges" or strap-type electrical connections supplied by the pipe manufacturer shall be provided at each joint to ensure electrical conductivity. A minimum of two wedges per joint shall be installed in accordance with the manufacturer's directions.

Strap-type electrical connections shall be connected at each joint in accordance with manufacturer's directions.

The wedges shall be installed only after the pipe has been laid to proper line and grade and shall be preferably located at 180⁰ apart.

.18.04 Permissible Deflection in Tyton-Joint Pipe

Refer to Table 4.2 in Form 1000 – Amendments to Ontario Provincial Standards Volume 1, Division 4 - Drainage and Tunnels.

.18.05 Jointing Flange Pipe

Unless otherwise specified, the Contractor shall furnish all bolts, studs, nuts and gaskets required to completely connect up all flanged pipe, fittings, flanges and other appurtenances attached to the pipe.

All bolts and nuts shall have American Standard threads of the Coarse Thread Series, and shall conform to ASA B18.2. For sizes 28mm diameter and below, they shall be of the conventional type and the material shall conform to ASTM

A-307 (Grade B). Materials for bolts and studs 31mm diameter and above shall conform to ASTM A-193 (Grade B-7) or to ASTM A-325 (S.A.E. Grade 5). Nuts shall conform to ASTM A-194 Grade 2H. Bolts shall have hexagonal heads and shall be held with hexagonal semi-finished nuts. The length of any bolt shall be such that it will not project beyond the nut more than 13mm or less than 6mm, and no bolt shall be less than the diameter of the hole in which it fits by more than 3mm.

Gaskets shall be red rubber full faced 3mm thick in accordance with dimensions given in the latest edition of ASA B16.21 for Non Metallic Gaskets for Pipe Flanges.

.19 SETTING VALVES AND FITTINGS

.19.01 Valve Boxes

Valve boxes shall be used for secondary valves at hydrants and where indicated on the watermain plans and profiles. Valve boxes shall be centred and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed. Refer to Standard Drawing WM-202. Installed valve boxes over gate valves shall be staked and the marking on the stake shall read "Gate Valve".

.19.02 Drainage of Mains

Drainage branches, blowoffs, air vents and appurtenances shall be provided with gate valves. Drainage branches or blowoffs shall not be connected to any sewer, submerged in any stream or be installed in any other manner that will permit back siphon into the distribution system.

.19.03 Dead Ends

All dead ends on new mains shall be closed with cast iron plugs or caps and provided with a 19mm corporation main stop.

.20 HYDRANTS

Hydrants supplied shall be in accordance with OPSS 441.05.10, as amended by City standards and must be selected from the Approved Products List. Hydrants shall be installed in accordance with OPSS 441.07.19, as amended and the following:

The contractor shall supply and install the standard 3-way hydrants complete with secondary valves. Hydrant extensions and connections to the proposed watermains in accordance with drawing WM-203.01 and WM-203.02, in the locations shown on the contract drawings. All hydrant extensions shall be done from the bottom, at the boot. No extension from the top will be permitted.

All proposed or replacement hydrant lead pipe material (DI or PVC) shall match the proposed watermain pipe material. Fittings at the watermain can be either DI or PVC.

The contractor shall paint all parts of the hydrant above ground "Red", including caps and bonnets, using Exterior Gloss Alkyd type CGSB 1-GP-59 paint. The Contractor shall apply a minimum 2 mm thickness in addition to the factory supplies primer and finish coat as required by Annual Supplies Specifications. The surface to be painted shall be clean, dry and free of grease.

For bedding and backfill requirements refer to 400.14.

.21 BACKFLOW PREVENTERS

OPSS 441.05.11 Double Check Valve Backflow Preventers

Backflow preventers shall be as selected from the Approved Products List, as amended.

.22 ANCHORAGE

.22.01 Anchorage for Fittings

All fittings shall be anchored according to the method shown on the standard drawings or as otherwise directed. The concrete shall be placed such that the joints will be accessible for repairs.

.22.02 Metal Harness

Metal harness of tie rods or clamps of adequate strength to prevent movement may be used instead of concrete backing, or if directed. Steel rods or clamps shall be galvanized or otherwise rustproof treated, or shall be painted as shown or directed.

.23 WATER SERVICES

Water services shall installed in accordance with AWWA C800, OPSS 441 and be selected from the Approved Products List.

.23.01 Services – 19mm to 50mm Diameter

Refer to OPSS 441.07.15.07 Service Connection Pipe and the following:

Water service pipe shall be Type "K" soft copper and include the connection at the main and a curb stop with rod.

19mm and 25mm water services shall be installed in accordance with WM-207.01

50mm water services shall be installed in accordance with OPSD 1104.02

Connections to ductile iron watermain pipe shall be in accordance with 400.05.

Connections to PVC watermain pipe shall use a service saddle and be in accordance with 400.07.

Where a water service is connected to a 50mm copper watermain loop, the connection shall be in accordance with WM-205.01 or WM-205.02.

Insulation of water services, where required, shall be in accordance with WM-207.03.

.23.02 Services - 100mm Diameter and Larger

Service connections shall be in accordance with OPSS 441.07.15.07 Service Connection Pipe and the following:

Services shall be installed in accordance with WM-207.04 and WM-207.05, include the connection at the main, a reducer where required, a gate valve and valve box at property line.

Service pipe shall be either ductile iron or polyvinyl chloride in accordance with Section 400.05 or 400.07 and shall be constructed using the same pipe material as the proposed watermain. Fittings at the main can be either DI or PVC.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

All fittings on all water services 100mm or greater shall be restrained for a minimum of 18m and shall extend to property line.

.23.03 Curb Boxes

Curb boxes are to be located in accordance with standard watermain drawing WM-207.01 and 207.02 or as otherwise directed.

The Contractor shall indicate the positions of all water services installed in the following manner:

At each curb box location, a 1.83 metre, 50mm x 100mm wooden stake shall be planted and shall have a 1 metre bury. Stakes shall be painted white, and each shall bear, on its broad side, above ground, the words "WATER SERVICE", painted in black.

The Contractor shall be responsible for the preservation of all marker stakes. Where stakes are damaged or displaced in any way, the Contractor shall arrange to have the stakes replaced and accurately positioned, at their own expense.

.23.04 Trench for Water Service

The Contractor shall excavate and backfill the service trench from the watermain to the street line to a minimum depth of 1.6 metres below the proposed road grade whichever is the lower elevation unless otherwise directed.

.23.05 Laying Water Service Pipe

The Contractor shall lay the service pipe and install fittings to the street line. Soldered joints will not be permitted.

The service shall be bedded in accordance with Standard Drawing No. WM-200.01 and WM-200.02.

If laid over a Sewer Service or in a rock trench, the pipe shall be laid on a minimum of 150mm of tamped earth or sand. Service corporation fittings shall be installed into the watermain under pressure.

Valves in service pipe lines shall be properly braced before any pressure test is conducted.

Backfill for water service trenches shall be as specified for the watermain trench.

Service pipe at street line shall be temporarily plugged to prevent entrance of foreign material.

.23.06 Leaks in Services

All leaks that may develop in service lines laid by the Contractor within two years after date of completion of contract shall be immediately repaired by the Contractor when notified by the Project Manager. Emergency repairs will be made by the City at the Contractor's expense.

.24 CONCRETE AND MORTAR

.24.01 Materials

Refer to OPSS 441.05.13, 441.07.23 and Division 9. Concrete shall be High Sulfate Resistant (formerly Type 50) in accordance with OPSS 1301 and Form 700.

.24.02 Proportioning and Mixing Mortars

Refer to OPSS 441.05.14 and Division 9.

.24.03 Jointing Old and New Work

All joints between different sections of concrete masonry shall be made in an approved manner after the adjoining surfaces are cleaned, washed, roughened and coated with a neat cement grout, at locations approved of by the Project Manager, suitable provisions being made for the bonding of said joints.

.24.04 Placing in Water

No concrete shall be laid in water, except by permission of the Project Manager, nor shall water be allowed to rise and flow over newly placed concrete for a period of 24 hours.

.24.05 Forms

Forms shall be of such strength and rigidity and so supported that they will not deflect objectionably under the weight of pressure of the wet concrete.

They shall be properly braced and tied together so as to maintain position and shape, and prevent leakage of mortar.

Forms shall be so constructed that the finished concrete will conform to the shapes, lines, grades and dimensions indicated on the plans.

The face adjacent to the exposed concrete face shall consist of dressed lumber, smooth and clean.

.24.06 Form Removal

Shoring and forms shall not be removed before the time determined by the Project Manager.

.24.07 Curing of Concrete

After concrete has sufficiently set, its exposed surfaces shall be kept continuously moist for a period of at least seven (7) days.

Effective means shall be provided for maintaining the temperature of the concrete at not less than 10 Degrees C for at least 72 hours after placing. The temperature shall then be reduced at a maximum rate of 5.6 C. Degrees per day until that of the surrounding atmosphere has been reached.

No concrete shall be deposited on ground that is frozen or which contains frozen materials.

Hydrostatic testing shall not be carried out until concrete anchor or thrust blocks have a minimum of 5 days curing time.

.24.08 Finish

Special care shall be used to secure smooth, uniform finish to the exposed surface of concrete. After form removal, concrete surfaces shall be immediately rubbed smooth to a uniform, satisfactory finish, and all surfaces subject to wear shall be faced with facing mixture where shown on the plans.

.24.09 Defects

Should any voids or other defects be discovered in any part of the work when the forms are taken down, or at any other time, the defective work shall be removed and the space refilled with a suitable concrete mortar in a proper manner at the expense of the Contractor.

.24.10 Reinforcing Steel

The ties for reinforcing shall not show on the exposed face of the concrete. All steel for reinforced concrete shall be supplied by the Contractor.

.25 DISINFECTION, TESTING AND CONNECTION OF WATERMAINS

OPSS 441.07.25 - Flushing and Disinfecting Watermains

Revised as follows:

All connections, flushing, hydrostatic testing, swabbing, and bacteriological testing procedures shall be in accordance with Appendix 400-A attached to this specification.

APPENDIX 400 A PROCEDURE FOR THE DISINFECTION, TESTING AND CONNECTION OF WATERMAINS

1.0 INTRODUCTION

1.1 Scope: Watermain Installation and Testing Procedures

This procedure covers the cleaning, disinfection, hydrostatic testing and sampling of watermains. Unless specified otherwise this procedure applies to all new watermains, above ground by-pass watermains and relined watermains.

1.2 Definitions

Project Manager – shall be the City of Hamilton, Public Works, Capital Planning, Development Engineering and Implementation Project Manager.

Construction Inspector – shall be the City of Hamilton, Public Works, Environment and Sustainable Infrastructure construction inspector.

Development Engineering Inspector - shall be the City of Hamilton's Planning and Economic Development construction inspector.

Specialist – shall be a company specializing in regulated water systems or a company approved by the Project Manager, whose personnel hold a minimum MOE, O.Reg. 170/03 Water Distribution Licence or licenced City of Hamilton Staff.

Contractor – shall be the person, partnership or corporation undertaking the Work as identified in the agreement.

CHEL – shall be the City of Hamilton Environmental Laboratory

CSR – shall be a City of Hamilton Customer Service Representative

CS&C0 – shall be City of Hamilton Customer Service and Community Outreach section

Disinfectants – shall be Calcium or Sodium Hypochlorite that meets or exceeds AWWA Standard B300.

LIMS – shall be the City of Hamilton Environmental Laboratory work order database

LWO Number – shall be the City of Hamilton Environmental Lab Work Order Number

Neutralizing Agent – shall be Sodium Thiosulfate that meets or exceeds AWWA Standard C651.

SDWA- Ontario Safe Drinking Water Act.

NSF 61 – National Sanitation Foundation

1.3 References

These procedures are based on, and shall be used in conjunction with, the Ontario Provincial Specifications (OPS), the American Waterworks Association (AWWA C651) Standards, and the Ontario Safe Drinking Water Act, City of Hamilton Design Criteria, CAN/CSA-B64.10

1.4 General Requirements For Watermain Installation

Keep pipes clean and dry. Take precautions to protect the interiors of pipes, fittings, and valves against contamination. Night plugs to be install when work is not in progress. Remove plugs only when connecting next pipe or appurtenance or continuing work. Pipes shall not be laid in water. Existing watermains, which are dead ended during construction, shall have a minimum 25 mm bleeder installed at the dead end. New watermains which are temporarily dead ended shall have a minimum 50mm blow off installed with a temporary cap if there is no hydrant “downstream” of the last water service on the watermain.

1.5 Supervision, Testing and Records

The City of Hamilton’s Construction Inspector shall witness all cleaning, hydrostatic testing, disinfection, and sampling activities. The Specialist / qualified person carrying out the cleaning and disinfection in conjunction with the City’s Construction Inspector shall take and record measurement on The City of Hamilton approved Watermain Disinfection, Pressure Testing and Acceptance form.

1.6 Valve Operation

The Contractor should note that The City of Hamilton Water Distribution staff must perform the operation of all existing valves inclusive of hydrant secondary valves. In an emergency the City of Hamilton’s Inspector may direct or operate valves.

The opening and closing of any valve should be coordinated with The City of Hamilton’s Construction Inspector. All residences shall be notified 48 hours prior to a planned disruption of water service.

1.7 Forms

The following forms are attached to this document: “Watermain Disinfection, Hydrostatic Testing and Acceptance”, “Chlorine Residual”, and “Schedule”.

1.8 Connection and Testing Procedures Plan

The Contractor shall provide a plan to the Project Manager and Construction Inspector, detailing the connection locations, swabbing locations, hydrostatic testing, chlorination and dechlorination methods, disposal of water, and final connection methods. If the project is being constructed in phases, this plan shall detail each of these items for each phase.

2. WATERMAIN TESTING PROCEDURE

This document to be read in conjunction with the forms entitled “Watermain Disinfection, Pressure Testing and Acceptance”, “Chlorine Residual”, and “Schedule”. These procedures are to be used in conjunction with the Ontario Provincial Specifications (OPS), the American Waterworks Association (AWWA) and the Ontario Safe Drinking Water Act (SDWA).

All required low-end chlorine residual tests shall be performed by the Specialist / Construction Inspector, with an electronic tester such as a Hach Pocket Colourimeter or equivalent, which is to be supplied by the Contractor/Specialist and witnessed by the Construction Inspector.

All works associated with leakage, testing, swabbing, chlorination, dechlorination and sterilization of the watermain are to be performed by a company specializing in this work or a company approved by the Project Manager.

Temporary by-pass piping shall meet all procedures and requirements of new watermain with the exception of hydrostatic pressure testing. A visual check shall be performed at line pressure on a temporary by-pass to ensure that it is leak free.

2.1 Temporary Connection and Backflow Preventer

The temporary connection is to be used for all water supplies to maintain continuous supply of water, unless otherwise noted. The size of the temporary connection shall be; 50mm diameter for watermains up to and including 200mm diameter, and 100mm diameter for watermains 250mm diameter to 400mm diameter inclusive. (All materials for the temporary connections are to conform to The City of Hamilton Approved Products List.). Watermains larger than 400mm in diameter shall be as per design standards.

The hydrant adapter (backflow preventer / meter) shall be a reduced pressure principle type and shall be supplied by the City of Hamilton upon receipt of request from the Project Manger on behalf of the contractor. Development Engineering will have special considerations as per the City of Hamilton Development Inspector. The adapter shall be installed and hydrant charged by a City of Hamilton Water Distribution Operator. The hydrant(s) that will be utilized as the source for the temporary by pass will be determined by the City of Hamilton Project Manager in consultation with City of Hamilton Water Distribution staff.

The existing distribution systems and the backflow preventer shall be physically disconnected from the test section during hydrostatic testing.

2.2 Charging of Watermains

The watermain is to be loaded via a temporary connection equipped with a backflow preventer.

2.3 Swabbing

The watermain is to be loaded (charged or pressurized) prior to the commencement of swabbing. The Construction Inspector is to record, on the “Watermain Disinfection Pressure Testing and Acceptance form”, the number of swabs inserted and retrieved. The main valve seat of the hydrant must be removed and a blind seat installed to prevent undermining the soil at the hydrant boot. Full reinstatement of the hydrant shall begin immediately after the swabbing process is completed. All swabs must be inspected prior to insertion and immediately after they exit the watermain to ensure that they have remained intact and that pieces of the

foam do not stay in the watermain. The swabs should also be numbered and carefully controlled by the Specialist and Construction Inspector to ensure that all swabs that are introduced into the watermain are retrieved and accounted for. Only new swabs will be permitted for use and under no circumstances will used swabs be allowed.

All watermain pipes must be swabbed with a minimum of THREE swabs plus a minimum of one swab shall be passed through each hydrant lead, large diameter water service, stub or blow-off. Additional swabs shall be used as directed by the Project Manager or Construction Inspector if discharge water does not run clear within ten seconds of the swab exiting the discharge point. No additional payment shall be made for subsequent swabbing. Swabs shall be forced through the watermain using potable water so that they maintain a minimum velocity of 0.6 to 1 meter per second. The Project Manager must approve all methods of disposal of the discharged water. The Contractor shall take the necessary precautions to minimize soil erosion and shall reinstate the area upon completion.

The swabs must be new open cell polyurethane foam, having a density of 1.5 pounds per cubic foot (24 kilograms per cubic meter), and are to be a minimum of 50mm larger than the nominal pipe diameter with a length at least one and a half times its diameter. Watermains 300mm or smaller shall be swabbed through hydrants on approval by the Project Manager. Procedures for swabbing watermains larger than 300mm must also be approved by the Project Manager.

2.4 Hydrostatic Testing

Leakage tests shall be applied to the section of watermain after the swabbing. The Contractor shall ensure that no air pockets are present in the section of watermain. The existing distribution systems and the backflow preventer shall be physically disconnected from the test section during hydrostatic testing. All hydrant assemblies shall be removed and a "blind flange" installed prior to conducting the pressure test. The ends of the mains shall be capped and the main filled with potable water under a pressure of 1035 kPa after which all visible leaks shall be stopped. Leakage shall then be measured by a calibrated meter with readings taken at fifteen minute intervals for a period of two hours and recorded on the "Watermain Disinfection, Pressure Testing and Acceptance form". The average rate of leakage shall not exceed 1.54 litres per mm of pipe diameter per km of pipe per day, and if the leakage exceeds this figure the contractor shall locate and correct the leaks. The watermain is to be tested in sections, where a section is a length of watermain between two valves, or a valve and a dead end. Should the contractor wish to test more than one section at a time, the Project Manager/ Inspector will calculate the allowable leakage for all sections within the tested portion and the smallest calculated leakage will become the allowable for the entire tested portion. The cost of the labour and the materials required shall be borne by the Contractor.

If the test is not successful the leak is to be found, repaired and the hydrostatic test to be applied again until it is successful.

Temporary above ground by-pass piping shall meet all procedures and requirements of new watermain with the exception of hydrostatic pressure testing. A visual check shall be performed at line pressure on a temporary by-pass to ensure that it is leak free.

2.5 Disinfection of Watermains

The method of disinfection to be used is the continuous feed method. The chlorine is to be injected into the system through the access point on the temporary connection. The chlorine solution is to be thoroughly mixed prior to pumping it into the system. The Specialist shall

ensure that no air pockets are present in the section of watermain. The chlorine solution shall be applied so that the chlorine concentration is a minimum of 50mg/L throughout the system and does not exceed 100mg/L and recorded. The chlorine solution is to be flowed through each hydrant and blow-off. The high chlorine residual is to be measured by the Specialist at each sample location and recorded by the Construction Inspector.

The high chlorine concentration will be isolated in the system for a minimum of 24 hours and recorded on the "Watermain Disinfection, Pressure Testing and Acceptance form". After the required contact time, the chlorine residual is to be taken at each sample location by the Specialist and recorded by the Construction Inspector. Flow required to take the chlorine residuals shall be provided through the temporary connection. If the chlorine residual is at or above 25mg/L the chlorine is ready to be discharged. In the event that the chlorine residual is less than 25mg/L, the chlorine in the system is to be discharged, and the system is to be rechlorinated. The Construction Inspector has the authority to require further swabbing if the residual is less than 25mg/L. Once this has been achieved, the watermain shall be flushed and sampled for appropriate chlorine residual levels. Minimum acceptable levels; Combined chlorine residual: 0.25mg/L and Free chlorine residual: 0.05mg/L.

2.6 Removal/Disposal of Super Chlorinated Water

The Contractor shall be capable of de-chlorinating the discharge water to protect receiving streams and other bodies of water, via catch basins or other points of entry, as per the Ministry of Environment (MOE) regulations and ANSI/AWWA C651 as amended. Dechlorination is not required when discharging directly into a Sanitary Sewer or Combined Sanitary Sewer system. If in near proximity to the sewer treatment plant, the plant is to be notified and approve receiving the water. The Contractor will be required to supply all labour, equipment and materials to dechlorinate water which includes, but is not limited to, dechlorination mats, diffusers, dechlorination chemicals and techniques. There shall be no separate payment for de-chlorination.

2.7 Bacteriological Sampling

Before the watermain, or temporary above ground by-pass system can be approved for connection to the existing water distribution system, two (2) consecutive rounds of water samples, taken 24 hours apart, shall pass the appropriate chlorine residual and bacteriological testing requirements as per the City of Hamilton Laboratory testing procedures. Prior to chlorine residual and bacteriological testing, all other testing and disinfection shall be completed and any super chlorinated water removed from all portions of the watermain system under consideration including hydrant leads, stubs, branches, services, etc.

The City of Hamilton will ensure the temporary connection is open and take a bacteriological sample at each sample location and deliver it to the City of Hamilton Environmental Laboratory. The watermain test section shall be immediately shut down and must not be disturbed or flushed for the period between this sample round and the next bacteriological sample round 24 hours later.

Samples shall be taken from the end of every dead end and from every 360 metres or less of new watermain pipe. No hose or hydrant shall be used in the collection of bacteriological samples.

The watermain must remain continually pressurized from the start of bacteriological testing until the connection to the existing system is undertaken.

2.8 Sample Results

Procedure

Once the new watermain is installed and pressure tested, the proper number of water samples are to be collected by Construction Inspectors & Development Engineering Inspectors. Inspectors shall drop off sample bottles at CHEL along with the completed chain of custody form(s).

Lab staff will process and log in the bottle(s). Each chain of custody form will be assigned an "LWO Number". In addition to the LWO, sample bottles will be assigned their own unique "record number". Samples delivered after 3:30pm on working days will be set up the same day, but may not be logged in until the next day. Samples delivered after 4:00pm on working days may not be set up for analysis nor logged in until the next day.

Lab staff, using the LIMS database, will generate an email that will be sent to the Inspector. The email will contain the LWO and record numbers that can then be used by the Inspector when calling in to the lab.

If special arrangements are made to bring sample bottles to the lab on a weekend, Construction Inspectors & Development Engineering Inspectors are to call CHEL on the Friday and provide the sample location, account number and the project/permit number (if applicable). In this case, CHEL will pre-log the samples into LIMS.

Construction Inspectors & Development Engineering Inspectors can call the CHEL after 24 hours and 48 hours to determine the status of water quality testing, with the understanding that these results are still provisional data until they have gone through the data approval process. The new watermain cannot be put into service until the Final Approved Lab Report from the CHEL has been obtained.

After the 48-hour testing period, data are entered into the LIMS database and go through a data approval process. CHEL will create a PDF file of the Final Approved Lab Report for each LWO and save the file at the following locations:

For CS&CO staff, the PDF file is saved at N: \ environmental laboratory reports\CSCCO_WmRech

For Planning and Economic Development, the PDF file is saved at N: \ environmental laboratory reports\ Development_Engineering

For Environment and Sustainable Infrastructure, the PDF file is saved at N: \ environmental laboratory reports \Construction

The files will be named as follows:

ROADS-PRIVATE_ _ ##### _YYYY-MM-DD HH-MM-SS Final Report.pdf

where:

represents the LWO Number

YYYY-MM-DD is the date that the PDF was created

HH-MM-SS is the time that the PDF was created

If changes are required to the staff permissions for the files above, the Project Manager Lab Services must be contacted (ext 7804).

Construction Inspectors and Development Engineering Inspectors shall also contact a CSR 24 hours and/or 48 hours ahead of the proposed watermain shutdown, depending on the project, to facilitate the connection of the new watermain to the source watermain and inform the CSR of the following information: Name of the Inspector, Contract Number or Development Site, Where/When to meet WDO, Duration of Shutdown and LWO number.

The CSR will create a Service Request containing (as a minimum) information listed above. The CSR will also attach by OLE the corresponding LWO PDF file from the network drive N: \ environmental laboratory reports\CSCO_WmRech . The CSR will then create the Service Request for a WDO to connect the new watermain to the existing water distribution system.

If sample results are successful the system will be put into service once a certified copy of the form entitled "Watermain Disinfection, Pressure Testing and Acceptance" has been received and accepted. A single failed bacteriological parameter will constitute a failure of the entire sampling round. If sample results do not meet requirements, the failed section must be flushed or re-disinfected, as directed by the Project Manager and re-sampled at sample locations. Sampling will continue until two (2) consecutive sets of water samples, taken 24 hours apart pass both the appropriate chlorine residual and bacteriological requirements as per the City of Hamilton Laboratory testing procedures.

Acceptable Bacteriological Test Results	
E. Coli	0 CFU/100ml
Total Coliform	0 CFU/100ml
Total Coliform Background	200 CFU/100ml
Heterotrophic Plate Count	500 CFU/ml

3. CONNECTION TO EXISTING WATER DISTRIBUTION SYSTEM

3.1 Procedure

Once the final rounds of bacteriological tests have passed, the connection to the existing watermain shall be performed.

A sump, minimum 300mm depth, shall be excavated in the trench bottom, and filled with clear stone, to provide a location to collect water 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 shall be taken as directed by the Construction Inspector.

3.2 Connections Equal to or Less than One Pipe Length

For a final connection length equal to or less than one pipe length, the new pipe, fittings and valves required for the connection shall be spray-disinfected and swabbed with a minimum 1% to maximum 5% solution of chlorine, immediately prior to being installed. As well the existing watermain being connected to shall be cleaned in the immediate area of the connection and spray-disinfected with the same solution.

The Contractor shall make every possible effort to ensure that the final connection is no more than one pipe length.

3.3 Connections Greater than One Pipe Length

For a final connection that is greater than one pipe length, the new pipe required for the connection shall be set up above ground, disinfected and bacteriological sample rounds taken as required for new watermain. After two consecutive rounds of satisfactory sample results have been received for the 'pre-disinfected' pipe, the pipe can be used in connecting the new main to the active distribution system. Between the time the satisfactory bacteriological sample results are received and the time that the connection piping is installed, the ends of the piping must be sealed with clean, disinfected, watertight plugs or caps.

All caps 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 maximum 5% solution of chlorine immediately prior to the connection.

4. WATER SERVICES

Service connections shall be tapped and connected under pressure. Inspect connections to ensure drip tight prior to backfilling. The pipe shall be left exposed where directed by the Construction Inspector, after which backfilling shall be completed.

All new water service pipe 38mm in diameter up to but not including 100mm diameter, as well as all sized of temporary by-pass service hose, shall be disinfected. The chlorine solution shall be applied so that the chlorine concentration is a minimum of 25mg/L and does not exceed 100mg/L. Pre-disinfected pipe shall be sealed immediately following disinfection until immediately prior to connection.

All services shall be thoroughly and aggressively flushed prior to connecting to existing service. Required fittings and valves shall be cleaned and spray-disinfected with a minimum 1% to maximum 5% solution of chlorine immediately prior to the connection.

Services 100mm in diameter and larger shall be considered mainline and shall meet all mainline procedures and testing requirements.

All by-pass services hoses to be used will be of potable water grade and shall meet the requirements of NSF 61 Standard.

- Service hoses to be capped on both ends with brass caps until installed.
- Service hoses will not be installed on by-pass piping until the day of the change over from distribution watermain to the above ground by-pass watermain.

5. WATERMAIN BREAKS

Watermain breaks shall be treated the same as noted in "Connection to Existing Water System".



SPECIFICATION FOR THE INSTALLATION
OF WATERMAINS

Watermain Disinfection, Pressure Testing, and Acceptance Form

Contract / Development No.: _____ Date: _____

Location: _____

Contractor: _____

Construction Inspector / Development Engineering Inspector: _____

<input checked="" type="checkbox"/> Description	Performed By	Date	Witnessed By
<input type="checkbox"/> Loading Watermain - Location			
<input type="checkbox"/> Swabbing – Number(s)		Re-swabbing – Number(s)	
<input type="checkbox"/> Swabs Retrieved – Number(s)			
<input type="checkbox"/> Hydrostatic Pressure Tests (record on attached table)			
<input type="checkbox"/> Chlorination			
High Chlorine Residual (50 mg/L to 100 mg/L) _____		24 hr Chlorine Residual (> OR = 25mg/L)	
If 24 hr residual fails, flush, re-chlorinate, note further residual results			
High Chlorine Residual (50 mg/L to 100 mg/L) _____		24 hr Chlorine Residual (> OR = 25mg/L)	
<input type="checkbox"/> Removal / Disposal of Super Chlorinated Water			
<input type="checkbox"/> Sample Round #	Sample Number(s)		<input type="checkbox"/> pass <input type="checkbox"/> fail
<input type="checkbox"/> Sample Round #	Sample Number(s)		<input type="checkbox"/> pass <input type="checkbox"/> fail
<input type="checkbox"/> Sample Round #	Sample Number(s)		<input type="checkbox"/> pass <input type="checkbox"/> fail
<input type="checkbox"/> Sample Round #	Sample Number(s)		<input type="checkbox"/> pass <input type="checkbox"/> fail
<input type="checkbox"/> Results - Passed			
<input type="checkbox"/> Valves operated - Location			
Comments:			

We acknowledge that this section of water system was constructed, cleaned, disinfected, and sampled as per the City of Hamilton Standards and Specifications and as outlined in the Procedure For Disinfection of Watermains In Ontario

Contractor Signature: _____

Water Distribution Operator Signature: _____

Construction Inspector / Development Engineering Inspector Signature: _____

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.01 CONCRETE PIPE

.01.01 General

This specification covers the material requirements for circular concrete pipe to be used for the conveyance of storm water and sewage. All pipe materials shall meet the requirements of OPSS 1301, 1820, this specification and be selected from the Approved Sewer Products List.

All pipe supplied shall be from a plant listed as Prequalified under the Plant Prequalification Program by the Ontario Concrete Pipe Association.

.01.02 Classes and Uses of Concrete Pipe

The classes of concrete pipe specified for various construction applications are outlined as follows:

- i) Standard Strength Non-Reinforced Concrete Pipe:
ASTM Designation C-14, or CSA A257.1
- ii) Reinforced Concrete Pipe:
ASTM Designation C-76, Class III, or CSA A257.2, 65-D
- iii) Reinforced Concrete Pipe:
ASTM Designation C-76, Class IV, or CSA A257.2, 100-D
- iv) Reinforced Concrete Pipe:
ASTM Designation C-76, Class V, or CSA A257.2, 140-D

Reinforced concrete pipe shall be used for the construction of storm sewers, manhole channels, and inlet chamber drains which require pipe with an internal diameter of 300 mm and larger.

.01.03 Sulphate Resistant Portland Cement

Portland cement used in the manufacture of concrete pipe shall be Type HS High Sulphate Resistant and meet the requirements of OPSS 1301. The type of cementing materials used shall be marked on each pipe in accordance with OPSS 1301.07.02.

.01.04 Inspection and Testing

Pipe manufacturers shall provide the City all reasonable facilities to permit the City representative to verify that the pipe conforms to the City's specification. The pipe manufacturer shall provide the required test specimens, labour and testing equipment required to satisfy the City that the proposed pipe materials needed.

The costs of all testing shall be at the expense of the pipe supplier and/or manufacturer.

.02 CLAY PIPE

.02.01 General

This specification covers the material requirements for circular clay pipe to be used for the conveyance of storm water, sewage, and industrial waste.

.02.02 Classes and Uses of Clay Pipe

Extra strength clay pipe shall be used for the construction of the following installations:

- a) Storm sewers, sanitary sewers and manhole channels up to and including pipe with an internal diameter of 600 mm.
- b) Inlet chamber drains up to and including pipe with an internal diameter of 600 mm, and inlet chamber drain risers up to and including pipe with an internal diameter of 250 mm.
- c) Private sanitary drains and private sanitary drain risers for pipe with an internal diameter up to and including 250 mm.
- d) Catch basin drains, catch basin drain risers, and manhole drop pipes for pipe up to and including an internal diameter of 250 mm.

.02.03 Inspection and Testing

Pipe manufacturers shall provide the City all reasonable facilities to permit the City's representative to verify that the pipe conforms to the City's specification. The pipe manufacturer shall provide the required test specimens, labour, and testing equipment and machine to meet the quality assurance conditions of the City.

The costs of all testing shall be at the expense of the pipe supplier and/or manufacturer.

.03 PVC PIPE

.03.01 GENERAL

This specification covers the material requirements for circular PVC pipe to be used for the conveyance of storm water and sewage. All pipe materials shall meet the requirements of OPSS 1841, this specification and be selected from the Approved Sewer Products List, latest edition.

.03.02 CLASSES AND USES OF PVC PIPE

The Standard Dimension Ratio (SDR) is the ratio of the average pipe diameter to the minimum wall thickness. The specified SDR values for main sewers and private drain laterals are as follows:

- a) SDR shall be 35, or as specified for main sewer installations with a pipe diameter of 200 mm up to and including 375 mm.
- b) SDR shall be 28, or as specified, for private drains and laterals.
- c) Profile or Ribbed pipe is not accepted.

.03.03 INSPECTION AND TESTING

Pipe manufacturers shall provide the City all reasonable facilities to permit the City's representative to verify that the pipe conforms to the City's specification. The pipe manufacturer shall provide the required test specimens, labour, and testing equipment and machine to meet the quality assurance conditions of the City.

The costs of all testing shall be at the expense of the pipe supplier and/or manufacturer.

.03.03.01 Pipe Stiffness

The pipe stiffness shall be determined at 5 percent deflection according to ASTM D2412. The minimum pipe stiffness requirements for SDR values of 35 and 28 shall be 50, and 100 respectively.

.03.03.02 Internal Hydrostatic Pressure

A typical joint assembly shall be subjected to an internal pressure of 74 kPa for 10 minutes without leakage.

.03.03.03 Internal Vacuum

A typical joint assembly shall be subjected to an internal vacuum of 74 kPa for 10 minutes without leakage.

.03.04 APPROVED SEWER PIPE MATERIALS

The following chart is a summary of the acceptable sewer pipe materials. This chart is for information purposes only and the use of any pipe material is subject to the approval by the City prior to installation.

SEWER PIPE SIZE													
Type and Application	150 mm	200 mm	250 mm	300 mm	375 mm	450 mm	525 mm	600 mm	675 mm	750 mm	825 mm	900 mm	>900 mm
PVC SDR 28													
SANITARY	X												
STORM	X												
PVC SDR 35													
SANITARY		X	X	X	X								
STORM		X	X	X	X								
VITRIFIED CLAY E.S.													
SANITARY	X	X	X	X	X	X	X	X					
STORM	X	X	X	X	X	X	X	X					
CONCRETE													
SANITARY	X	(1)	(1)	X	X	X	X	X	X	X	X	X	X
STORM	X	(1)	(1)	X	X	X	X	X	X	X	X	X	X

NOTES:

(1) 200 AND 250 DIAMETER NOT PERMITTED DUE TO PROBLEMS WITH JOINTS

.04 CCTV SEWER INSPECTION

All works shall be in accordance with these Special Provisions and OPSS 409, with precedents being these Special Provisions.

The Contractor shall ensure that all sewers are completely clean and free of debris and ready for CCTV inspection

All inspectors shall be NAAPI qualified for CCTV operations.

All CCTV video inspections of sewers must be in colour and must conform completely with Appendix "A" and the following:

The Contractor will be required to inspect and record sewer pipe and assess the condition of the pipe according to WRc defect coding standards including but not limited to:

- a) Structural condition of pipe walls. Length, size, material type, and depth of each pipe (all depths shall be referenced from the top of the manhole frame to the invert of the pipe being inspected).
- b) Any blockage or obstructions located within the pipe.
- c) Condition of pipe joints, and lateral connections.
- d) Any change in pipe diameter or pipe materials encountered in any section between two manholes.
- e) Report on grade of pipe as to whether it is uniform or whether there appears to be sectional settlement or grade changes.
- f) Infiltration.
- g) Explanations for water level fluctuations.
- h) Location and condition of connection of sewer laterals, **including pan and tilt of all junctions/connections** unless otherwise specified by City staff.
- l) Still capture pictures shall be taken of all significant structural and/or operational deficiencies.

The operator shall utilize the pan and tilt capability of the camera at the time of inspection to obtain still pictures of the defect that represent the extent of the defect and any other pertinent features related to the defect.

Special problems and conditions, such as sources of inflow, overflows, bypasses, and manholes located in natural ponding areas etc.

All measuring equipment shall be calibrated for accuracy before the work starts and maintained throughout the work.

The CCTV camera and illumination system shall be capable of providing a clean, accurate colour and in-focus record of the sewers internal condition.

The video inspection equipment and methods used shall be such that a clear pictorial record of the entire sewer line is obtained with digital readout of all titles for each sewer line and running chainage displayed.

The C.C.T.V. monitor shall also display a full description at the beginning of each survey stating date, time, job location, street name, pipe diameter, start M.H. No., and end M.H. No.

At all significant pipe defects observed during an inspection, the operator shall record a still capture picture of the defect, the description of the defect, the chainage in meters from the manhole, and the CD counter location. Flow and camera direction, type of pipe, pipe condition, weather conditions, other specified information will also be documented as directed by the Project Manager.

.04.01 CCTV Reports and submittals

The Contractor shall submit the following deliverables once all video inspections are complete:

- a) video inspection data including defect coding data recorded on CD
- b) CD data to be formatted to enable direct upload of the defect coding data into the City's Hansen database
- c) still capture pictures of all defects

Data shall be configured according to the definitions and database structures included in this specification. Video must be able to be viewed using Windows Media Player 9 Series and have the ability to use all features of the video player including fast forward capability. **CD's must be in the specified format to download directly into Hansen or the entire report will be returned to the Contractor and no payment will be made.**

Each CD will be permanently labelled with the following information.

Job/Work Order No.: _____ Contractor Name: _____

CD No.: _____ Date Televised: _____ Date Submitted: _____

Street/Easement (Location): _____

From: _____ To: _____ (Hansen ID's required)

These CD's will become the property of the City. If these CD's are of such poor quality that the Project Manager is unable to evaluate the condition of the sewer/lateral, the Contractor shall be required to re-CCTV the sewer and provide a CD of good quality at no additional cost to the City. **No payment will be made for poor or unacceptable quality CD's, or for portions of sewer mains not televised for any reason.**

The successful Contractor will be required keep a record of their reports and compact disk for the duration of the maintenance period.

.04.02 Inspection Related Instructions

The Contractor will be held responsible for damage to street surfaces, curbs, gutters, existing utilities, etc. that result from their negligence during any inspection. The

Contractor shall repair, at their cost, any damage resulting there from, which shall be subject to approval, by the City.

The Contractor will be required to inspect all sewers without disturbing the existing condition of the sewer. Should the contractor decide to use a stringing method to inspect the sewer, the stringing lines shall not be left in the sewer for more than five days or without consent of the Project Manager.

All obstructions, cracks, irregularities must be fully inspected and documented. The Contractor must inform the City's representative immediately of any obstruction encountered, locations of hazardous atmosphere, or sewers that are in immediate danger of structural failure while the inspection is still in progress. Where possible, the survey shall be reversed so that the extent of the blockage can be assessed.

The Contractor, under the supervision of the Project Manager, or their representative, may install plugs in the sewers to prevent the flow of sewage during inspection for a period of no longer than 10 minutes. The plugs must then be removed for a minimum of 10 minutes after which time they may be installed again for the period stated above. Plugs shall only be installed when and for the time period directed by the Project Manager where the existing flow hinders a proper inspection.

.04.03 Occupational Health and Safety – Confined Space Entry

The Contractor shall ensure that all aspects of the required work are, at all times, in full and complete compliance with the Occupational Health and Safety Act, as amended.

The Contractor shall provide approved equipment and training to personnel who enter confined spaces as may be required on this project. The procedures the contractor follows for Confined Space Entry must meet or exceed the requirements outlined by the Occupational Health and Safety Act.

.04.04 CCTV Sewer Inspection and Data Format

- a) Inspect sewers and code all observations in accordance to WRc "Manual of Sewer Condition Classification" Third Edition.
- b) CCTV inspection shall only be carried out by NAAPI certified operators or operators trained by other means to inspect and code as per the WRc "Manual of Sewer Condition Classification" Third Edition. Proof of such training must be submitted to the City for approval upon request.
- c) Pan and tilt camera to observe both start and finish Manhole structures and observe connection of pipe to manhole structure.
- d) Pan and tilt in pipe to observe defects and other features only when the camera has fully stopped travelling.
- e) Camera speed shall not exceed 9 meters/minute.
- f) Ensure distance measurement within the sewer is accurate to within 0.5% of the above ground measurement.

- g) Upstream and downstream pipe invert depths (manhole lid to pipe invert) must be accurately measured and recorded when access is possible. Do not provide a value if measurements were not accurately taken.
- h) The camera lens must be positioned to view along the central axis of the pipe +/- 10% in circular shaped pipes, and 2/3 of the vertical dimension of the pipe in irregular shaped pipes.
- i) Ensure picture quality and clarity is maintained during entire inspection. Lighting and focus should be adjusted to sufficiently illuminate and observe the entire circumference of the pipe during inspection.
- j) At the start of each survey use a video overlay system to clearly display the inspection header information for 5 seconds.
- k) During the inspection clearly display 'From' and 'To' Manhole IDs and travel distance in meters on the periphery of the screen. Arrange the information to minimize interference with the inspection image. Defect code and description should appear on the screen while 'coding' for at least 5 seconds.
- l) CCTV inspection while cleaning operations are underway will not be accepted by the City unless previously authorized by the Project Manager or designate. If pipe segment to be inspected was just cleaned, wait 5 minutes for water levels to stabilize before starting inspection.
- m) Inspect sewers from the upstream manhole (travel with flow) when possible.

.04.04.01 Digital Video Format

Minimum Digital Video Standard

- a) Capture in colour from the live video source directly to the recording equipment in digital format
- b) MPEG-1
- c) Picture Size: 320 x 240
- d) Minimum Data/Bit Rate: 1,800 kilobits per second
- e) Minimum Frame rate: 29.97 frames per second

.04.4.02 Camera

The camera must provide at least 400 H lines of resolution and have the capability to pan at least 360° and tilt at least 275° to ensure complete inspections and view of all laterals and deficiencies.

.04.04.03 Data Format

The following describes the database format and data deliverable requirements.

Since Inspection Numbers and Hansen Manhole IDs are the only means of identifying pipe segments, care should be taken to obtain and input these IDs correctly.

- a) All electronic deliverables shall be delivered in CD/DVD/portable hard drive. Depending on the size of the work package, more than one CD/DVD might be required. The first CD/DVD shall contain the **WRc.mdb** database file containing all inspection data related to the contract.
- b) The Database file (mdb and all video files (mpg) on all deliverables shall be in the root directory (no folders) of CD/DVD.
- c) The database file must be named WRc.mdb
- d) Inspections done prior to reaming, cleaning etc. must be excluded from the database. Only final video inspections to be included.
- e) Video files can be named under any convention but **MUST** start with the Job number that has been provided by the City for each sewer segment. Good practice is to also include the Manhole to Manhole IDs.
- f) Required fields are mandatory for successful data transfer.
- g) Some non-required fields depend on whether the information needs to be provided i.e. photograph number, etc. Other non-required fields should be included to maintain inspection quality.
- h) All preceding and trailing spaces must be removed from all fields.
- i) Not populated fields shall be NULL (empty).

HEADER Table Details

COLUMN	TYPE	REQUIRED	NOTES
ID	LONG	YES	PRIMARY KEY
SURVEYEDBY	CHAR(12)	YES	COMPANY NAME AND INSPECTOR'S INITIALS (XYZ HK)
CONTRACTNUMBER	CHAR(8)	YES	CONTRACT NUMBER PROVIDED BY CITY
JOBNUMBER	CHAR(10)	YES	PROVIDED BY THE CITY
DATE	DATETIME	YES	DATE OF INSPECTION
TIME	DATETIME	YES	TIME OF INSPECTION
LOCATION	CHAR(30)		STREET NAME
STARTMANHOLE	CHAR(10)	YES	START MANHOLE
SDEPTH	DOUBLE		DEPTH OF START MANHOLE
FINISHMANHOLE	CHAR(10)	YES	FINISH MANHOLE
FDEPTH	DOUBLE		DEPTH OF FINISH MANHOLE
DIRECTION	CHAR(1)	YES	DIRECTION OF INSPECTION (U OR D)
SIZE1	INTEGER	YES	DIAMETER OR WIDTH
SIZE2	INTEGER		HEIGHT
SHAPE	CHAR(1)		SHAPE CODE
MATERIAL	CHAR(5)		MATERIAL CODE
PIPELENGTH	INTEGER		PIPE SEGMENT LENGTH (JOINT TO JOINT DISTANCE)
TOTALLENGTH	DOUBLE	YES	TOTAL LENGTH OF PIPE FROM MH TO MH
VIDEONUMBER	CHAR(5)		NOT REQUIRED
COMMENTS	CHAR(50)		COMMENTS
PURPOSE	CHAR(1)		NOT REQUIRED
SEWERCATEGORY	CHAR(1)		NOT REQUIRED
PRECLEANING	CHAR(1)		INDICATE IF PIPE WAS CLEANED BEFORE INSPECTION Y OR N
WEATHER	CHAR(1)		WEATHER CODE (1 TO 5)
FURTHERDETAILS	CHAR(48)		COMMENTS (AVOID USE OF " ' \ \ CHARACTERS)

CONDDetails Table Details

COLUMN	TYPE	REQUIRED	NOTES
ID	LONG	YES	PRIMARY KEY
VIDEONUMBER	INTEGER		ELAPSED TIME
PHOTOGRAPHNUMBER	INTEGER		PHOTOGRAPH NUMBER (1,2,3)
DISTANCE	DOUBLE	YES	CHAINAGE (4.2)
CONTINUOUSDEFECT	CHAR(2)		CONTINUOUS DEFECT CODE (F1, F2, S1,S2)
CODE	CHAR(4)	YES	WRc OBSERVATION CODE
DIAMETER_DIMENSION	INTEGER		DIAMETER_DIMENSION OF OBSERVATION
CLOCKFROM	CHAR(2)		CLOCK FROM OBSERVATION POSITION (01,06,11,12)
CLOCKTO	CHAR(2)		CLOCK TO OBSERVATION POSITION (01,06,11,12)
PERCENTAGE	INTEGER		PERCENTAGE OF OBSERVATION (5,10,50)
INTRUSION	INTEGER		INTRUSION OF OBSERVATION
REMARKS	CHAR(34)		REMARKS FOR OBSERVATION (AVOID USE OF " ' \ \ CHARACTERS)
JOBNUMBER	CHAR(10)	YES	PROVIDED BY THE CITY
HEADERID	LONG	YES	FOREIGN KEY LINKING THIS RECORD TO HEADER TABLE

.01 GENERAL

This specification covers mixed Portland cement concrete to be used for the construction of sidewalks, pavements, structures, appurtenances, sewers and water mains. Concrete shall be in accordance with OPSS.MUNI 1350 and the following:

.02 AGGREGATES

Concrete aggregates shall conform to OPSS 1001 and 1002. Coarse aggregate shall have a nominal maximum size of 19 mm, with corresponding gradation requirements as given in OPSS 1002, Tables 3 and 4.

.03 COMPRESSIVE STRENGTH CLASS

The class of concrete specified for the various construction applications is outlined in Table 700-1.

.04 CHEMICAL ADMIXTURES

Chemical admixtures shall conform to the requirements of OPSS 1303.

.05 HYDRAULIC CEMENTING MATERIALS

Hydraulic cementing materials shall conform to the requirements of OPSS 1301. Unless otherwise specified in the contract. Type GU general use Portland cement shall be used for all above grade concrete.

All below grade concrete shall be resistant to a "very severe" sulphate environment as defined CAN/CSA-A23.1, latest edition. This concrete mix shall incorporate Type HS high sulphate resistant cement, or slag cement and normal Portland cement in the proportions required to achieve a sulphate resistant concrete. The potential sulphate resistance of the slag and cement blend shall be determined by ASTM specification C 1012.

Type HS cement shall be used in all concrete for the construction of pre-cast and cast in place sections of manholes, valve chambers, thrust blocks and concrete pipe.

.06 CONCRETE CURING

Curing of concrete surfaces shall be undertaken by using one of three alternatives:

- 1) White waterproof paper, white opaque polyethylene film, or white burlap-polyethylene sheeting which conforms to OPSS 1305
- 2) Burlap as specified in OPSS 1306
- 3) White or green pigmented membrane curing compound as specified in OPSS 1315

.07 PLACEMENT BY SLIPFORM

The concrete slump for slipform placement shall be generally in accordance with OPSS 1350. The mix slump, however, must be compatible with the type of placement equipment in order to eliminate honeycombing.

.08 FINISHING CONCRETE

Sidewalks shall be finished in 1.5 metre blocks, unless otherwise specified by the Project Manager, with all edges, except the curb on the combined walk and curb, to be finished with an edging tool having a 13mm radius.

The concrete shall be struck off and floated to a true surface. Care shall be taken not to bring to the surface an excess of water and fine sand by overfinishing.

When required by the Project Manager or Inspector, the contractor will be required to furnish wooden templates cut to the exact form and slope of the alleyway or sidewalk, for use by the inspector.

The top surface of the concrete shall be screeded to true grade and cross section using a straight edge and an oscillating motion.

The screeded surface shall be floated using a hardwood float so that the entire surface is tight and compact. Cement or sand shall not be added to the surface. Any surface imperfections shall be removed and replaced before the concrete has set. Patching shall not be done unless authorized by the Project Manager.

A coarse textured broom finish shall be applied on all exposed Concrete sidewalk unless otherwise directed by the Project Manager. The presence of footprints or other marks in the completed sidewalk shall require the removal and replacement of the complete bay of sidewalk. Separation of unacceptable from acceptable sidewalk shall be by sawcutting.

Table 700-1
Minimum Compressive Strength of Concrete

COMPRESSIVE STRENGTH CLASS OF CONCRETE	APPLICATION OR LOCATION OF CONCRETE
32 MPa	sidewalks, curbs, road base, manholes, valve chambers, catch basins and pole bases
15 MPa	concrete pipe bedding
as specified in the contract	structural concrete for bridges and culverts

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800-A	LS-318 PRACTICE FOR THE DESIGN OF SUPERPAVE WARM MIX ASPHALT (WMA)

.01 GENERAL

This specification covers the requirements for hot mix asphalt designed using the Superpave or Marshall methods including warm mixes. Unless otherwise amended herein the design, materials, production and placement of hot mix asphalt shall conform to OPSS 310, OPSS.MUNI 1101, OPSS 1150 and OPSS.MUNI 1151.

.01.01 Superpave and Marshall Mixes

The use of Superpave or Marshall hot mix asphalt types shall be as specified in the contract documents and shall be approved prior to use.

.02 SUPERPAVE MIXES

For Superpave mixes, the type shall be specified in the contract documents and shall be in accordance with Tables 1 and 2 of OPSS.MUNI 1151. The Performance Graded Asphalt Cement (PGAC) shall be in accordance with OPSS.MUNI.1101.

.02.01 Design Requirements – Superpave Asphalt Mixes

.02.01.01 Submission and Design Requirements

The design of Superpave mixes shall be in accordance with the requirements of OPSS.MUNI 1151 Material Specification for Superpave and Stone Mastic Asphalt Mixes, as amended by this specification.

.02.01.02 Mix Requirements for Design Purposes – Hot Mix and Warm Mix

1151.04.01 of OPSS.MUNI 1151 is amended by the addition of the following:

Asphalt cement shall be performance graded asphalt cement and shall be as described in section .02.02.02.

The Contractor shall design, produce and place Warm Mix Asphalt for all surface or binder course asphalt produced and placed on or after November 1 of any year. Warm mix asphalt shall be in accordance with section 02.01.05.

.02.01.03 PGAC Testing

Complex shear modulus (G^*) and phase angle (δ) of asphalt cement shall be tested on the Rolling Thin Film Oven (RTFO) residue in accordance with the Asphalt Institute “Superpave Performance Graded Asphalt Binder Specification and Testing” Superpave Series SP-1.

.02.01.04 Additional Design Requirements for Warm Mix Asphalt

OPSS 310.04.04 is hereby deleted and replaced with the following:

The Contractor shall be responsible for the following:

- a) Using an approved WMA additive listed below:
 - i) Advera
 - ii) Evotherm
 - iii) Hyper Therm
 - iv) Sasobit
 - v) SonneWarmix
- b) Preparation of the mix design and reporting of all testing results in accordance with test method LS-318 Draft - Practice for the Design of Superpave Warm Mix Asphalt (WMA). A copy of the LS 318 document is attached in Appendix A.
- c) Any WMA technology not listed in a) above shall be subject to review and approval by the City.
- d) The WMA mix design and the job mix formula at the anticipated WMA production temperature, both of which shall be according to the requirements of this specification.
- e) Ensuring that, during the development and verification of the WMA mix design, the WMA technology does not adversely affect the asphalt cement performance grade and the WMA mixture performance.
- f) Moisture content of the aggregate coming from the dryers shall not exceed 0.5%.

.02.01.05 Submission Requirements – Warm Mix Asphalt

OPSS 310.04.02 is deleted and replaced by following:

A minimum of 4 weeks prior to paving with WMA, the following information shall be submitted to the Project Manager, in writing:

- a) The name of the supplier and the approved WMA technology selected.
- b) All test results required under LS-318 and any other details on how the requirements of this specification shall be met.
- c) If applicable, the type and dosage of WMA additives, how the additives are to be incorporated to produce the WMA, and the WMA technology supplier's established recommendations for usage.
- e) Where a proposed technology is not currently approved, the Contractor shall submit the following information a minimum of 4 weeks prior to proposed paving dates for review and approval:

- i) Name of process, manufacturer, type of process and the technology group;
- ii) Manufacturer's recommendations including:
 - a) Process description and mix design recommendations;
 - b) Required plant modification and hauling recommendations;
 - c) Mixing and compaction temperatures;
 - d) Construction aspects, if any differences from conventional HMA paving besides temperatures.
- iii) Projects where the process has been used including:
 - a) Client including contact information (telephone, email);
 - b) Mix designs;
 - c) Date and location of construction;
 - d) To date performance.

Where the proposed technology is not approved, the Contractor shall be required to supply and place an approved technology.

.02.01.06 Superpave and SMA Mix Verification

1151.04.02.02 of OPSS.MUNI 1151 is amended by adding the following:

After receiving the asphalt mix design from the Contractor or asphalt supplier, the Contractor shall provide asphalt mix verification test results in accordance with the following criteria:

- a) The tests must be performed by a laboratory independent from the firm producing the asphalt mix design.
- b) The laboratory performing verification testing must have a valid "Certificate of Conformance" issued by the Canadian Council of Independent Laboratories (CCIL) Asphalt Laboratory Certification Program and be qualified under the following categories:
 - i) Asphalt Mix Design – Marshall and Superpave Methods (Type A)
 - ii) Asphalt Mix Compliance – Marshall and Superpave Methods (Type B)

All verification testing must be reviewed and accepted by the City of Hamilton prior to the start of any paving operations.

The mix design shall be submitted for acceptance at least 4 weeks before construction. The mix design shall be reviewed and approved by the City. Where requested, a trial batch shall be submitted to the Project manager for verification and approval.

The submitted mix design shall include the JMF and the documents listed in Section 1151.04.05 of OPS 1151 MUNI. The mix design that does not include the required documents will not be reviewed and accepted.

A sample of Performance Graded asphalt cement specified for the subject project shall be submitted with the mix design for future testing, when requested.

.02.01.07 Asphalt Cement Requirements

The asphalt cement content of the approved JMF shall be equivalent to or greater than those shown in Table 800-1.

.02.02 Materials

Aggregates used shall be in accordance with OPSS.MUNI 1003 Material Specification for Aggregates as amended by the following:

.02.02.01 Steel Slag Aggregate

1151.05.02 of OPSS.MUNI 1151 is amended by the addition of the following:

Where a SP12.5 FC1 is specified, the Contractor shall have the option of supplying either Superpave 12.5 FC1 (OPSS) or Superpave 12.5 FC1 Steel Slag.

Steel slag aggregate shall be in accordance with the following:

- a) Designated source for coarse aggregates shall be ArcelorMittal's K.O.B.M. Processed Course Steel Slag Aggregate, Contractor shall secure the supply of all required steel slag aggregate.
- b) F.O.B. Heckett Multiserve Facilities at ArcelorMittal's Bay Front Operations.
- c) The Contractor is required to submit the proposed mix design, fine aggregate sources and asphalt cement supplier to the City of Hamilton for review and approval.
- d) In the event that the above steel slag aggregate is not available at the time of construction, the Contractor shall not be entitled to any delay or financial compensation for the supply of an approved substitute aggregate.

.02.02.02 Performance Graded Asphalt Cement (PGAC)

Performance Graded Asphalt Cement shall be in accordance with OPSS.MUNI 1101, Material Specification for Performance Graded Asphalt Cement, as amended by the following:

1101.05 of OPSS.MUNI 1101 is amended by the addition of the following:

The basic grade of asphalt cement shall be PG 58–28.

Asphalt cements bumped by 1 or 2 grades, i.e. from PG 58-28 to PG 64-28 or to PG 70-28 shall be polymer modified and their designation shall be PG 64-28 PM and PG 70-28 PM, accordingly.

.02.02.03 Engine Oil Residue (EOR)

The addition of Engine Oil Residue (EOR) to any asphalt cement is not allowed.

As part of the Quality Control (QC) and Quality Assurance (QA) procedures samples of the asphalt cement will be obtained from the asphalt plant from asphalt tank(s) during asphalt production. One sample will be taken for the Contractor, one for the City of Hamilton and one for referee testing. The samples shall be 1 litre each and stored in glass containers.

If there is any concern about the quality of the asphalt cement in the mix, the samples of the asphalt cement will be tested using a Gas Chromatography Mass Spectrometer (GCMS) for the presence of deleterious components not anticipated in good quality asphalt cement.

.02.03 Construction

The supply and placement of hot mix and warm mix asphalt shall be in accordance with the following:

- a) OPSS 310 Construction Specification for Hot Mix Asphalt, April 2011, as amended;
- b) OPSS 310 - Appendix C for the placement of warm mix asphalt.

.02.03.01 Pre-pave Meeting

At least one (1) week prior to any scheduled milling or paving operation to occur, a mandatory Pre-pave meeting shall be held. The Contractor shall ensure that all required documentation relating to the milling and paving operations has been submitted for review and approved prior to the meeting. The items shall include, but are not limited to, the following:

- a) approved mix designs and Job Mix Formulas;
- b) proposed milling and paving dates and paving equipment to be used;
- c) asphalt placement and compaction rolling patterns;
- d) roadway, lane closures and vehicle access restrictions;
- e) tack coat scheduling and application patterns.

.02.03.02 Tack Coat

Prior to the application of any of surface or binder coarse asphalt, tack coat shall be applied.

.02.03.03 Placement of Binder and Surface Course Asphalt

Any type of asphalt having a thickness of 80mm or more shall be placed in a minimum of 2 lifts unless otherwise directed by the Project Manager.

The finished elevation of the surface course asphalt shall be placed so as to be flush with the lower edge of curb at the depressed portion of all wheelchair ramps.

The surface course asphalt shall slope down and away from the curb to form a gutter line in front of the wheelchair ramp.

.02.03.04 Binder Course Asphalt – Temporary Ramping

When the surface course asphalt is to be delayed or placed the following year, temporary asphalt ramps shall be placed at all wheelchair ramps and driveway approaches. The top of the temporary asphalt ramps shall be placed so as to be flush with the lower edge of curb at the depressed portion of all wheelchair ramps and driveway approaches. The temporary asphalt ramps shall be removed at the time of placement of the surface course asphalt at no additional cost.

.02.03.05 Use of Paving Equipment – Paving in Echelon

OPSS 310.07.07 is amended with the addition of the following paragraph:

Paving in Echelon is mandatory for the placement of binder and surface course asphalt. The pavers shall be operated at the same time and maintain a distance of not more than 50 m from each other so that a hot joint is obtained between the lanes of mixtures being placed. The Contractor shall supply sufficient personnel to adequately control both spreading operations simultaneously.

Where the entire width of the proposed pavement platform cannot be paved in echelon with 2 pavers, one longitudinal construction joint is permitted. Each half of the road shall be paved in echelon resulting in only one longitudinal joint in the binder and surface courses located at the centreline of the road. The joint shall be located to ensure that it does not align with the wheel path of traffic.

.02.03.06 Asphalt Material Transfer Vehicle

OPSS 310.07.07 is amended with the addition of the following paragraph:

A Shuttle Buggy® Asphalt Material Transfer Vehicle (AMTV) is required for all paving operations, including paving using only one paver. The use of an AMTV will be paid for by the tonne.

.02.03.07 Re-Heating and Compaction of Longitudinal Joints

OPSS 310.07.07 is amended with the addition of the following paragraph:

For surface course, the Contractor shall use an approved method of re-heating, re-working and compacting all centreline longitudinal cold joints. Pricing shall be based on an infra-red heating system capable of maintaining a minimum temperature of 93° C to produce a welded joint, without scorching or burning the mix.

All re-heating methods shall be approved prior to the start of any asphalt placement.

The density of the mix at any longitudinal joint shall be within 1.5 percent of the mainline mat density. Compaction of longitudinal joint shall be measured within 0.3 m from the joint.

.02.03.08 Review of Longitudinal Joint Quality

Prior to the expiry of the 24 month maintenance period, all joints in surface course asphalt shall be reviewed. The review will consider weld quality, proper compaction and separation. All joints showing signs of separation or poor welding shall be re-heated and compacted to achieve a welded joint. All repairs to longitudinal joints shall be at the cost of the Contractor.

.02.03.09 Aggregate Gradation and Asphalt Cement Content Acceptance

OPSS 310.08.02 is deleted and replaced by the following:

If the HMA is borderline for aggregate gradation or asphalt cement content specified in Table 800-2, the Contractor shall take immediate corrective action through process control at the HMA plant. A total of three consecutive borderline test results for any attribute representing up to 1,000 tonnes of HMA production shall result in the work being deemed rejectable and shall be removed and replaced with acceptable HMA.

Rejected HMA due to aggregate gradation, such as non-compliance on the DLS 4.75mm, 600 µm, or 75 µm sieve sizes, or non-compliance due to the asphalt cement content specified in Table 800-2, shall be removed and replaced with acceptable HMA.

The asphalt cement content and aggregate gradation shall be determined for each day's mix production for a given plant location on the basis of the sampling frequency criteria in Table 800-7.

Table 7 found in OPSS 310 is hereby deleted and replaced by Table 800-2 contained in this specification.

.02.03.10 Asphalt Layer Segregation

All hot mix asphalt shall be inspected for segregation in accordance with the following:

.02.03.10.01 Types of Segregation

Segregation consists of areas with comparatively coarser texture than that of the surrounding pavement. All segregation is deemed to be deficient materials and/or workmanship, regardless of the type, location, cause or severity. The Contractor shall provide traffic control, as required, to conduct all segregation assessments.

Two main types of segregation are recognized:

Mid-lane Segregation: consists of any continuous or semi-continuous longitudinal mark or "streak", typically no greater than 300mm in width. Such segregation is often found in the middle of the lane, in the vicinity of a paver's gearbox, but may be located anywhere across the width of the lane.

Other Segregation: consists of discrete areas or patches of regular, irregular or chevron shape.

.02.03.10.02 Severity of Segregation

The severity of segregation is categorized as follows:

Slight Segregation: The pavement matrix is in place between the coarse aggregate particles; however there are slightly more coarse aggregate particles in comparison with the surrounding acceptable mix.

Medium Segregation: The pavement has significantly more coarse aggregate particles than the surrounding acceptable mat and usually exhibits some lack of surface matrix.

Severe Segregation: The pavement appears very coarse, with coarse aggregate particle against coarse aggregate particle and the pavement has little or no matrix.

.02.03.10.03 Paving Segregation

If the Contractor fails to prevent slight segregation in paving, the Project Manager will issue a written warning and request the Contractor to address the problem. The contractor may be allowed to continue paving at the discretion of the Project Manager. If medium segregation is observed, the paving operation will be stopped. The Contractor shall prove to the satisfaction of the Project Manager that the paving can be continued without any medium segregation.

.02.03.10.04 Correction of Segregation

If the Contractor's actions fail to prevent continued slight to medium segregation from any source, the Project Manager may instruct the Contractor to cease paving until the problem has been corrected and the City shall not be held responsible for any additional costs that the Contractor may incur as a result.

From the time that the Contractor receives notification of mid-lane segregation, the Contractor will be allowed a maximum of 100 tonnes of mix to be placed on the Contract, in order to demonstrate the effectiveness of any repairs and/or adjustments that have been made to a defective paver.

The Contractor shall demonstrate the repairs and/or adjustments to the paver, which is acceptable to the Project Manager. If the Contractor is unable to eliminate segregation to the satisfaction of the Project Manager, by making repairs or adjustments to the paver within the allowable 100 tonnes of hot mix, then the Contractor shall discontinue the use of that machine.

.02.03.10.05 Mid-Lane Segregation

Medium to severe mid-lane segregation shall be repaired by removal and replacement at no cost to the City. Slight mid-lane segregation will be accepted into the work with no payment reduction.

.02.03.10.06 Other Segregation

The disposition of Other Segregation shall be as follows:

Slight Segregation: Slightly segregated mix will be accepted into the work with no payment reduction.

Medium Segregation: Medium segregation in all HMA lifts shall be repaired at the direction of the Project Manager at no cost to the City.

Severe Segregation: All severely segregated mix shall be repaired by removal and replacement at no cost to the City.

Levelling or padding courses with a total thickness which is less than that is normally placed in a lift of hot mix (i.e., usually 40mm), that is not machine-laid and any areas of "handwork" shall not be assessed on the basis of segregation but on the basis of other workmanship-related problems. However, if they deteriorate prior to being overlaid by another pavement course, the Project Manager will assess the causes of the deterioration before determining responsibility for the cost of repairs.

.02.03.10.07 Repairs

All repairs shall be subjected to the approval by the Project Manager.

Repairs shall consist of removal and replacement with new hot mix or a hot mix overlay, where permitted.

Repairs for segregated hot mix shall be full lane or shoulder width. However, localized repairs may be permissible for mid-lane segregation in binder courses provided hot joints are used or the mat is still hot.

A paver shall be used for all repairs except those where localized repairs are allowed.

Where localized repairs are allowed for mid-lane segregation in binder courses, these repairs shall be:

- Less than or equal to 300mm in width;
- To the full depth of the subject lift; and
- Entirely tack-coated.

Hot mix used in all repairs shall meet the requirements specified for the tender item in the Contract. All repairs shall be done in a workmanlike manner complying with all requirements for placing hot mix stated in the Contract. All repaired areas must be entirely tack-coated and all transverse joints in surface course repairs must butt up to a vertical face.

For surface and binder courses, all repairs for remedial work due to visually defective mix, including pavement removal and replacement, overlays where permitted, additional shouldering, traffic control and any other work which has to be redone such as line painting shall be made entirely at the Contractor's expense.

.03 MARSHALL MIXES**.03.01 Design Requirements – Marshall Mixes**

For Marshall mixes, the type specified for various construction applications are outlined in Table 800-3.

.03.01.01 Design Properties

The required mix design properties of the paving mixtures are presented in Table 800-6. Voids in the Mineral Aggregate (VMA) requirements are specified in OPSS 1150, Table 7. The VMA requirements for HM-3, HM-3 (HD) and HL-8 (HS) are specified in OPSS Table 7 based on aggregate particle gradation.

.03.01.02 Mix Design and Quality Assurance Testing

Mix designs, by the Asphalt Institute Marshall Mix design method, shall be completed by an independent engineering and materials testing firm, or asphalt producer/contractor with an asphalt laboratory that has current Type "A" and "E" certification from the Canadian Council of Independent Laboratories (CCIL). All quality assurance testing performed under the annual testing contract shall be by an independent engineering and materials testing firm with office and laboratory facilities located within the City boundaries, and having current CCIL Type "A" and "E" certification.

Mix design approval shall be contingent upon the submission of aggregate physical properties with the mix design, and the successful duplication of the mix design Marshall properties by the City's testing laboratory. Mix designs incorporating Reclaimed Asphalt Pavement (RAP) shall be carried out in accordance with the current MTO recycled mix design procedure.

.03.02 Materials**.03.02.01 Physical Properties of Aggregates**

Asphalt aggregate physical properties shall conform to OPSS 1001, and 1003. In addition, aggregates shall meet the requirements of the Micro-Deval Abrasion Test as per LS 619. The maximum allowable loss for surface course mixes is 20 %, and the maximum allowable loss for binder mixes is 25 %.

.03.02.02 Gradation Properties of Aggregates

The coarse and total fine aggregates for HL-8, and HL-8 (HS) shall meet the HL-8 gradation requirements of OPSS 1003. The coarse and total fine aggregates for HM-3 and HM-3 (HD) shall meet the requirements of Table 800-4.

Gradation properties of the total aggregate blends for HL-8 and HL-8 (HS) shall meet the requirements of OPSS 1150, Table 2 for HL-8 binder course mixes. The specified total aggregate blends for HM-3, HM-3 (HD) are given in Table 800-5.

.03.02.03 Steel Slag Aggregate

1151.05.02 of OPSS.MUNI 1151 is amended by the addition of the following:

Where a HL-1 is specified, the Contractor shall have the option of supplying either HL-1 (OPSS) or HL-1 Steel Slag.

Steel slag aggregate shall be in accordance with the following:

- a) Designated source for coarse aggregates shall be ArcelorMittal's K.O.B.M. Processed Course Steel Slag Aggregate, Contractor shall secure the supply of all required steel slag aggregate.
- b) F.O.B. Heckett Multiserve Facilities at ArcelorMittal's Bay Front Operations.
- c) The Contractor is required to submit the proposed mix design, fine aggregate sources and asphalt cement supplier to the City of Hamilton for review and approval.
- d) In the event that the above steel slag aggregate is not available at the time of construction, the Contractor shall not be entitled to any delay or financial compensation for the supply of an approved substitute aggregate.

.03.02.04 Performance Graded Asphalt Cement (PGAC)

Asphalt cement shall meet the requirement of OPSS.MUNI.1101, unless otherwise specified in the contract.

The grade of asphalt cement shall be PGAC 58-28 unless otherwise specified in the contract, or as required for blending in mixes containing Reclaimed Asphalt Pavement (RAP).

The addition of Engine Oil Residue (EOR) to any asphalt cement is not allowed.

As part of the Quality Control (QC) and Quality Assurance (QA) procedures samples of the asphalt cement will be obtained from the asphalt plant from asphalt tank(s) during asphalt production. One sample will be taken for the Contractor, one for the City of Hamilton and one for referee testing. The samples shall be 1 litre each and stored in glass containers.

If there is any concern about the quality of the asphalt cement in the mix, the samples of the asphalt cement will be tested using a Gas Chromatography Mass Spectrometer (GCMS) for the presence of deleterious components not anticipated in good quality asphalt cement.

.03.04 Construction

The supply and placement of hot mix and warm mix asphalt shall be in accordance with OPSS 310 Construction Specification for Hot Mix Asphalt as amended by this specification.

.03.04.01 Pre-pave Meeting

At least one (1) week prior to any scheduled milling or paving operation to occur, a mandatory Pre-pave meeting shall be held. The Contractor shall ensure that all required documentation relating to the milling and paving operations has been submitted for review and approved prior to the meeting. The items shall include, but are not limited to, the following:

- a) approved mix designs and Job Mix Formulas;
- b) proposed milling and paving dates and paving equipment to be used;
- c) asphalt placement and compaction rolling patterns;
- d) roadway, lane closures and vehicle access restrictions;
- e) tack coat scheduling and application patterns.

.03.04.02 Tack Coat

Tack coat shall be applied between all lifts of surface and binder asphalt.

.03.04.03 Placement of Binder and Surface Course Asphalt

Any type of asphalt having a thickness of 80mm or more shall be placed in a minimum of 2 lifts unless otherwise directed by the Project Manager.

The finished elevation of the surface course asphalt shall be placed so as to be flush with the lower edge of curb at the depressed portion of all wheelchair ramps. The surface course asphalt shall slope down and away from the curb to form a gutter line in front of the wheelchair ramp.

.03.04.04 Binder Course Asphalt – Temporary Ramping

When the surface course asphalt is to be delayed or placed the following year, temporary asphalt ramps shall be placed at all wheelchair ramps and driveway approaches. The top of the temporary asphalt ramps shall be placed so as to be flush with the lower edge of curb at the depressed portion of all wheelchair ramps and driveway approaches. The temporary asphalt ramps shall be removed at the time of placement of the surface course asphalt at no additional cost.

.03.04.05 Penetration of Recovered Asphalt Cement

The asphalt mix, after production and placement, shall have a recovered asphalt cement penetration between 50 and 90 units. The recovered asphalt cement penetration shall be determined by MTO test methods LS 284 and LS 200. The allowable limits for recovered asphalt cement penetration apply to results obtained within 60 days of asphalt placement.

.03.04.06 In-Place Asphalt Cement Content

The asphalt cement content of the mix, after placement, shall be a minimum of 5.0 % for HL-8 and HL-8 (HS) binder course mixes. For HM-3 and HM-3 (HD) surface course mixes, the minimum in-place asphalt cement content shall be 5.7 %. The

asphalt cement content shall be determined for each day's mix production for a given plant location on the basis of the sampling frequency criteria in Table 800-7.

The asphalt cement contents shall be determined using MTO test methods in LS 282.

Where asphalt mix quantities for a given day exceed 1000 tonnes from a single plant source, additional samples shall be taken and tested at a frequency of 1 additional sample for each lot of 200 tonnes of asphalt over 1000.

03.04.07 Consistency of Mix Production

The City reserves the right to withdraw their approval of a given asphalt plant as a source of asphalt supply if the following criteria on consistency of mix production is not maintained:

1. Asphalt Marshall mix properties must meet specifications for at least 80 % of the samples tested, each day for any 3 consecutive paving days. Where 80 % of the samples represents a fraction, such as 4.8, the number shall be rounded off to the lower value, ie 4.
2. Asphalt cement contents must meet specifications for at least 90 % of the samples tested, each day for any 3 consecutive paving days. Where 90 % of the samples represents a fraction, such as 5.4 or 3.7, the number shall be rounded off to the lower value, i.e. 5.

**TABLE 800-1
Superpave Minimum Asphalt Cement Content**

Mix Type	Asphalt Cement Content for Bid Purposes	Minimum Asphalt Cement Content for JMF
Superpave 9.5	5.5	5.3
Superpave 12.5	5.0	4.8
Superpave 19mm	4.8	4.6
Superpave 25mm or greater	4.6	4.4

**TABLE 800-2
Tolerances for the Job-Mix Formula Aggregate Gradation and Asphalt Cement Content**

Mix	Attribute	Tolerances on the Job-Mix Formula % (Note 1)		
		Acceptable	Borderline	Rejectable
Surface Course	DLS, 4.75mm sieve size	< 5.0	5.0 to 7.5	>7.5
	600 µm sieve size	< 3.5	3.5 to 5.0	>5.0
	75 µm sieve size	< 2.0	2.0 to 3.0	>3.0
Binder and Levelling Courses	DLS, 4.75mm sieve size	< 7.0	7.0 to 10.0	>10.0
	600 µm sieve size	< 4.5	4.5 to 6.0	>6.0
	75 µm sieve size	< 2.0	2.0 to 3.0	>3.0
All Mixes	Asphalt Cement Content	< 0.20	0.2 to 0.30	>0.30
<p>Note 1: Tolerances on the job-mix formula apply as both plus and minus from the job-mix formula percent.</p>				

**TABLE 800-3
Marshall Hot Mix Types**

MIX TYPE	TYPICAL USE	AGGREGATE REQUIREMENTS
HM-3	Surface course for local and collector subdivision roads and roads without bus traffic	OPSS 1003
HM-3 (HD)	Surface course for arterial roads AADT > 3000; HCT > 10 %	Coarse and fine aggregate shall be 100 % crushed material, coarse shall have at least 1 freshly fractured face
HL-1	Surface course for roads subject to mixed heavy truck, bus and car traffic. AADT > 3000 both ways; HCT > 15 %	Coarse and fine aggregate shall be from crushed bedrock (Steel Slag or OPSS Mix)
HL-8 (HS)	Binder course for roads with heavy truck traffic and bus routes. AADT > 3000 both ways; HCT > 10 %	Coarse and fine aggregate shall be from crushed bedrock
HL-8	Binder course for local and collector subdivision roads and roads without bus traffic	Shall meet OPSS 1003; max. Recycled Asphalt Pavement (RAP) Content = 25% by mass

- (1) AADT - Average Annual Daily Traffic;
- (2) HCT - Heavy Commercial Truck Traffic

TABLE 800-4
Gradation Requirements for HM-3 and HM-3 (HD)
Coarse and Fine Aggregates

SIEVE SIZE	PERCENT PASSING HM-3 & HM-3 (HD) COARSE AGGREGATE	PERCENT PASSING HM-3 & HM-3 (HD) TOTAL FINE AGGREGATE
26.5 mm		
19.0 mm		
16.0 mm		
13.2 mm		
9.5 mm	100	100
4.75 mm	40 - 70	85 - 100
2.36 mm	0 - 10	70 - 100
1.18 mm		50 - 75
0.600 mm		30 - 55
0.300 mm		15 - 35
0.150 mm		5 - 15
0.075 mm	0 - 2	0 - 8

TABLE 800-5
HM-3 and HM-3 (HD) Gradation Requirements for
Blended Coarse and Fine Asphalt Aggregates

SIEVE SIZE	PERCENT PASSING HM-3 & HM-3 (HD) COARSE AGGREGATE
26.5 mm	
19.0 mm	
16.0 mm	
13.2 mm	
9.5 mm	100
4.75 mm	75 - 100
2.36 mm	50 - 80
1.18 mm	
0.600 mm	
0.300 mm	5 - 20
0.150 mm	
0.075 mm	0 - 5

TABLE 800-6
Specified Marshall Design Properties of Asphalt Mixes

MARSHALL PROPERTY	HM-3	HM-3 (HD)	HL-8 (HS)	HL-8
STABILITY N @ 60 °C	7,000 MIN.	12,000 MIN.	14,000 MIN.	9,000 MIN.
FLOW Units of 25 mm	8 MIN.	8 MIN.	8 MIN.	8 MIN.
AIR VOIDS %	2 - 4	2 - 4	2 - 4	2 - 4
ASPHALT CEMENT CONTENT %	6.0 MIN.	6.0 MIN.	5.3 MIN.	5.3 MIN.

TABLE 800-7
Criteria for Asphalt Cement Content Sampling and Testing

MIX TYPE	ASPHALT PLANT DAILY PRODUCTION FOR PROJECT	MINIMUM TEST SAMPLES
Surface Course	< 200 tonnes	3
	> 200 tonnes	5
Binder Course	< 500 tonnes	3
	> 500 tonnes	5

APPENDIX 800 A PRACTICE FOR THE DESIGN OF SUPERPAVE WARM MIX ASPHALT (WMA)

This document is the Ministry of transportation Laboratory Testing Manual, Draft Test Method LS-318 dated May 31, 2012.

This is a mandatory appendix for use in the design of Superpave and Warm Mix asphalt.

1. SCOPE

- 1.1 This standard provides special considerations and procedures for the design of Warm Mix Asphalt (WMA) when there is already an approved Job Mix Formula (JMF) for the corresponding Hot Mix Asphalt (HMA) Superpave mix. WMA represents technologies which allow a reduction in the temperature at which asphalt mixtures are produced and placed. ***For situations, when there is not an approved HMA JMF, see Section 7 of this standard for WMA mix design considerations.***
- 1.2 The intent of this standard is to verify the mixing/compaction temperatures supplied by the WMA technology manufacturer/supplier, and to ensure that the WMA mix design meets the volumetrics and other requirements stated here-in.
- 1.3 This standard is applicable to a number of WMA processes including those in which the additive is mixed with the asphalt cement or added to the mixture during production, and to plant foaming processes.

Note 1: *This protocol is for Superpave-designed mixes. For Marshall mixes, please refer to the guidelines provided by NCHRP Report 691 Mix Design Practices for Warm Mix Asphalt.*

Note 2: *The laboratory modification of the asphalt cement either using additives or by foaming shall be in accordance with the written recommendations of the manufacturer and/or proponent of the WMA technology. The WMA technology manufacturer/proponent shall provide the laboratory mixing/compaction temperature for mix design and for the testing of plant produced mix.*

2. REFERENCES

- 2.1 MTO Test Methods
 - LS-307 Recycled Hot Mix Asphalt
 - LS-309 Practice for Superpave Mix Design
 - LS-312 Method for the Fractionation of Unextracted Reclaimed Asphalt Pavement (RAP) for Testing and For Incorporating in Other Test Samples
- 2.2 AASHTO Standards
 - T 283 Resistance of Compacted Asphalt Mixture to Moisture-Induced Damage
 - T195 Standard Method of Test for Determining Degree of Particle Coating of Asphalt Mixtures
 - TP 79 Determining the Dynamic Modulus and Flow Number of Hot Mix Asphalt Using the Asphalt Mixture Performance Tester (AMPT)
 - R 30 Mixture Conditioning of Hot Mix Asphalt (HMA)
- 2.3 National Cooperative Highway Research Program (NCHRP) Reports

NCHRP Report 691	Mix Design Practices for Warm Mix Asphalt
NCHRP Report 714	Special Mixture Design Considerations and Methods for Warm Mix Asphalt: A Supplement to NCHRP Report 673: A Manual for Design of Hot Mix Asphalt with Commentary

3. EQUIPMENT

- 3.1 For all WMA processes: a mechanical mixer (planetary mixer) of sufficient capacity to adequately mix the aggregates and modified asphalt cement. Mix until fully coated (the recommended mixing time for planetary mixer is about 90 sec to get adequate full coating).
- 3.2 For processes requiring that additives be blended into the AC: a low shear mechanical stirrer with appropriate impeller to uniformly blend the AC and the additive.
- 3.3 For foaming processes: a laboratory scale foamed asphalt unit capable of producing consistent foamed AC at a water content to be used in the plant during mix production. The unit shall be calibrated to ensure that the design AC content is achieved in the foamed warm mix.

4. AGGREGATES AND MIXTURE PREPARATION PROCEDURES

- 4.1 Prepare the WMA aggregate batch samples by reconstituting to the JMF gradation.
 - 4.1.1 Each constituent aggregate shall be fractioned on all sieves down to the 2.36 mm sieve, with the passing 2.36 mm sieve collected as a single fraction. The total fraction passing the 2.36 mm shall be obtained by drawing from the passing 2.36 mm of each constituent in the proportion of its source material as per the JMF.
 - 4.1.2 For recycled mixes, include the amount of RAP calculated on the basis of the mix design to the aggregate blend. The RAP shall be prepared in accordance with LS-312.
- 4.2 If the WMA technology involves dosing the AC with the product, prepare the blend of asphalt cement and WMA additive by heating the AC to 135° C or in accordance with the mixing AC temperature recommended by the AC Supplier and incorporating the WMA using the low shear mixer. The resulting blend can be stored at room temperature until needed. Liquid anti-stripping agent, if required by the HMA design, can be added to this blend at this stage in accordance with manufacturer's recommendations.
- 4.3 Heat the aggregate batches to a temperature set approximately 15° C higher than the mixing temperature, and the AC to the mixing temperature recommended by the WMA

technology supplier. Pre-heat a forced draft oven and all necessary pans and tools to the proposed compaction temperature for use in short-term conditioning of the mixture.

- 4.4 The lab batch sizes for various WMA processes including foaming process shall be of suitable sizes to get consistent mixture for WMA mix design purposes and the required amount of foamed asphalt shall be within the calibrated range of the foaming device.

4.5 Mixture and Samples Fabrication

- 4.5.1 Using the JMF mix design information prepare, at the designed asphalt cement (AC) content in suitable size batches, material for the following:

4.5.1.1 Conduct sufficient testing to confirm the WMA technology supplier's recommended compaction temperature. The WMA technology supplier's recommended temperature shall be deemed to be confirmed if the WMA air voids are within 4.0 ± 0.5 percent of the HMA mix design air voids, when compacted at the design number of gyrations (N_{des}) at the designed AC content.

4.5.1.2 Two (2) specimens that will be compacted to the maximum number of gyrations at the compaction temperature determined above.

4.5.1.3 Maximum theoretical density testing in accordance with LS-264.

- 4.5.2 The procedures to be followed in the sample preparation and fabrication of the compacted specimens are as per LS-309, including the conditioning which shall be at the compaction temperature supplied by the WMA technology supplier (Note 3). For the testing to be performed at higher than the compaction temperature, the mixture shall be heated in a forced air oven set no more than 10° C above the elevated temperature following the conditioning.

Note 3: *Short-term conditioning means placing the mixture in a flat pan at an even thickness of 25 to 50 mm and placing the pan in the forced draft oven at the planned field compaction temperature for 2 hours (Please refer to AASHTO R 30 for details).*

- 4.5.3 For foaming technologies, the modification of the AC and the preparation of the mixtures will likely occur within a single process. The conditioning and sample preparation shall be as per 4.5.2.

- 4.5.4 Determine volumetric properties of the WMA mix using the results of the tests carried out under this section.

5. EVALUATING MOISTURE SENSITIVITY, COATING AND COMPACTABILITY OF WMA MIXTURE

The following testing shall be carried out on WMA samples prepared under Section 4, and test results shall meet the requirements as described here-in.

- 5.1 For moisture sensitivity testing, prepare sufficient material at the design AC content for 6 gyratory specimens as described in Section 4 including short-term conditioning. Compact test specimens to 7.0 ± 0.5 percent air voids in accordance with AASHTO T 312. Group, condition and test the specimens in accordance with AASHTO T283. TSR shall meet minimum value of 0.8.
- 5.2 For Coating test, prepare sufficient material at the design AC content using the procedure described in Section 4. Do not short-term condition the mixture. Evaluate the coating in accordance with AASHTO T195. This test method consists of separating out the coarse aggregates of the WMA mixture and determining the percentage of the coarse aggregate particles that are fully coated. The requirement is that 95% of the coarse aggregate particles shall be fully coated.
- 5.3 Compactability test for WMA mixture shall be completed as follows:
Prepare sufficient WMA mixture at the design AC content for 4 gyratory specimens and one theoretical maximum specific gravity using the appropriate WMA mixture preparation procedure from Section 4, including short-term conditioning for 2 hours at the compaction temperature.
- 5.3.1 Compact duplicate gyratory specimens at the design AC content to the design number of gyrations (N_{des}) at the compaction temperature as determined in Section 4.5. Record the specimen height for each gyration.
- 5.3.2 Allow the mixture to cool to 30° C below the compaction temperature and compact duplicate gyratory specimens to N_{des} at 30° C below the compaction temperature. Record the specimen height for each gyration.
- 5.3.3 Determine the theoretical maximum specific gravity (G_{mm}) of the mixture.
- 5.3.4 Determine the bulk specific density of each sample (G_{mb}).
- 5.3.5 For each specimen compacted at the compaction temperature, determine the relative densities ($\%G_{mmN}$) at each gyration by using Equation 1 and determine the average relative density for the two specimens for each gyration. Then determine the number of gyrations, where the average relative density is equal to or exceeds 92% of G_{mm} and report it as $(N_{92})_T$ in Equation 2. Repeat the above procedure for the other duplicate specimens compacted at 30° C below the compaction temperature and determine $(N_{92})_{T-30}$.

$$\%G_{mmN} = 100 \times \left[\frac{G_{mb} \times h_d}{G_{mm} \times h_N} \right]$$

Where

$\%G_{mmN}$ = relative density at N gyrations;

G_{mb} = bulk relative density of specimen compacted to N_{des} gyrations

h_d = height of the specimen after N_{des} gyrations, from the Superpave gyratory compactor in mm; and

h_N = height of the specimen after N gyrations, from the Superpave gyratory compactor in mm.

5.3.6 Determine the gyration ratio using Equation 2.

$$\text{Gyration Ratio} = \frac{(N_{92})_{T-30}}{(N_{92})_T}$$

Where°

$(N_{92})_{T-30}$ = gyrations to 92% of G_{mm} at 30° C below the compaction temperature and;

$(N_{92})_T$ = gyrations to 92% of G_{mm} at the compaction temperature.

5.3.7 The compactability is acceptable if the gyration ratio is less than 1.25.

6. ADDITIONAL TESTING ON WMA MIXTURE (FOR INFORMATION PURPOSES ONLY)

The following additional testing shall be carried out on WMA samples prepared under Section 4, and test results shall be provided for information purposes only.

6.1 Evaluate the rutting resistance using the Flow Number Test, AASHTO TP79.

6.1.1 Prepare sufficient material at the design AC content for four Flow Number tests, as described in Section 4. The test is conducted on 100 mm diameter by 150 mm high specimens that are sawed and cored from larger gyratory specimens that are 150 mm diameter by at least 175 mm high. Refer to AASHTO PP60 for detailed procedures for test specimen fabrication procedures. The short-term conditioning for WMA specimens is 2 hours at the compaction temperature.

6.1.2 Prepare the flow number specimens to 7.0 ± 0.5 percent air voids.

6.1.3 Perform the Flow Number Test at the design high temperature corresponding to the 50 percent reliability using the LTPP Bind Version 3.1 with no traffic adjustment for traffic and speed. The temperature is computed at 20 mm depth for surface course mixes and at the top of any pavement layer below the surface course (**Note 4**).

Note 4: LTPP Bind is software that is downloadable free of charge from the U.S. Federal Highway Administration website
<http://ltp-products.com/OtherProducts.asp>.

6.1.4 Perform the Flow Number Test unconfined using repeated deviatoric stress of 600 kPa with a contact deviatoric stress of 30 kPa. Determine the flow number for each specimen, and then average the results.

7. Mix Design Considerations For doing Stand-Alone WMA Mix Design (When there is not an Approved HMA Job Mix Formula)

- 7.1 When there is not an approved HMA Job Mix Formula in place, a WMA mix design shall be completed in accordance with LS-309, with the exception that the specimen fabrication, and mixing/compaction temperatures shall be in accordance with the written recommendations of the manufacturer and/or proponent of the WMA technology utilized in the WMA mix design.
- 7.2 The new WMA mix design shall meet the Moisture Sensitivity (TSR), Coating and Compactability requirements as per this draft LS-318. The Flow Number testing shall be for information purposes only.
- 7.3 An independent mix check (IMC) shall be submitted along with the new WMA mix design submission and the IMC check should meet the minimum TSR and Coating requirements. Compactability test results shall be submitted for information purposes only as part of the IMC.
- 7.4 New WMA mix design and JMF documents shall be signed, dated, and certified by the person accountable for the engineering and management responsibility for the laboratory that conducted the work. Reporting shall be in accordance with applicable draft LS-318 and LS-309 reporting requirements.

8. REPORTING REQUIREMENTS

The Warm Mix Asphalt (WMA) mix design submission shall include, but not limited to, the following information:

- 8.1 A WMA Superpave Mix Design Report clearly indicating the mix type as WMA including the test temperatures used for confirming the WMA technology supplier's recommended mixing and compaction temperature and the resulting volumetrics as well as the design BRD (G_{mb}) and MRD (G_{mm}).
- 8.2 The corresponding HMA Superpave mix design, including the Independent Check when required by the Owner.
- 8.3 The effective specific density of the aggregate as determined for the HMA and the WMA.
- 8.4 The recompaction temperature of the reheated WMA mixture to be employed in the laboratory testing of the production mix (**Note 5**).
Note 5: For some WMA processes, the recompaction temperature may be different from lab design compaction temperature.
- 8.5 TSR test results as per AASHTO T283.
- 8.6 The coating at the design AC content.
- 8.7 Gyration to 92 percent G_{mm} at the proposed compaction temperature and 30° below the compaction temperature, as well as the gyration ratio.

- 8.8 The Flow Number test temperature, specimen air voids and Flow Number at the design AC content.
- 8.9 Name and percent of the additive by weight of AC, added to the AC for WMA process.
- 8.10 The WMA process description, the WMA technology supplier's recommended production and compaction temperatures.

9. ADDITIONAL REFERENCE

Additional information regarding the WMA mix design practices can be obtained from the following NCHRP Reports:

- NCHRP Report 691 Mix Design Practices for Warm Mix Asphalt.
- NCHRP Report 714 Special Mixture Design Considerations and Methods for Warm Mix Asphalt: A Supplement to NCHRP Report 673: A Manual for Design of Hot Mix Asphalt with Commentary



Hamilton

APPROVED PRODUCT LIST

JUNE 2013

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PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Backflow Preventers		Watts	009 (16mm to 50mm) 909 (75mm to 200mm)
Backwater Valve		Bibby-Ste-Croix	69060
Corrosion Protection	Zinc Anodes: 5.4 Kg and 10.5 Kg ASTM B-418, Type 2 Magnesium Anodes: 14.5 Kg - B-107, ASTM 843, Type M1 OPSS 442		
	Protective coatings for metal fittings	Denso North America	Denso Wrap (primer, mastic and tape)
		PetroWrap	PetroWrap (primer, mastic and tape)
		Trenton	No. 1 Wax Tape (primer, mastic and tape)
Polyethylene encasement for ductile iron watermain pipe and fittings ANSI/AWWA C105 A21.5 - 8 mil low density Poly-Tube with overlap			
Couplings	Water Service Couplings 19mm to 50mm AWWA C800, NSF 61(Annex G) compression fit copper to copper connections	Cambridge Brass	118, 118NL, 119, 119NL
		Ford Meter Box Co.	C44, – Q type
		Mueller	H-15403
	Water Service Couplings 19mm to 50mm AWWA C800, NSF 61(Annex G) copper to lead or alloy connection	Ford Meter Box Co.	Q14 Series, Q24 Series and Q34 Series With internal stop

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Couplings Cont'd...	Watermain Pipe Couplings AWWA C219-06 epoxy coated with stainless steel straps, nuts and bolts	Ford	FC1 and FC2 100mm to 300mm DI and PVC
		Robar Industries	1506 (4 or 5 bolt model) 100mm to 400mm DI and PVC
		Straub Tadco	Straub-Flex, non-restrained up to 1200mm (modified for Hamilton)
		Victaulic	Vic 31 400mm DI only
		Viking Johnson	MaxiFit (100mm to 1200mm)
Curb Stops	19mm to 50mm AWWA C800 NSF 61(Annex G) compression ends ball type, non-draining	Cambridge Brass	202 and 202NL Series
		Ford Meter Box Co.	B44 Series – Q Type
		Mueller	300 B-25209
Fittings	Ductile Iron Up to 300mm Pressure Class 350, cement lined, AWWA C104, C110 / A21.10, C153/A2.53, OPSS 441, NSF 61	Bibby	
		Sigma	
		Star Pipe Products	
		Tyler/Union	DM, DFF and XM
	Ductile Iron 400mm and larger Class 52, cement lined restrained mechanical joint AWWA C104, C110 / A21.10, OPSS 441.05.02	Bibby	
		Sigma	
		Star Pipe Products	
		Tyler/Union	DM, DFF and XM
	PVC 100mm, 150mm and 200mm, injection molded AWWA C907, B137.3 OPSS 441	Ipex	Blue Brute
		Royal Pipe	Royal Seal
	PVC 250 mm to 750mm CSA B137.3 250 mm and 300 mm shall use AWWA C900 and C905 PVC pipe, bonded and over- wrapped with fiberglass- reinforced polyester	Ipex	Blue Brute, Big Brute
		Royal Pipe	Royal Seal

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Hydrants	3 way hydrants AWWA C502 CAN / ULC S-520 2-63.5 mm side ports, CSA standard thread, stainless steel nuts, bolts and studs 100mm "STORZ" pumper connection 25mm hydrant operating nut - open left (Counter clockwise) Extensions permitted at boot only	American AVK	Style 2780
		Clow Canada Ltd.	Brigadier Series M -67
		Mueller Canada Inc.	Darling B-50-B
Insulation	Extruded Polystyrene	Dow	Styrofoam Highload 100
		Owens Corning	Foamular 1000 (Pink)
Joint Restraint	Ductile Iron Pipe	Ebaa Iron	Mega-Lug Series 1100 Black epoxy coated wedges and nuts (100mm to 1200mm)
			Tru-Dual Series 1500TD (100mm to 300mm)
		Ford	Uni-Flange Series 1390 (100mm to 300mm)
		Smith-Blair	Cam-Lock Series 111 - epoxy coated wedges and nuts (100mm to 600 mm)
			Bell-Lock 115 and 165 (100mm to 300mm)
		Sigma	One-Lok - SLD (100mm to 600mm)
		Star	Stargrip Series 3000 and 3100 (100mm to 1200mm)
		Tyler/Union	TUFGrip TLD (black)

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Joint Restraint Cont'd...	Polyvinyl Chloride Pipe (PVC) AWWA C900 and C905 ASTM F1674	Ebaa Iron	Tru-Dual Series 1500TD (100mm to 300mm)
		Ford	Uni-Flange Series 1390 (100mm to 300mm)
		Sigma	PV-Lok - SLC (100mm to 600mm)
		Star	Stargrip Series 4000 Top breakaway nut same size as the T-bolt (100mm to 750mm)
		Smith Blair	Bell-Lock 115 (100mm to 300mm)
			Cam-Lock Series 120 (100mm to 600 mm)
		Tyler/Union	TUFGrip TLP (red)
Main Stops (Corporations)	19mm to 50mm AWWA C800 NSF 61(Annex G) compression end, ball Type non-draining	Cambridge Brass	301 and 301NL Series A3H3, A4H4, A6H6, A7H7
		Ford Meter Box Co.	FB1000 Series, Q Type
		Mueller	300 B-25008
Pipe	Concrete Pressure Pipe 500mm and larger AWWA C300, C301, C302 and C303, OPSS 441 Plant pre-qualified by OCPA	Hyprescon	
		Munro Concrete	
	Ductile Iron Pipe 100mm to 300mm Pressure Class 350, tyton joint, AWWA C104 / A21.3, C110 / A21.10, OPSS 441	Canada Pipe Company	Includes polyethylene encasement of pipe and fittings AWWA C105 / A21.5
		Canada Pipe Company	Includes polyethylene encasement of pipe and fittings AWWA C105 / A21.5
Ductile Iron Pipe 400mm to 1050mm tyton joint, Class 52 AWWA C104 / A21.3, C110 / A21.10, OPSS 441	Canada Pipe Company	Includes polyethylene encasement of pipe and fittings AWWA C105 / A21.5	

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Pipe Cont'd.	Polyvinyl Chloride (PVC) 100mm to 300mm AWWA C900 - DR18 OPSS 441	Ipex	Blue Brute
		Royal Pipe	Royal Seal
		National Pipe and Plastics	AWWA C900
	Polyvinyl Chloride (PVC) 400mm AWWA C905 – DR18 OPSS 441	Ipex	Big Brute, Centurion
		Royal Pipe	Royal Seal
	Polyvinyl Chloride (PVC) 500mm to 750mm AWWA C905, OPSS 441	Ipex	Big Brute, Centurion
		Royal Pipe	Royal Seal
	Water Service Pipe 19mm to 50mm AWWA C800, OPSS 441, ASTM B88, Type K Soft Copper	Wolverine	
Repair Clamps	clamps to be supplied with conductivity strip	Robar Industries	5616, 5626, 5636
		Ford Meter Box Co.	Style FS1, FS2 and FS3
Service Boxes	Slide adjustment type Stainless steel rods brass cotter pin	Mueller	H-10300 Series
		Clow	"D" Series
Service Saddles	DI, PVC Pipe Outlet size: 19mm to 50mm stainless steel straps Denso protection at installation AWWA taper (cc)	Cambridge Brass	403 and 812 Series
		Ford	FS202
		Robar Industries	2506 DS, 2616
		Romac	202 BS (2 strap model)
		Smith Blair	317
	Concrete Pressure Pipe Outlet size: 19mm to 50mm	Ayotte Enterprises	A-900 with A-571 thermoplastic coating (400 mm only)
Tapping Sleeves	Outlet size: 100mm to 400mm Protective coating shall be applied to all steel sleeves.	Ayotte Enterprises	A-600 with A-571 thermoplastic coating, stainless steel nuts and bolts - concrete pipe only
		JCM Industries	JCM 415 epoxy coated with stainless steel nuts and bolts, concrete pipe only
		Smith Blair (Steel)	#622 epoxy coated (up to 750mm) Ductile Iron and PVC pipe
		Robar Industries (Steel)	6808 and 6906 epoxy coated (100mm to 500mm) Ductile Iron, C900 PVC pipe only

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
		Romac (Steel)	FTS420 epoxy coated Ductile Iron pipe
Tracer Wire	Solid 12 gauge copper		TWU75 or RWU90XLPE
Valves	<p>Butterfly Valve 450mm and Larger</p> <p>AWWA C504, Class 150B manual actuator - traveling nut type with external position indicator nuts, bolts, and bolt studs to be stainless steel</p> <p>Former City of Hamilton: 25mm operating nut, open right (clockwise)</p> <p>Former Municipalities: 50mm operating nut, open left (counter clockwise)</p>	Clow Canada	M & H 504 (450mm to 500mm) M & H AWWA Large Diameter (600mm and larger) Valve seat adjustment to face spool piece side
		Mueller	Lineseal
	<p>Gate Valve* Resilient Wedge 100mm to 300mm</p> <p>AWWA C509, C515 nuts, bolts, and bolt studs to be stainless steel, bronze pin top adjustment not permitted</p> <p>Former City of Hamilton: 25mm operating nut, open right (clockwise)</p> <p>Former Municipalities: 50mm operating nut, open left (counter clockwise)</p> <p>*includes hydrant secondary valves</p>	Clow	F-6100, F-6102, F-6106
		Mueller	A2360-6, A2360-19, A2360-23
		American AVK Co.	Series 45
	<p>Gate Valve Resilient Wedge 400mm</p> <p>AWWA C509, C515</p> <p>nuts, bolts, and bolt studs to be stainless steel</p> <p>Former City of Hamilton: 25mm operating nut, open right (clockwise)</p> <p>Former Municipalities: 50mm operating nut, open left (counter clockwise)</p>	Clow	F-6102
		Mueller	A2361-6

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Valves Cont'd...	Combination Air Release and Vacuum Breaker Valves AWWA C512 with surge protection	A.R.I Flow Control Accessories	D-060 C HF NS
		Vent-O-Mat	Water RBX Series
	Tapping Valves 100mm to 300 mm AWWA C509	Clow	F-6106
		Mueller	A2360-19
	Tapping Valves 400mm to 600mm AWWA C509	Clow	F-6106BG
		Mueller	A-2361-19
Valve Boxes	Sliding Type with 6mm pre- drilled tracer wire hole and grommet in upper section	Bibby Ste. Croix	VB1000 Series
Valve Chambers	OPSS 407, 1351 Plant must be pre-qualified by the Ontario Concrete Pipe Association	Anchor	
		Con Cast	
		Hanson	
		M-Con	
		Munro Concrete	
		Wilkinson	
Valve Chamber Frame and Cover	OPSS 1850 OPSD 402.011 WM 212.03	Bibby	
		R.B. Agarwalla	
		Mueller	
		EJ (McCoy)	
	750mm cover OPSS 1850 10 - 25mm vent holes "WATER" cast into cover 4 lifting keyways	EJ (McCoy)	Frame 1220Z1, Product No. 00122016 Cover 1220B, Product No. 00122028
Water Meter Reader Enclosure		Hoffman Nema 4x, fiberglass	Includes internal mounting plate

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Catch Basins	CSA A257.4 Form 700 OPSS 407, 1351 Supplied from a plant prequalified by the OCPA	Co-Pipe	
		Con Cast	
		Hanson	
		M-Con	
		Munro	
		Wilkinson	
Catch Basin Frames & Covers	OPSD 400.100 ASTM A48 OPSS 1850	Bibby	
		Labco	
		EJ (McCoy)	"All in one" cover
		Mueller Canada	
		R.B. Agarwalla	
Couplings	CSA B182.2 CSA B182.4 OPSS 1841	Fernco Connectors	
		Kwik Connectors	
		Mission Rubber Co.	
		Pipe Conx	
		Preper-PLS Tech	
Culvert Pipe	Corrugated Steel (CSP) Riveted or Spiral CSA G401 galvanized or aluminized (Type 2) OPSS 1801 and 1841 up to 1000mm - 1.6 Gauge over 1000mm - 2.0 Gauge	Armtec	Hel-Cor, Ultra Flo
		Atlantic Industries	
		Canada Culvert	Steelcor
	HDPE and PVC OPSS 1840, ASTM F 894	Armtec	Big "O", Boss 2000
		Ideal Drain Tile Ltd.	Challenger 2000
Goss Traps	SEW-304	EJ (McCoy)	
		Hanson	Poet
		CB Trap	

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.	
Maintenance Holes	CSA A257.4-M92 Form 700 OPSS 1351 1200mm to 3000mm Supplied from a plant prequalified by the OCPA	Coldstream		
		Co-Pipe		
		Con Cast		
		Hanson		
		M-Con		
		Munro		
		Wilkinson		
Maintenance Hole Frames & Covers	OPSD 401.010 Type A and B ASTM A48	Bibby		
		EJ (McCoy)		
		Mueller Canada		
		R.B. Agarwalla		
Sewer Pipe	Vitrified Clay Pipe 150mm to 600mm CSA A60.1M-1976 Form 500	Logan	T-Tap (without flanges)	
		Concrete Pipe - Reinforced 300mm or greater CSA A257.2 65-D, 100-D, 140-D Form 500 and 700 OPSS 1820 Supplied from a plant pre-qualified by the OCPA	Co-Pipe	
			Con Cast Pipe	
	Hanson		Concrete Bell (mortared in)	
	Hyprescon			
	M-Con			
	Munro			
	Polyvinyl Chloride Pipe (PVC) Smooth Wall DR-28 / DR-35 CSA B182.2 200mm to 375mm Form 500 OPSS 1841		Ipex	Ring-Tite
		Rehau Pipe	Duraloc	
		Royal Pipe Co.	Royal Seal	

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
<p>Saddles / Connections</p>	<p>CSA B182.2 CSA B182.4 100mm to 300mm</p>	<p>ADS Canada</p>	<p>Inserta – Tee Saddle Tee (2 straps) Saddle Wye (2 straps) Wing Adapter Universal Sewer Saddle 22 ½° to 45° bends</p>
		<p>Fernco 100mm and 150mm</p>	<p>EZ Tap</p>
		<p>Specialty Products 2000 Inc. (150mm)</p>	<p>Core Bell Adaptor</p>
<p>Valves</p>	<p>Combination Air / Vacuum Breaker AWWA C512</p>	<p>A.R.I</p>	<p>D-020 (stainless steel)</p>

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
High Pressure Sodium Lamps – all wattages, medium and mogul base	Non-cycling, TCLP compliant including lead-free brass base. 30,000+ hours life, universal operating position. Meet ANSI specification corresponding to wattage.	General Electric	Ecolux NC
		Osram Sylvania	Lumalux Plus/Eco
		Philips	Ceramalux ALTO Non-Cycling
Metal Halide Lamps – all wattages, medium and mogul base	Inclusive of probe start, pulse start and ceramic metal halide. Operating position designation as per luminaire requirements. Meet ANSI specification corresponding to wattage.	General Electric	Multi-Vapor
		Osram Sylvania	Metalarc
		Philips	Metal Halide (standard)
Metal Halide Lamps – 200W	200W pulse start lamps	Venture	Unit-Form
Photocell – Standard life, twist-lock type	Standard Life Photoelectric controller with NEMA rated locking type blades. OPSS 2485 Note: Use only permitted for maintenance/replacement. Prohibited for use with LED luminaires.	Fisher-Pierce	FP-N770 Series Instant Response
		DTL	DSS Series
		Precision	
Photocell – Long life, twist-lock type	Long Life Photoelectric controller with NEMA rated locking type blades. OPSS 2485	Fisher-Pierce	TRS Series
		SELC	8483 Range
Photocell – Standard life, button type	Photoelectric controller – button/mirco CSA C239	Fisher-Pierce	B Series
		DTL	DBE Series

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Cobra-head Luminaires – drop glass, all wattages	Prismatic drop glass high pressure sodium and metal halide 'cobra-head' luminaires Integral twist-lock photocell socket CSA C22.2 No. 9.0-96 CSA C653-08, OPSS 2432 Note: Use only permitted for maintenance/replacement.	Cooper Lighting	OVZ Series
		American Electric Lighting	115 Series
		General Electric	M-250R2 Series
LED Cobra-head Luminaires – all wattages	Light Emitting Diode (LED) 'cobra-head' luminaires, conforming to specifications established in RFPQ C11- 59-12	Philips Lumec	Roadview Series
		General Electric	ERS Series
		Cooper Lighting	Navion LED Series
Cobra-head Luminaire – sag/flat glass, all wattages	Sag glass/flat glass (cut-off) high pressure sodium and metal halide 'cobra-head' luminaire. Integral twist-lock photocell socket CSA C22.2 No. 9.0-96 CSA C653-08 OPSS 2432 Note: Use only permitted for maintenance/replacement.	Cooper Lighting	OVF Series
		American Electric Lighting	115 Series
		General Electric	M-250R2 Series
Decorative Luminaire – Carriage Style, all wattages	Decorative carriage (4-sided lantern) high pressure sodium luminaire. Integral twist-lock photocell socket CSA 22.2 No. 9.0-96 CSA C653-08	King Luminaire	K601 Empress Series
		Cooper Lighting	Springdale Series
		Cyclone	Elencia Series

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Decorative Luminaire – Tear Drop Style, all wattages	Decorative tear-drop (lantern) high pressure sodium luminaire. Integral twist-lock photocell socket CSA 22.2 No. 9.0-96 CSA C653-08	King Luminaire	K211 Manchester Series
		Holophane	Memphis Series
		Philips Lumec	Renaissance Series
Decorative Luminaire – Acorn Style, all wattages	Decorative post-top (lantern) high pressure sodium luminaire. Integral twist-lock photocell socket CSA 22.2 No. 9.0-96 CSA C653-08	King Luminaire	K118 Washington Series
		Cooper Lighting	ARN Acorn Series
Power Supply Pedestal Feeder Wiring	Single conductor, stranded copper wire 90 degree Celsius, 600V rated Type RWU90-XLPE #2 AWG (minimum) CSA C22.2 No.38	Anixter Canada	6CN Series (or equal)
		General Cable	
		Southwire	
Pole-to-pole and Branch Feeder Wiring	Single conductor, stranded copper wire 90 degree Celsius, 600V rated Type RWU90-XLPE #6 AWG (minimum) CSA C22.2 No.38	Anixter Canada	6CN Series (or equal)
		General Cable	
		Southwire	
In-pole/In-arm (internal) Wiring	Single conductor, solid copper wire 90 degree Celsius, 600V rated Type TWU #12 AWG (minimum) CSA C22.2 No.75	Anixter Canada	6CA Series (or equal)
		General Cable	
		Southwire	
Electrical Conduit and Fittings	Type II rigid polyvinyl chloride (PVC) 50mm (minimum) CSA C22.2 No.211.2-06	Ipex	Scepter
		Royal	Rigicon

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Concrete Pole – Standard Duty, all lengths	Direct buried, spun concrete pole– street lighting use. Class B (minimum) CSA A14-M1979 CSA C22.2 No. 206-M OPSS 2421 OPSD 2225.01	Stresscrete Group	
		Utility Structures Inc. (USI)	
Concrete Pole – Heavy Duty, all lengths	Direct buried, spun concrete pole – combined use (street lighting & traffic signals). Class D (minimum) CSA A14-M1979 CSA C22.2 No. 206-M OPSS 2421 OPSD 2225.01	Stresscrete Group	
		Utility Structures Inc. (USI)	
Concrete Pole – Decorative Octagonal, all lengths	Direct buried, spun concrete pole – street lighting use. Class B (minimum) Octagonal decorative tapered profile, midnight black etched finish CSA A14-M1979 CSA C22.2 No.206-M OPSS 2421 OPSD 2225.01	Stresscrete Group	
		Utility Structures Inc. (USI)	
Concrete Pole – Decorative Post/Top Mount, all lengths	Direct buried, spun concrete pole – street lighting use. Decorative, including profiled decorative base, midnight black etched finish – post top luminaire mounting. CSA A14-M1979 CSA22.2 No.206-M OPSS 2421 OPSD 2225.01	Stresscrete Group	Sheridan Collection Series

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Street Light Luminaire Bracket Arm - Standard, all projection lengths	Aluminum tapered sidemount elliptical bracket arms. OPSS 2428 OPSD 2250.01 OPSD 2420.01	Aluminous Lighting Products	
		Stresscrete Group	
		Dynapole	
Street Light Luminaire Bracket Arm – Decorative, all projection lengths	Decorative metal ‘Victorian’ scroll arm – side mount configuration – midnight black painted finish	Stresscrete Group	17x Series
Pole Identification Tag	Aluminum Engraved modular number/letter insert type pole ID tags. 25mm letter/numbers, black text on white or natural aluminum background. Vertical orientation, affixed with aluminum banding	Almetek	E-Z Tag V400-TH-A
		Electromark	
Power Supply Pedestal	Complete pedestal assembly consisting of the following: - 100A rated meter socket c/w blank/shorting meter socket insert - 120/240V, 100A panelboard c/w 60A-2P main breaker, 6x40A-1P branch breakers and provision for up to 12 breakers - All equipment contained within a weather proof, tamper proof, dark green in colour metal ground/pad mounted enclosure - Enclosure door and internal panelboard door shall have provision for pad-locking CSA or ESA Approved	Pedestal Solutions Inc.	HSLM271-6-40
		Keltour Controls Inc.	



APPROVED PRODUCTS LIST
SECTION 3 – STREET LIGHTING

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PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Ground Rod Inspection Well	Polymer 254mm dia. Light duty inspection well/handwell ASTM C857 – A0.3 SCTE – Light Duty	Carson	L Series 910

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Electrical Conduit and Fittings	Polyvinyl Chloride (PVC) 25 mm, 50 mm and 75 mm Bell end conduit NEMA TC-2 Schedule 80 CSA C22.2 No. 211.2-06 DT:0111-01 and DT:0111-02	IPEX	Scepter (type II), includes IPEX 100 conduit cement
	High Density Polyethylene (HDPE) - CSA B137.1-05, ASTM F2160 DT:0111-01 and DT:0111-02	IPEX Carlton	
Electrical Handholes	Polyvinyl Chloride (PVC) OPSD 2113.010 - Type III, rectangular	IPEX	
	Precast concrete with cast iron frame & cover OPSD 2112.02 (460 mm dia.) ANSI/ASTM A48	HY-GRADE	
Detector Loop Lead-in Cable	# 14 AWG Overall shielded, twisted pair Polyethylene insulation PVC Jacket, 600 V	Belden	8720
Detector Loop Sealant	Non-shrinking Won't fracture at - 40 ° C	3M	Detector loop sealant 5000
		Chemque Canada	Q-Seal: 290S, 290W 295S, 295M
Detector Loop Splice Tape	Vinyl electrical tape OPSS 623 compliant CSA 22.2 No. 197 600 volts (- 18° C to 105° C)	3M	Scotch Super 88
Detector Loop Wire	Stranded copper wire #14 AWG, Black Type RWU-90 X-link 1000 V - 40° C OPSS 623 - CSA 22.2 No. 38	General Cable	Spec. # 5600

PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION/ MODEL No.
Grid Interconnecting Conductors	Solid, soft drawn, un-insulated Bare #2 AWG copper wire	Erico	Eritech
		Southwire	
Ground Electrode Conductor	Stranded copper wire RWU90-XLPE - insulated Green #3 AWG	Noramco	
		General Cable	
Ground Electrode Connectors	Compression connectors	Thomas & Betts	Blackburn E-Z-Ground
Ground Enhancement Material	< 20 ohm-cm resistivity MSDS sheet required DT:011-01 and DT:011-02	SAE Inc.	Conducrete DM100
		Erico	GEM25A
		Harger Lighting and Grounding	Ultrafill
Ground Rod Inspection Well	Polymer Concrete	Oldcastle Precast	Carson H-Series
Grounding Plates	254 mm x 400 mm x 6mm (10" x 16" x 1/4") galvanized steel CSA C22.2 No. 41-M or UL467 Min 0.2 sq. meter surface area DT:011-01 and DT:011-02	Thomas & Betts	Blackburn 1016TB
		Erico	Eritech EGGPC
		Hydel Enterprises	1016GPGC
Grounding Rods	3.0 m x 19mm (10' x 3/4 ") copper clad steel, pointed minimum 10 mils of copper CSA C22.2 No. 41-M or UL467 DT:011-01 and DT:011-02	Thomas & Betts	Blackburn 7510
		Erico	Eritech 61340
		Hydel Enterprises	3410CC
Junction Boxes for Detector Loop Splices	Fibre reinforced PVC OPSD 2300.010, Type No. P1-5 200mm x 200mm x 175mm Flanged with cover H-10 highway loading	IPEX	Scepter - H887

DRAWING No.	DATE	DESCRIPTION
WM-200.01	May 2013	Bedding & Backfill for Concrete & PVC Watermains and Water Services
WM-200.02	November 2005	Bedding & Backfill for Ductile Iron Watermains and Water Services
WM-201.01	November 2005	1200mm Dia. Precast Valve Chamber for 300mm Dia. Watermains & Smaller
WM-201.02	November 2005	Tapping Valve Installation for D.I. Watermain 300mm Dia. and Smaller
WM-202	November 2005	Valve Box Installation For 100mm to 300mm Dia. Watermains
WM-203.01	November 2005	Hydrant Installation
WM-203.02	November 2005	Hydrant Installation using Anchor Tee
WM-203.03	November 2005	Relocation of Ditches at Hydrants
WM-203.04	January 2011	Operating Nut Adaptor for Use on Open Right (Clockwise) Valves
WM-204.01	January 2011	Concrete Anchor Blocks For 300mm Dia. Watermains And Smaller
WM-204.02	January 2011	11-1/4° & 22-1/2° Angle Anchor Block Details for 400mm to 600mm Dia. D.I. Watermains
WM-204.03	January 2011	45° Angle Anchor Block Details for 400mm to 600mm Dia. D.I. Watermains
WM-204.04	January 2011	45° Angle Anchor Block with Leg for 400mm to 600mm Dia. D.I. Watermains
WM-204.05	January 2011	90° Angle Anchor Block Details for 400mm to 600mm Dia. D.I. Watermains
WM-204.06	January 2011	90° Angle Anchor Block with Leg for 400mm to 600mm Dia. DI Watermains
WM-204.07	January 2011	Tee Anchor Block Details for 400mm to 600mm Dia. D.I. Watermain Branches
WM-204.08	January 2011	Tee Anchor Block with Leg for 400mm to 600mm Dia. D.I. Branch Watermains
WM-204.09	January 2011	Concrete Thrust Block for 400mm to 600mm Dia. D.I. Watermains

*24' x 36' size drawings are not bound in this document

DRAWING No.	DATE	DESCRIPTION
WM-204.10	January 2011	Concrete Anchor Blocks for 100mm to 300mm Dia. D.I. Watermains at 11 1/4° & 22 1/2° Vertical Bends
WM-204.11	January 2011	Concrete Anchor Blocks for 100mm to 300mm Dia. D.I. Watermains at 45° Vertical Bend
WM-204.12	January 2011	Vertical Bend Anchor Block 7 1/2° to 22 1/2° for 400mm Dia.D.I. Watermain
WM-204.13 (1 of 2)	November 2005	Concrete Anchor Block for 100mm to 300mm Dia. Watermain Lowering
WM-204.13 (2 of 2)	January 2011	Concrete Anchor Block for 100mm to 300mm Dia. Watermain Lowering
WM-205.01	March 2008	50mm Dia. Watermain Looping in Cul De Sacs (20.0 m R.O.W.)
WM-205.02	March 2008	50mm Dia. Watermain Looping in Cul De Sacs (18.0 m R.O.W.)
WM-206	November 2005	50mm Dia. Dead End Blow-Off
WM-207.01	November 2005	Piping Arrangement for 19-25mm Dia. Water Service Connection and Yard Service
WM-207.02	November 2005	Piping Arrangement for 19-25mm Dia. Water Service Connections in a Common Trench
WM-207.03	November 2005	Insulation Details for Water Services at Gooseneck
WM-207.04	November 2005	Piping for 100mm to 300mm Dia. Water Service Connection & Yard Service to Meter with Cut in Tee & Sleeve
WM-207.05	November 2005	Piping for 100mm to 300mm Dia. Water Service Connection & Yard Service to Meter using Tapping Sleeve & Valve
WM-208	November 2005	Remote Receptacle Installation for Meter Chambers
WM-209	November 2005	Piping & Chamber for 16-50mm Dia. Meter Installation
WM-210	November 2005	Piping for 16-250mm Dia. Meter for Internal Installation
WM-211.01	November 2005	Standard Remote Installation for 16-25mm Dia. Meters
WM-211.02	November 2005	Alterations of Existing 16-25mm Dia. Piping Prior to Meter Installation

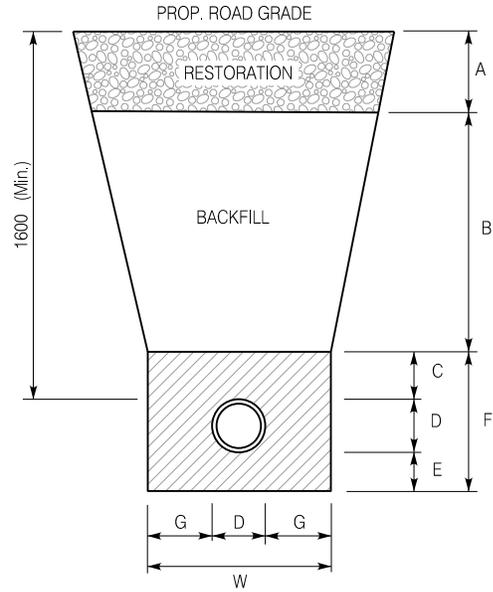
*24' x 36' size drawings are not bound in this document

DRAWING No.	DATE	DESCRIPTION
WM-211.03	November 2005	Single Family Residential Water Meter Installation for 16-25mm Dia. Services
WM-211.04	November 2005	Meter Pipe Spacer Installation
WM-212.03	November 2005	Valve Key Frame & Cover
WM-213	November 2005	Chamber End Plates for 100mm Dia. to 300mm Dia. Watermains
WM-214	November 2005	Removable Slab Lifting Hole Details & Lifting Hook Detail for Chambers
WM-215.01	November 2005	Valve Support
WM-215.02	November 2005	Pipe & Valve Support
WM-216	November 2005	Blow-Off Connection at Access Chamber
WM-217	November 2005	Pitometer Connection for Steel & Concrete Pipe
WM-230	January 2011	2400mm Precast Valve chamber for 400mm Dia. Concrete or Ductile Iron Pipe with 50mm Air Valve & 100mm Blow-Off (Size 24" x 36")
WM-231	January 2011	1800mm x 2400mm Precast Valve Chamber for 450mm Dia. or 500mm Dia. Concrete or Ductile Iron Pipe *(Size 24" x 36")
WM-232	January 2011	1800mm Precast Valve Chamber for 400mm to 500mm Dia. Concrete or Ductile Iron Pipe with 50mm Air Valve & 100mm Blow-Off *(Size 24" x 36")
WM-233	January 2011	1800mm x 3000mm Precast Valve Chamber for 400mm Dia. Concrete or Ductile Iron Pipe with 100mm Dia. to 300mm Dia. Branch *(Size 24" x 36")
WM-234	November 2005	1800mm x 2400mm and 1800mm x 3000mm Precast Meter Chambers for 100mm Dia. To 250 mm Dia. Water Services *(Size 24" x 36")
WM-235	November 2005	1800mm x 2400mm Precast Tapping Valve Chamber for 100mm to 300mm Dia. D.I. Pipe Tapping off 400mm to 600mm Dia. Watermain *(Size 24" x 36")

*24' x 36' size drawings are not bound in this document

CONCRETE & PVC WATERMAIN BEDDING & BACKFILL

REFER TO SPECIFICATIONS AND PLANS
FOR BEDDING AND BACKFILL MATERIALS

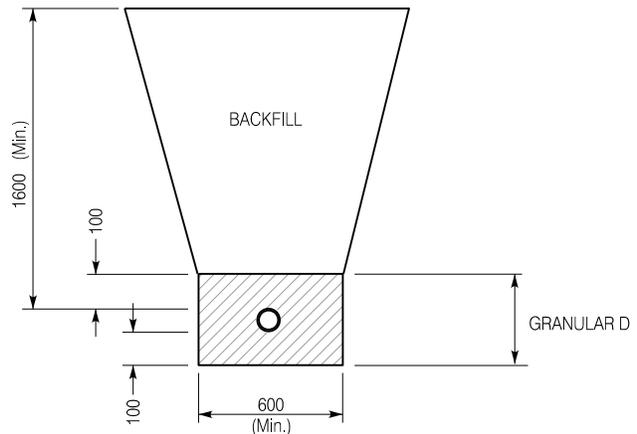


DIM	300mm DIA WATERMAINS AND SMALLER	350mm DIA WATERMAINS AND LARGER
A	FOR RESTORATION SEE RD-100.01 & RD-100.02	FOR RESTORATION SEE RD-100.01 & RD-100.02
B	750 (Min.)	600 MIN.
C	300 (Min.)	450 MIN.
D	O.D. OF PIPE	O.D. OF PIPE
E	150 (Min.)	225 MIN.
F	D + 450 (Min.)	D + 675 MIN.
G	225 (Min.)	225 MIN.
W	D + 450 (Min.)	D + 450 (Min.)

COPPER WATERMAIN & WATER SERVICE BEDDING & BACKFILL

NOTES:

1. WATER SERVICES WILL BE NORMALLY LOCATED 1000mm TO THE LEFT OF THE Q. OF THE LOT & MINIMUM 2500mm CLEARANCE FROM A SEWER SERVICE.
2. FINAL LOCATION TO BE DETERMINED BY THE PROJECT MANAGER.



City of Hamilton
Public Works Department

BEDDING & BACKFILL FOR CONCRETE AND PVC WATERMAINS AND WATER SERVICES

DIMENSIONS SHOWN ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED (N.T.S.)

DATE
May 2013

REV No
1

FORMERLY: RWS 500(1)

HAMILTON STD No

WM-200.01