

**DIVISION 4.1
CITY OF SARNIA
WATERMAIN
STANDARDS
2025**

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A. MATERIALS

Spec. OPSS.MUNI. Form 441, 514, 517, and 518; C.S.W.S., Standard Detail Drawing 112-SF

1. WATERMAIN PIPE

Supply and Place Watermain pipe and appurtenances meeting the specifications outlined below, (unless the pipe material is stated on the contract drawings or otherwise specified):

- For sizes of 100mm to 300mm, pipe must conform to, A.W.W.A.C-900, Pressure Class 150 psi, (DR 18) OPSS.MUNI.441 and certified Third Party in accordance with OPSS and Standards Council of Canada; CSA B137.3 PVC watermain pipe and appurtenances.

Or

- "Molecularly oriented PVC pipe in sizes 100mm (4") through 300mm (12") shall be Biaxially Oriented (molecular orientation in two directions), CSA certified to CSA Standard B137.3.1-09, third party certified to AWWA C909 and NSF 61 for potable water use. The pipe shall have Cast Iron Outside Diameters (CIOD), be color coded blue and have a Pressure Class of 235 psi." Where required, Bionax PVCO Approved Restraints Pipe-to-Pipe and Pipe-to-Fittings Restrainers shall be used as per manufacturer's recommendations". Pipe to be IPEX Bionax PVCO, CIOD watermain pressure pipe 100mm (4") through 300mm (12").
- For sizes of 350mm to 600mm (C.I.O.D.) pipe must conform to AWWA C905, Pressure Rating 165 psi, (DR 25) and be certified by CSA; CSA B137.3 "Rigid Poly (Vinyl Chloride)(PVC) Pipe for Pressure Applications." For pressure applications, each length of pipe must be hydro-tested at twice the rating and a short-term pressure test must be conducted once per production run.
- All joints to be bell and spigot with NSF approved rubber gaskets conforming to ASTM D3139; CSA logo must be clearly and permanently marked on all products; all watermain to be blue in colour.
- All pipes and fittings shall be manufactured by IPEX Inc; Northern Pipes; Rehau Industries Inc; Royal Pipe Co; Harrington Corporation; Diamond Plastic Corporation or National Pipe and Plastic Inc; or approved equal.
- Injection molded fittings (AWWA C907) shall be used up to 12"

(300mm) diameter size. Fabricated fittings shall not be used.

- Ductile Iron Fittings (Self-Restrained) shall have distinctly cast on them the pressure rating, nominal diameter, manufacturers name and AWWA Standard. All fittings shall be fusion bonded epoxy coated inside & out to NSF-61 standard and come capped from the factory to prevent contaminants inside the fitting. Joints and Fittings shall be in accordance with AWWA C111 & C153 latest revisions. Petroleum tape is not required on epoxy coated fittings. Self-Restrained fittings will be rated for 350PSI and can be used on PVC/PVCO and HDPE DIPS sizes. RCT Flex-Tite for sizes 4" (100mm) to 12" (300mm) size.
- Appurtenance and fittings for pipe sizes 350mm (14") diameter and greater, shall be, Ductile Iron, confirming to ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. Appurtenance and fittings shall be furnished with MJ (Mechanical type Joints) in accordance with ANSI/AWWA C111/A21.11, of latest revision. The fittings must meet the requirements of pressure rating of the pipe system. All Ductile Iron fitting are required to be treated with full petrolatum coating as detailed in Watermain - Materials.
- Tracer wire shall be installed on all non-metallic watermains, hydrants lateral and water services except where such water service pipe is of copper material.

2. WATER SERVICES AND METERS

i) Residential

Each property, including vacant lots, shall require a minimum diameter of 20 mm (3/4") copper service or 25mm (1") PEX/PE-RT tubing. The water services shall be a Type K soft copper material and or PEX/PE-RT Tubing extending from the watermain to the curb stop box.

Copper pipe for services shall conform to A.W.W.A. C800-89 Appendix A and OPSS.MUNI 401 and ASTM B88 and shall be Type "K"soft copper.

All Cross Linked Polyethylene (PEX)/PE-RT pipe shall be manufactured to AWWA C904/C901 and to SDR9 Copper tube size. All Pex/PE-RT shall be Blue in colour for potable water and certified to CSA B137.5 - cross linked polyethylene tubing for pressure application. All tubing will be certified to ASTM F876 and F877 and certified to NSF 14 and NSF 61. Approved PEX tubing may be Rehau Municipex and Ipex C-904/C901. Polyethylene tubing is to be used with standard copper O.D. brass fittings. Mueller foot piece or approved equal to be placed at curb stop as per Manufacture's requirements.

All Polyethylene of Raised Temperature (PE-RT) potable water service tubing shall be in accordance with AWWA 901, ASTM F2769, CSA B137.18 and NSF 61.

PE-RT water service tubing (SDR-9) copper tube size is to be used with standard O.D. brass fitting. PE-RT tubing ends to be installed with stainless steel inserts.

All PEX/PE-RT tubing to be installed with tracer wire as per standard specification.

Any connection from the mainstop to the curbstop shall be a continuous piece; couplings are not permitted within the City right of way.

Any connection from the curbstop to the inside face of the building shall be a continuous piece; couplings are not permitted as per OBC 7.3.5.7(4).

Where the water meter is not installed inside a new or existing dwelling, at the discretion of the City Engineer, the meter may be installed in a meter pit at the property line as per City of Sarnia Standard Drawing #100-SF. The additional costs for an outside meter and the meter pit will be at the owner's expense.

ii) Commercial, Industrial

All new water services 100mm (4") diameter and larger must be installed into the building as per City of Sarnia Standard 137-F before the watermain will be tested. Backflow preventors must be installed as per the current City of Sarnia backflow prevention program requirements.

3. GATE VALVES

Gate valves for watermain use shall conform to A.W.W.A. C509-87 Standard for Resilient Seated Gate Valves for Water and Sewage Systems and shall conform to OPSS.MUNI 441 and shall:

- For pipe sizes 100 mm (4") diameter to 200 mm (8") diameter, joint ends must be push on, complete with valve box, cover, riser and fittings.
- For pipe sizes 250 mm (10") and greater diameter, joint ends must be mechanical joint with restrained gland packs, complete with valve box, cover, riser and fittings.
- Have resilient seated fully encapsulated gates
- Have a working design water pressure of 14.1 kg/cm (200 PSI) for all pipe sizes from 75 mm to 300 mm nominal pipe sizes
- All watermain gate valves turn to the right hand (clockwise) to open

and shall have red painted operating nuts

- All sanitary forcemain gate valves turn to the left hand (counter clockwise) to open and shall have a black painted operating nut
- Have all exposed nuts and bolts made of type 304 stainless steel
- Have push-on joints (see A.W.W.A. 509 Sec 4.5.3 as per ANSI/A.W.W.A. C110/A21.11)
- Have epoxy coating to all interior and exterior ferrous surfaces as per A.W.W.A. C550-81
- Have a valve stem made of manganese bronze which has a yield strength greater than 207 MPa (30,000 PSI) or made of stainless steel BS420S37
- Be manufactured by Mueller (Model #A-2360-40) or American AVK Co series #25, #65 or Clow (model F6112)
- For pipe sizes 100mm (4") diameter to 200mm (8") diameter push on joints, injection molded complete with valve box, cover, riser and fittings
- For pipe sizes 250mm (10") diameter and greater shall be mechanical joint with restrained gland packs, complete with valve box, cover, riser and fittings.
- All valves supplied shall be new, the City of Sarnia will not accept refurbished valves. The City Engineer has the authority to reject any valves.
- All valves to be backfilled with 19mm Clearstone
- Pea stone backfill is not an allowable option

4. VALVE BOXES

Valve boxes shall be the 130 mm screw type as supplied by Bibby Waterworks Inc. or Domestic Foundry Limited. Valve boxes to come with a hole to accommodate the tracer wire. They shall not transmit shock or stress to the valve and shall be centered and plumbed over the wrench nut of the valve with the box cover flush with the ground surface. Extensions to be installed on the operating nuts of valves and be sized to extend up to within 150 mm and 450 mm below the valve box cover.

5. FIRE HYDRANTS

Fire hydrants shall be Mueller Canada Valve "Century Hydrant", conforming to A.W.W.A Standard C502 with an easy maintenance hydrant operating system. Hydrants shall be a minimum of 1.98 meters long from the springline of the hydrant lead to the fracture head flange (6'-6" buried) unless otherwise required, opening counter clockwise, plugged wet barrel (non- draining). Base connections are to be push-on style, ground and barrel flanges, base and barrel flanges to have stainless steel nuts and bolts.

In commercial, institutional, rural, industrial and high density residential locations they will be required to have two C.S.A. 65 mm hose nozzles and a standard 100 mm storz pumper connection (painted black).

Fire Hydrant Detail - City of Sarnia Standard 95-SF

6. HYDRANT EXTENSIONS

Hydrant extensions shall be complete with one piece rod and all necessary appurtenances to a maximum height of 300mm (12"). Multiple hydrant extensions are not permitted.

7. BRASS VALVES & FITTINGS TO SERVICE LINES

Brass valves and fittings to service lines shall conform to ANSI/A.W.W.A. C800 latest revisions. All connections shall be compression connections unless individual approval is given by the City Engineer for an alternate connection. All connections must provide a leak-proof seal and retaining service tubing or copper without slippage at a working pressure of 1050 KPa (150 PSI).

i) Corporation Stops

Corporation stops shall be no-lead brass, have inlet of A.W.W.A. taper thread (CC) and outlet shall be compression type (Mueller 110 style). All brass cast parts shall be certified to NSF-61 standard. Corporation stops shall be Mueller 300, Ford FB100NL or Cambridge Brass Series 301NL.

ii) Curb Stops and Boxes

Curbstops shall be ball style for all sizes and be no-lead brass certified to NSF-61 standard. Valves will have a minimum working pressure of 150 PSI and have a full bore ball. Approved manufacturers are Mueller 300, Cambridge 202NL & Ford B44NL. Curb stop boxes shall be Mueller type H-10306 – H-10334 or Clow Model No. VSP1 and VSP2. Service boxes shall have type 304 stainless steel rods and stainless steel cotter pins.

iii) Couplings and Adapters

Couplings and adapters shall be three piece couplings with compression joints at each end to fit the applicable connecting pipe sizes. Couplings shall be Mueller H15403 or Cambridge Brass 119NL or Ford C44 series with "Grip" or "Pack" or "Quick" joints.

8. RESTRAINT CLAMPS, TIE-BACKS, ANCHOR RODS

- For permanent installations, all clamps shall be smoothed over by using mastic and then the surface wrapped with Denso Tape.
- All restraining clamps shall be torqued to the Manufacturer's Specifications.
- Tie-backs and anchor rods used for restraining, anchoring or for thrusting of the watermain will be of 19 mm diameter solid threaded bar and bolts and treated with Petrolatum and Petroleum coating system
- Concrete thrust blocks should be used wherever possible as per O.P.S.D. 1103.01
- Restraint clamps shall be manufactured by Uniflange, model 1300 series, Sigma or Clow or equivalent as approved by the Manufacturer.
- Restraint clamps for mechanical joint fittings shall be Mega-Lug, One-Lok or approved equal for all sizes 300mm (12") in diameter or larger.
- Refer to City of Sarnia Standard Drawing 2500 for PVC thrust restraint.
- Restraint design calculations may be required by Manufacturer for pipe over 300mm diameter.

9. REPAIR CLAMPS AND COUPLINGS

Stainless Steel repair clamps will be a minimum thickness of 20 gauge for sizes up to 200mm (8") 18 gauge for sizes over 300mm (12") Stainless steel will be fully passivated and gasket material shall be certified to NSF-61. All clamps will be a minimum of 300mm (12") long, nuts and or bolts shall be Teflon coated to prevent galling. Clamps will be Cambridge Brass model 425 or Smith Blair model 261. All repair clamps and couplings shall be installed to manufacturer's recommendations for pipe prep and torque.

All couplings shall be fusion bonded epoxy coated and supplied with 304 stainless steel bolts. Gaskets and Epoxy in contact with potable water will be certified to NSF-61. Approved bolted couplings shall be Smith-Blair Model 441, Robar Model 1506.

Two bolt wide range couplings shall be Epoxy Coated with 304 Stainless Steel Bolts NSF-61 certified. Approved manufacturers Smith-Blair model 421 and Hymax model 2000.

10. SERVICE SADDLES

i) Ductile Iron, Cast Iron and Asbestos Cement

Saddles for Ductile Iron, Cast Iron, and Asbestos Cement pipe shall have Ductile Iron epoxy body, galvanized steel straps and bolts. Saddles shall be manufactured by Smith Blair model 313, Robar 2506/2508, Mueller 521-529 or approved equal.

ii) PVC

Saddles for PVC pipe shall be full circumference wide band with stainless steel band, nuts, bolts and outlet. Band shall be type 304 Stainless Steel of minimum 18 gauge thickness. Saddles shall be manufactured by Smith Blair No. 375; Robar 2600 series; Cambridge Brass 8403 (double bolt).

11. TRACER WIRE

Tracer wire shall be installed on all non-metallic watermains, hydrant laterals and water services except where such water service pipe is of copper material. The wire shall be installed in such a manner as to be able to properly trace all watermains, hydrant laterals and water services without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire. Tracer wire is to be brought up the outside of the hydrant valves only and inserted in the upper section of the valve box.

Tracer wire shall be RWU90, 12 gauge copper clad steel wire single stand colour coded blue for water, insulated jacket will be 30 ml HDPE suitable for direct bury application and break load of 452 lbs.

All spliced or repaired wire connections to be made using SnakeBite Locking Connectors Part #LSC1230B, DRYCONN Waterproof Connectors or approved equivalent specifically designed for direct burial applications complete with water proof closure. The Inspector may test the tracing wire for conductivity. If it is not continuous the Contractor shall at his expense, replace or repair the wire.

12. TAPPING VALVES AND SLEEVES

Tapping valves to be Mechanical Joint by Flange. Tapping valves shall conform to A.W.W.A. C509-87 and must open right (clockwise). All tapping sleeves shall be stainless steel complete with 20mm diameter NPT test plug. The Pressure test to never exceed the static pressure of the watermain.

Approved resilient seat tapping valves shall be McAvity No. 20675R, Mueller T20360, Clow R/W F-6114, AVK Series 65.

Approved Tapping Sleeves to be Romac SST Series, Robar 6606 Series, Ford Fast-xxx-MM Style and Smith Blair 663, or alternative

approved by the Engineer.

An OPSS designed thrust block as per OPSD 1103.010 to be installed behind all tapping sleeves and valves.

13. INSULATION FOR WATERMAINS

Insulation for placing over watermains shall be 50mm STYROFOAM SM(HI)-40 as per City of Sarnia Standard for Insulation of Shallow Mains and Offsets.

14. PETROLATUM AND PETROLEUM COATING SYSTEMS

Reference to petrolatum coating systems means an approved petrolatum and petroleum coating system that conforms to A.W.W.A. C217-90 standard and is approved for use by the City Engineer.

While each product must be applied according to the manufacturer's instructions, the application will generally be done in the following fashion:

The item to be coated shall be cleaned of all dirt, oil, grease, flakes of paint and metal and any other item that might prevent adhesion of the petrolatum system. If the item requires blast cleaning or heavy wire brushing to prepare it, it will be rejected.

After cleaning, a uniform and continuous coat having a film thickness of at least 3 mil (76 µm). Any rough or uneven surfaces shall be filled in or smoothed over by using the mastic supplied by the manufacturer.

The whole surface shall then be wrapped with the top coating at 55% overlap and a minimum thickness of 40 mil (1016 µm). Petrolatum and petroleum coating systems approved by the City Engineer are Denso Petrolatum Products as supplied through Denso of Canada Limited and Petro Petrolatum Coating Systems as supplied by Petrolatum Coating Systems Pty. Ltd.

All watermain appurtenances including caps, valves (bolts and bonnet only), hydrants, restrainer clamps, nuts, bolts, tees, elbows, fittings, clamps, couplings, blow offs, and transition joints are required to be treated with full petrolatum Coating System complying with manufacturer instructions.

15. PIPE BEDDING AND COVER MATERIAL

All watermain pipe bedding and cover shall be Granular "A", using 100% S.B.C.M. as per drawing 112-SF.

When trench conditions are wet so that the Granular "A" bedding becomes saturated and soft, but the bottom and side of the trench remain solid, then the bedding material is to be 20 mm uniformly graded clear crushed stone.

Pea stone bedding or backfill is not an acceptable material.

16. GRANULAR BACKFILL MATERIAL

All granular backfill material shall be Granular "B" Type 1 in OPSS MUNI 1010 or be approved excavated native granular material complying to the requirements of select subgrade material in OPSS MUNI 1010, and be approved for use by the City Engineer.

17. ACCEPTABLE NATIVE MATERIAL

Acceptable native material shall be friable and free from rubbish, wires, cans or debris of any sort; boulders or rock or concrete fragments with a dimension greater than 150 mm; roots, stumps, trees or timbers; and frozen materials. Material shall be compatible with native material.

18. BACKFLOW PREVENTORS

A Temporary Water Connection Agreement must be approved prior to any connections to new or existing hydrants. The backflow and hydrants are only to be operated by The City of Sarnia Public Works Department.

A minimum charge for installation, testing and removal of the backflow preventor is accepted at the Engineering Department. A refundable damage deposit is also required to be submitted to the Engineering Department. The deposit will not be refunded if damages have occurred including lost or stolen parts, misuse or from freezing. Consumption charges will be deducted from the refundable deposit.

B. CONSTRUCTION METHODS

1. TRENCH EXCAVATION

i) General

For shoring or bracing, a trench is defined as an excavation in which the depth is greater than the width of the bottom of the excavation.

Excavation shall include the removal of all water and materials of any nature which interfere with the construction work. Removal of ground water to a level below the structure subgrade will be necessary only when required by the plans or elsewhere in these specifications. Excavation for conduits shall be by open trench unless otherwise specified or shown on the drawings. However, should the Contractor elect to tunnel or jack any portion not specified, he shall first obtain approval from the Engineer.

ii) Protection of Existing Utilities

It shall be the Contractor's responsibility to protect and support existing underground utilities such as gas, watermain, telephone and electric cables, sewers, etc., which may be encountered during the progress of the work. The Contractor shall arrange for stakeout of such utilities by the appropriate owning authorities prior to commencement of excavation. This shall be done at no extra cost to the City and shall be included in the tendered unit prices.

All existing gas pipes, water pipes, electric conduits, sewers, drains, fire cisterns, hydrants, oil pipe lines, gas pipe lines, Bell Telephone conduits, railway tracks, and other structures, which, in the opinion of the Engineer, do not require to be changed in location, shall be carefully supported and protected from injury by the Contractor, and in case of injury, they shall be restored by him, without additional compensation, to as good condition as that in which they are found. Supply to the utility company shop drawings describing the method of support for the approval of the utility company. Where pipes, conduits, or sewers are removed from the trench, leaving dead ends in the ground, such dead ends shall be carefully plugged or bulkheaded with brick, mortar or concrete by the Contractor, without additional compensation.

iii) Maximum Length of Open Trench

Except by permission of the Engineer, the maximum length of open trench shall be 30 meters or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is greater. The distance is the collective length at any location including open excavation, pipe length and appurtenant construction, and backfill which has not been completed.

iv) Maximum and Minimum Width of Trench

The Contractor shall comply with the Occupational Health and Safety Act, latest version, and regulations for construction projects. For pipe (except corrugated metal pipe), the minimum and/or maximum width of trench permitted at the top of the pipe shall be as shown on the standard drawings (O.P.S.D. 802.010). The sides to the trench shall be vertical.

For corrugated metal pipe, the trench shall be at least 300 mm wider for pipe 900mm dia. or less; the trench shall be at least 500mm wider for pipe 900mm or greater than the diameter of the pipe to be installed as per OPDS 802.010.

If the maximum trench width is exceeded, the Contractor may be required to provide additional bedding, another type of bedding, or a higher strength of pipe, as shown on the plans, or approved by the Engineer.

2. TRENCH BACKFILLING

The trench backfill, from 300 mm over the pipe to the frost line, which is approximately 1.5 meters below grade, shall be approved imported fill material or acceptable native material placed in 300 mm layers and compacted to 95% of the maximum dry density, depending on the material. Where native material is acceptable for backfill, it must be used from the frost line to the subgrade, placed in 300 mm layers, and compacted to 95% of the maximum dry density.

3. SHEATHING AND SHORING

The Contractor shall furnish, put in place, and maintain such sheathing, shoring, and bracing and at such locations and elevations as are necessary or as may be required to support and protect the sides, bottom and roof (if any) of the excavation, and to prevent any movement which can in any way disturb or weaken the supporting material below or beside the works or diminish the width of the excavation or otherwise disturb, damage, or delay the work or damage or endanger adjacent pavements, property, buildings, or other works. The cost of such measures shall be allowed for by the tenderer in the prices tendered in the Schedule of Items and Prices for the relevant structures or pipe laying.

If, in the opinion of the Engineer and at any location, the Contractor has not taken adequate or satisfactory measures to fulfill his responsibilities as set out in the preceding paragraph hereof or elsewhere herein, the Engineer may direct the Contractor to take corrective action, and on being so directed, the Contractor shall forthwith furnish, put in place, and maintain satisfactory sheathing, shoring, and bracing at no additional cost to the Owner.

Neither the absence of a direction from the Engineer or the Inspector

to the Contractor with respect to sheathing, shoring, or bracing hereunder, nor the approval or disapproval by the Engineer or the Ministry of Labor Inspector of the measures taken by the Contractor hereunder shall relieve the Contractor of his responsibilities as set out herein.

4. DEWATERING

Unless the Municipality has identified dewatering as an item in the schedule of quantities due to extenuating circumstances, the Contractor shall always keep all excavations, trenches, and tunnels free from water at their own expense. The Contractor shall employ pumps, deep wells, well points, or any other method necessary to remove the water in a manner that will prevent loss of soil and maintain the stability of the sides and bottom of the excavation.

The Contractor shall provide for the disposal of water removed from the excavation in such a manner as shall not be a danger to the public health, private property, or to any portion of the work completed or under construction either by themselves or any other contractor, or to the surface of the streets, and shall cause no impediment to the use of the streets by the public.

The Contractor shall not hold the Owner or other Contractors liable for leakage encountered in work from existing sewers, watermains, or drains or from other sewers or drains under construction.

Gutters shall always be kept open for surface drainage and no damming or ponding of water in gutters or other waterways will be allowed except with the permission of the Engineer. The Contractor shall not direct any flow of water across or over pavements except through approved pipes or properly constructed troughs.

i) Depth of Trenches

Trenches shall be excavated to the depth required for the foundations of the sewers, watermains, and appurtenances shown on the drawings. If the trench is excavated below required grade, the Contractor shall fill it to grade with approved structural fill at his own expense and to the satisfaction of the Engineer.

ii) Disposal of Excavated Material

No excavated material shall be stockpiled within street lines of any roadway. Material excavated within the limits of street lines shall be removed at the Contractor's expense. In all other areas, the Contractor shall stockpile sufficient excavated material as may be required to fill completely any temporary diversions, together with material required for normal backfilling around structures.

Excavated material in these areas more than that required for

backfilling shall be disposed of at the Contractor's expense.

A release letter may be requested by The City of Sarnia from the owner of the disposal site detailing contact information, location, and site condition. This release letter in no way grants approval, accepts, responsibility or liability by the City of Sarnia.

5. PIPE BEDDING - Watermain and Appurtenances

i) Sub-Base

The surface upon which the water pipe is to be laid shall be firm and true to grade. If soft, spongy, unstable, or unsuitable material is encountered upon which the bedding material is to be placed, this unsuitable material shall be removed to a depth ordered by the Engineer and replaced with compacted approved bedding material.

ii) Granular Bedding

Granular bedding shall be laid to the dimensions shown on the drawing. Care shall be taken that there is even compaction of the bedding. The Contractor shall ensure that the material at the side of the pipe is compacted to the trench wall to the same degree as that underneath the pipe.

The pipe shall be supported for the full length of the barrel with bearing along the bottom four-tenths of its diameter. The coupling or bell shall not rest on the bedding or subgrade. The bedding shall then be compacted under the haunches of the pipe.

Granular bedding shall be granular "A" as per drawing 112-SF. Where pipe is bedded on rock, 19mm clear stone will be supplied by the Contractor to a height of the exterior diameter of the pipe. Pea stone bedding is not an acceptable material. The granular material shall be placed in 150 mm layers and compacted to 100% maximum dry density.

6. PIPE LAYING

Pipe shall be carefully inspected in the field before and after lying. If any cause for objection is discovered in a pipe after it has been laid, it shall be subject to rejection. Any corrective work shall be approved by the Engineer.

Pipe shall be laid at a minimum depth of 1.8 meters with the bell end of the pipe upgrade.

Pipe shall be laid true to line and grade with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the bell or collar which shall not bear upon the subgrade or bedding. Any pipe which is not in true alignment or

shows any undue settlement after laying shall be taken out and re-laid at the Contractor's expense.

Any change in direction shall be approved by the Engineer using radius pipe and/or fittings. and deflections of the pipe as per manufacturer's requirements.

Trenches where pipe laying is in progress shall be kept dry and no pipe shall be laid in water or upon wet bedding, or on frozen ground. As the pipes are laid, they must be thoroughly cleaned and protected from dirt and water. No length of pipe shall be laid until the preceding length has been thoroughly embedded and secured in place to prevent any movement or disturbance of the finished joint.

No walking on or working over the pipes after they have been laid shall be allowed until there is at least 300 mm of cover over them, except as may be necessary in refilling the trench and compacting the backfill.

A watertight plug shall be used whenever pipe laying is not in progress. Care should be taken to prevent pipe flotation should the trench fill with water.

There shall be a minimum of 500mm of vertical separation between the watermain and any sewer or other pipeline which must be crossed.

7. CONCRETE THRUST BLOCKS

When concrete thrust blocks are required, the concrete shall be 20 MPa and shall be constructed to the dimensions shown on the Standard Drawings. After the pipe has been jointed and the laying approved, the trench shall be cleared of all loose material and the trench wall neatly trimmed to provide the thrust block with support against an undisturbed solid surface.

The side of the thrust block shall be formed to the required dimensions before pouring concrete. When soft unstable soils such as clay, muck, or peat occur, the Engineer shall determine the safe bearing loads and order the removal and replacement of it with ballast before casting thrust blocks or recommend the use of corrosion resistant tie rods as per OPSD 1103.010.

8. VALVES AND APPURTENANCES

Valves shall be installed along the property line extension at intersections in an unpaved area as per drawing 134-F. Otherwise, valves shall be installed as shown on the construction drawings. All valves are to be backfilled with 19mm clearstone. Pea

stone is not an acceptable material. Align accurately and support both valve and connecting pipes as per drawing 2082-S.

A valve box shall be provided for every valve which has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a metal grease case. The valve box shall not transmit shock or stress to the valve. It shall be centered and plumb over the operating nut of the valve, with the box cover set to finished grade. A stem extension shall then be installed in accordance with the standard drawing.

9. HYDRANTS

All hydrants shall stand plumb and shall have their hose nozzles parallel with the street line and the pumper (steamer) nozzle perpendicular to the curb. The hydrant shall be set with the breakaway flange 75-150 mm above finished grade. The hydrant shall be located as indicated on the drawings. Mid-block installations shall be those shown on the drawings or as directed by the Engineer. The hydrant shall be supported by concrete blocking set on a solid foundation. Each hydrant shall be connected to the main with a 150 mm branch controlled by an independent 150 mm valve. Restrainers or thrust blocks are required at the tee and behind the hydrant as shown on the Standard Drawing 95-SF. Hydrant drain holes are to be plugged. All hydrants will be required to have a push on boot.

All Hydrants are to be painted yellow following installation and prior to release of holdbacks. The Contractor shall apply two coats of "Sico Safety Yellow Code #635-520" paint or approved equal over quick dry red oxide primer. Cost of supply and application of paint and primer shall be included in the price of hydrant installation. Temperature of air must be a minimum of 10°C during application and curing of paint.

10 CUTTING IN SLEEVES

This assembly allows a new gate valve, tee, or other fitting to be inserted into an existing main. The following table gives the length of pipe to be cut out for the various valve and tee sizes.

MAIN SIZE (mm)	100	150	200	250	300
FOR VALVE	540	560	590	605	685
FOR TEE	710	795	835	920	1015

After the main has been shut down, the pipe shall be cut and the section removed. An approved coupling by the City Engineer, is placed over each of the exposed pipe ends. The valve or tee is

supported, aligned, and securely coupled to the appropriate length spool pieces. With the valve or tee in its final position, the remaining couplings are coupled to the pipe ends.

11. INSULATION OVER WATERMAINS

Installation depth of the watermain shall be 1.8 meters, where a minimum of 1.5 meters of cover cannot be achieved insulation shall be installed over watermain. Insulation thickness and width as per drawing 138-F. The material shall be Styrofoam SM (HI)-40, with 150mm of compacted fine sand material below and above the insulation. All inside edges or ends shall be butted tightly together and all end joints shall be staggered, as required by the Engineer.

Thermal insulation shall be anchored with two 6mm (1/4 inch) diameter hardwood skewers per sheet of Styrofoam. The skewers shall be 150mm longer than the total board thickness and shall be inserted at opposing angles of 30 degrees from the vertical. insulation to extend until watermain has a minimum of 1.5 m of natural cover.

12. METER PITS

Meter pits shall be installed as per City of Sarnia standard drawing 100-SF. All meter pits shall be set to finish ground elevation.

13. WATER SERVICE CONNECTIONS

All connections shall be laid perpendicular to the main and extended to the center of each lot as indicated on the Contract Drawings or as directed by the Engineer. Tapping methods must be completed using a Mueller Drilling/Tapping Machine or approved equal. Dry tapping is not an approved procedure by the City Engineer.

Taps should be at least 300mm (12") apart and staggered around the top section of the pipe. The corporation stop, when installed, shall engage at least three full threads and be left fully open. Service saddles shall be installed a minimum distance of 1.0 meters from the mainline joint. A vertical gooseneck shall be provided on the service, as shown on the Standard Drawing 150- F for all 19mm (3/4") diameter copper services. Water Services 25mm (1") and above shall be tapped into the main at least 45 degrees above the horizontal as shown on Standard Drawing 150-G. It shall be terminated at the property line with a curb stop and box which should rest on a concrete brick for support. The box shall be plumb and the top set to finished grade.

Any services not immediately connected to an existing service will require a series 160 polyethylene tail at the property line rising from

the curb stop to 1.0 meters above service grade. Poly to be folded over and zip tied to the marker stake and backfilled.

All services shall have a minimum of 1.8 meters of cover. Place and compact 150mm of Granular "A" bedding, and 300mm of Granular "A" cover material, to 100% S.P.D.

Services shall be bedded and installed in accordance with Standard Drawings 112-SF.

All fittings including corporation stop, curb stop, and connection materials are to be "no lead" or lead free.

No unions will be permitted on any portion of the service in the City right-of-way unless directed by the Engineer or for a repair situation.

Each family unit of a single family detached house, semi- detached, duplex, or row housing shall have an individual 20 mm service.

C. GENERAL PROVISIONS

All pipes up to and including 600 mm diameter shall be delivered to the Work Area with end covers by Manufacturers. A tamper evident seal shall be placed on the bell end. These components shall adhere sufficiently to withstand the stresses caused during shipment. (Refer OPSS.MUNI 441 for further details)

The Contractor shall supply and install a tracer wire and connections with the watermain. Tracer wire must be continuous (unspliced), 12 gauge, solid copper plastic coated wire, RWU90, 600V, or approved equal. Tracer wire is to be brought up the outside of the hydrant valves only and inserted in the upper section of the valve box.

Excavate, remove, and dispose of materials of all types and descriptions, including rock and concrete, from the installation of the watermain pipes.

Any sections of abandoned underground utilities and municipal services (i.e. gas main, bell conduit, watermain, sewer pipe and services, etc.) encountered as part of watermain installation and found to be in conflict shall be removed by the contractor at his cost.

Prior to removal of any abandoned sections of underground utilities, the contractor will contact the relevant utility company to confirm the nature of the piping/conduit and whether any special means of removal/abandonment are required.

Supply, place and compact Granular "A" bedding and cover, using 100% S.P.D.

Supply, place, and compact approved backfill material using Standard Backfill and Compaction Method. (SBCM)

When backfilling any excavation, trench, and void of any nature or description, the backfill from 300 mm over the pipe to the frost line, which is approximately 1.5 meters below grade, shall be acceptable native material or approved imported fill material placed in 300 mm layers and compacted to 95% S.P.D. Where native material is acceptable for backfill, it must be used from the frost line to the subgrade, placed in 300 mm layers and compacted to 95% S.P.D.

The Contractor is responsible for dewatering the trench of water from all sources. Under no circumstances is ground or surface water to enter the watermain pipe.

Provide a temporary bulkhead and sufficient thrust block required to perform the necessary tests prior to connecting to the existing watermain, so that shutdown time of existing watermain is limited.

This shall also apply to sections of watermain constructed in which the Contractor wishes the Municipality to fully accept part of the constructed system and the temporary bulkhead is the only means to isolate part of the system to be tested.

Install blow-offs as required on the proposed main to perform the necessary tests.

Provide a watertight plug, as outlined in the watermain specifications. Provide and use a temporary watertight plug to protect against unsuitable material during working hours.

All existing and new watermain services shall be reconnected or connected to the new watermain with 20mm diameter pipe (or as directed by the Engineer), soft copper, Type "K", including main stop, complete in every respect and as required by the Engineer.

Supply and place concrete thrust blocks in accordance to OPSD 1103.010 for horizontal bends and OPSD 1103.020 for vertical bends and OPSS.MUNI 441 when thrust blocks are not possible or as requested by the City Engineer, restraint systems may be installed as per City of Sarnia Standard Drawing 2500.

Provide the necessary equipment and materials to perform pressure test, leakage test, and to chlorinate and flush the watermain constructed in this Contract. All lengths of watermain are to be hydraulically foam swabbed to remove any possible debris.

Cap or plug with concrete any abandoned watermain or pipes, as required by the Engineer.

Always provide potable water to the residential and commercial units affected by the shutdown of the water supply during construction, to the satisfaction of the Engineer.

Connect the proposed watermain to the existing watermain, complete in every respect.

1. PETROLATUM AND PETROLEUM COATING SYSTEMS

Reference to petrolatum coating systems means an approved petrolatum and petroleum coating system that conforms to A.W.W.A. C217-90 standard and is approved for use by the City Engineer.

While each product must be applied according to the manufacturer's instructions, the application will generally be done in the following fashion. The item to be coated shall be cleaned of all dirt, oil, grease, flakes of paint and metal and any other thing that might prevent adhesion of the petrolatum system. If the item requires blast

cleaning or heavy wire brushing to prepare it, it will be rejected.

After cleaning, a uniform and continuous coat having a film thickness of at least 3 mil (76 μm). Any rough or uneven surfaces shall be filled in or smoothed over by using the mastic supplied by the manufacturer. The whole surface shall then be wrapped with the top coating at 55% overlap and a minimum thickness of 40 mil (1016 μm).

Petrolatum and petroleum coating systems approved by the City Engineer are Denso Petrolatum Products as supplied through Denso of Canada Limited and Petro Petrolatum Coating Systems as supplied by Petrolatum Coating Systems Pty. Ltd.

All watermain appurtenances including caps, valves (bolts and bonnet only), hydrants, restrainer clamps, nuts, bolts, tees, elbows, fittings, clamps, couplings, blow offs, and transition joints are required to be treated with full Petrolatum Coating System complying with manufacturer's instructions.

2. INSULATION FOR WATERMAINS

Insulation shall be installed over watermain where a minimum of 1.5m of cover cannot be achieved. Insulation thickness and width as per drawing 138-F. The material shall be Styrofoam SM (HI)-40, with 150mm of compacted fine sand material below and above insulation. All inside edges or ends shall be butted tightly together and all end joints shall be staggered, as required by the Engineer.

Thermal insulation shall be anchored with two 6mm (1/4 inch) diameter hardwood skewers per sheet of Styrofoam. The skewers shall be 150mm longer than the total board thickness and shall be inserted at opposing angles of 30 degrees from the vertical. Insulation to extend until watermain has a minimum of 1.5m of natural cover.

3. BACKFILLING MATERIALS

i) Pipe Bedding and Cover Material

The material used for pipe bedding and pipe cover, to 300 mm above the top of the pipe, shall be Granular "A" is to be from a quarried bedrock source.

When trench conditions are wet so that the Granular "A" bedding becomes saturated and soft but the bottom and side of the trench remain solid, then the bedding material is to be 20 mm uniformly graded clear crushed stone.

ii) Granular Backfill Material

All granular backfill material shall be Granular "B" Type 1 in OPSS MUNI 1010 or be approved excavated native granular material complying to the requirements of select subgrade material in OPSS MUNI 1010, and be approved for use by the City Engineer.

iii) Acceptable Native Material

Acceptable native material shall be friable and free from rubbish, wires, cans or debris of any sort; boulders or rock or concrete fragments with a dimension greater than 150 mm; roots, stumps, trees or timbers; and frozen materials. Material shall be compatible with native material.

4. SHUTTING DOWN OR CHARGING WATERMAIN

The Contractor shall not shut down or charge any watermain or operate any gate valve or hydrant for any reason outside the construction limits. The operation of valves and hydrants shall be performed by City forces only. Twenty-four (24) hours advance notice shall be given to the City Public Works Department when a valve or hydrant operation is required. The Contractor may operate new water valves on uncommissioned watermains to the satisfaction of the Engineer.

All water users supplied by a main scheduled to be shut down, for any length of time, shall be notified by the Contractor at least forty-eight (48) hours prior to shut down. The Contractor shall advise in writing the water users when the service will be restored.

D. WATERMAIN TESTING PROCEDURES

1. VISUAL INSPECTION

The watermain and all related appurtenances shall be cleaned of all foreign material before installation to the satisfaction of the Engineer.

The valves must be thoroughly inspected for defects, damages, and proper operation before installation.

The watermain shall be inspected by the Engineer for alignment and obstructions during the installation of the pipe.

2. PRESSURE AND LEAKAGE TEST

The work of laying the pipe and all appurtenances shall be of such a character as to leave all pipe and connections watertight and able to withstand a static pressure of 1 MPa (150 psi).

Hydrostatic pressure test and leakage test must be performed on all watermains and appurtenances constructed. All valves shall be tested.

The Contractor must follow these procedures when testing the constructed watermain:

At no time will the Contractor be permitted to operate any valves on the distribution system. The Public Works Department must be called to operate valves.

The Contractor's Foreman or Superintendent must notify the Engineering Department and Public Works Department 24 hours before the watermain is to be charged and later tested. Before the above is done, the Contractor must be certain that he has all the required test material, labour, and equipment. The Contractor must also make the required arrangement to obtain an approved water supply.

The City of Sarnia Public Works Department shall supply and install an independent cross connection control apparatus for the filling of watermains for pressure testing, flushing and disinfection. As recommended practice of A.W.W.A. C651.

Watermains must be filled using a temporary connection from a hydrant or may require supply of water and a tanker. Only potable water must be used, with chlorine residual consistent with the Ontario Drinking Water Standards.

When temperature is 0°C or lower, the Contractor must construct a temporarily heated enclosure with a minimum dimension of 2.4 m square by 2.0 m high located at the point where pressure is to be introduced, and a 1.2 m square by 2.0 m high heated enclosure around hydrants and blow-offs to be used to remove air from the watermains and to be used to flush the watermains.

This requirement must be fulfilled if temperature is at 0°C or is anticipated to decrease below 0°C during the test period.

In temperature 0°C or lower, the Contractor, at their cost, must take all precautions required to prevent watermains and appurtenances from freezing and will be responsible to undertake all necessary measures to repair or replace frozen watermains and appurtenances that are damaged.

Before filling the new watermains, the Contractor must verify that all required blow-offs have been installed at locations required to remove air from the watermain, and as required to achieve adequate flushing.

The Contractor must introduce water gradually into the main and fill at a rate that will not cause water hammer or damage to the main in any way.

When filling the watermain, the Contractor must make certain that blow-offs and hydrants located at high points of the system to be tested are opened. These must remain open until all air has been expelled from the sections of watermains to be tested and until the flushing of the main has been completed.

The watermains constructed must be flushed through hydrants and main-cocks (blow-offs) to produce a flushing velocity of not less than 0.76 m/second.

Watermains to be cleaned with foam swabs in each branch. Two new swabs shall be placed inside the watermain being a minimum of 50mm larger than the diameter of the main.

Once the Contractor has flushed the watermains to be tested for the required period and is certain that all the air has been removed from the system, the blow-offs and hydrants can be completely closed.

After the above procedure is followed, the valve feeding the system to be tested can also be completely closed and the hydrostatic and leakage test can begin.

The hydrostatic and leakage test to be carried out is a one test

operation and the Contractor must complete all the previous procedures and proceed as follows:

- a) install the required main-cock to perform the test;
- b) install the complete hook-up to perform the test (i.e. the fittings from the main-cock to the pressure pump, from the pressure pump to the pressure gauge, and from the pressure pump to the supply barrel);
- c) install the approved test gauge;
- d) apply the pressure to the watermains to be tested until the pressure reads 1 MPa (150 psi). This pressure is to be maintained for a period of two (2) hours (120 minutes).

When the Contractor is ready to perform the Official Watermain Hydrostatic and Pressure test, he must contact the Project Supervisor and inform them that he wishes the test to begin. At this time, if the Project Supervisor agrees that all procedures and requirements to perform the test have been fulfilled, he will then give the Contractor authorization to continue with the test. When authorization is given to continue with the official test, the City's Inspector or Project Supervisor will record:

- a) the initial time of the test;
- b) the time and pressure reading before the pressure is re-applied, the procedure required to raise the pressure from the dropped value to the required pressure value of 1 MPa. This procedure must be carried out as often as required during the test period to maintain the pressure as specified above. The dropped value must not be lower than 150 psi, the water volume used in Section 2 to raise the pressure from the dropped value to 1 MPa (150 psi).
- c) all test data shall be recorded on the City of Sarnia Official Test Sheet. When the test is completed, the Project Supervisor shall determine the amount of leakage and compare it to the allowable leakage.

$$A = F \times D \times L$$

Where:

- A = total allowable leakage in liters for the 2-hour test period
- F = allowable leakage of 0.082 liters per mm of pipe diameter per kilometer of pipe for the 2-hour test period
- D = diameter of pipe in millimeters
- L = length of pipe being tested in kilometers

If the watermain has failed the leakage test, it is necessary to find the point or points where the excessive leakage is taking place. There are a few steps that can be taken to ensure that it is a pipe leak, and not a leak at a fitting. First, leave the line under normal

pressure. The next day, repeat the test. If the leakage measured the next day is greater than before, the leak probably is in a pipe joint or a damaged pipe. If the leakage is the same, it is more probably in a valve or a service connection.

To determine which it is, take the following steps. Insert the key for the curb stops in each shutoff and listen at the top of the key. It may be possible to hear a leak since the key acts somewhat like a stethoscope.

If a leak is heard, open the shutoff and close it again. If there is now no audible leak, test the section again.

If no leaking curb stops are found, crack the main valves at the ends of the test section several times and close them again. This is to flush out any sand grains in the valve seats that may prevent the valves from closing completely causing slight leakages.

If it is found that the leakage does not occur at either of the above points, it is then necessary to try and find a leak through trial and error. Some sort of leak detector, such as a sensitive microphone with amplifier and earphones is necessary.

Any leaks in the line should be repaired and the line retested until the measured leakage is less than the allowable leakage.

The Contractor shall bear the expense of all labour, material, and equipment incurred in eliminating the leak or leaks, and the retesting until successful results are obtained.

On the successful completion of the hydrostatic and leakage test, the Contractor must immediately disinfect the watermains tested.

The City of Sarnia will only accept the watermain section tested after the results of the hydrostatic and leakage test are acceptable; the chlorination test has been performed; the flushing of the watermain is completed; the Waterworks Section has checked all valves on the system; the hydrants have all been inspected; and bacteriological testing has been successfully completed.

When all the above have been met, the Engineering Department will confirm the acceptance in writing.

The cost for providing all necessary labour, material, and equipment required to carry out all the procedures set in this section to perform the required tests is to be included in the Unit Prices of the Tender Items. No extra payment will be made.

3. DISINFECTION AND FLUSHING

In a public water distribution system, all newly laid watermains, temporary water systems, or existing watermains which have been repaired, must be disinfected before being placed into service, in accordance with **ANSI/AWWA C651** or latest revision. It is necessary to follow this practice to protect consumers against the possibility of infection which could result from ingestion of water contaminated by disease producing organisms.

Likely, the newly constructed system will have sustained contamination during transit, storage of the components, and laying of the piping. Often the pipe must be laid in soggy trenches and possibly on occasions be in contact with wastewater or even sewage admitted into the trench through service cuts.

In general, the disinfection procedure consists of twenty-two operations:

1. Inspecting all materials to be used to ensure the integrity of the materials.
2. Preventing contaminating materials from entering the watermain during storage, construction, or repair and noting potential contamination at the construction site.
3. Removing, by flushing or other means, those materials that may have entered the watermain.
4. Physical isolation is required for all new watermains.
5. Testing against valves will not be permitted.
6. Mechanical tie-ins are to be kept to not more than 6 meters.
7. Watermain is to be installed completely with the addition of swab launchers.
8. Contractor is to confirm the line and grade of existing mains by means of excavation prior to commencing line laying. Physical ties are to be free from bends elbows.
9. Watermain is to be pressurized to line pressure using an adequate backflow preventer prior to tapping any services. All services to be tapped under pressure.
10. All services are to be installed as per the City of Sarnia Standards
11. Services are to be installed complete with a series 160 polyethylene tail at the property line rising from the curb stop to 1.0 meter above grade.
12. All lengths of watermain are to be hydraulically foam swabbed to remove any possible debris.
13. All watermain and services are to undergo pressure testing, leakage testing, and bacteriological testing as per Sarnia Standards.
14. All watermain and services shall be disinfected with heavily chlorinated water for a period of 24 hours as per City of Sarnia Watermain Disinfection Procedures.

15. All watermain and services shall be de-chlorinated as per the requirements of the M.O.E.
16. All services to be flushed following de-chlorination.
17. Upon successful completion of all testing, tie-ins and connections all services are to be flushed resulting in an adequate chlorine residual.
18. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
19. Protecting the existing distribution system from backflow caused by hydrostatic pressure test and disinfection procedures.
20. Documenting that an adequate level of chlorine contacted each pipe to provide disinfection.
21. Determining the bacteriological quality by laboratory test after disinfection.
22. Final connection of the approved new watermain to the active distribution system.

The cost of providing all necessary labour, material, and equipment required to carry out all the requirements of this section is to be included in the Unit Prices of the Tender items. No extra payment will be made.

4. DISINFECTION

The acceptable method of disinfecting newly constructed watermains is the continuous-feed method.

The continuous-feed method is suitable for general application, and because no tablets are required to be left in the pipe during construction and preliminary flushing can be done to remove light particulates from the main. This is the procedure recommended for typical installations and is described below.

The continuous-feed method consists of completely filling the main to remove all air pockets, flushing with potable water to remove particulates, and chlorinating the water in the main. Chlorination is done by introducing a solution to create an initial chlorine concentration of ≥ 25 mg/L (25ppm). After a minimum contact time of 24 hours in the main, there must be a free chlorine residual of not less than 40% of the Initial Chlorine Concentration to a maximum of 50 mg/L (50ppm).

Disinfection Method	Minimum Contact Time	Initial Chlorine Concentration	Maximum Allowable Decrease in Chlorine Concentration
Continuous Feed	24 hours	≥ 25 mg/L	40 % of the Initial Chlorine Concentration to a Maximum of 50 mg/L

For preliminary flushing, the velocity in the main shall not be less than 0.75 m/s. The following table indicates the flow rates required for commonly used pipe:

Diameter (mm)	Flow to Produce 0.75 m/s (l/s)	Size of Taps			No of 64mm Hydrant Outlets
		25	38	50	
		No. of Taps in Pipe			
100	6.3	1	-	-	1
150	12.6	-	1	-	1
200	25.2	-	2	1	1
250	37.9	-	3	2	1
300	56.8	-	-	2	2
400	100.9	-	-	4	2

(Source: AWWA C651-14 Table 3)

Typically, chlorine solutions are available as calcium hypochlorite, a granular product having 65% available chlorine, or sodium hypochlorite, a liquid product having 10% to 15% available chlorine. They are prepared for feeding into the main as a one-percent solution (10,000 ppm). For calcium hypochlorite, a 1% solution requires 1 lb. (454 g.) in 30.0 liters of water. Appendix "A" provides a reference for comparison of measures of concentration. The quantity of one-percent solution required to produce 25 mg/L concentration in 30m of pipe is as follows:

Pipe Diameter (mm)	1% Chlorine Solution (l)
100	0.6
150	1.4
200	2.5
150	3.9
300	5.4
400	9.8

(Source: AWWA C651-14 Table 4)

Chlorine solution shall be introduced into the main not more than 3m. downstream from the beginning of the pipe. It may be applied to the watermain with a gasoline or electrically powered chemical-feed pump designed for feeding chlorine solutions. Feed lines shall be made of material capable of withstanding the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the main.

Chlorine application shall not cease until the entire main is filled with a solution having a concentration of at least 25 mg/L. To ensure that this concentration is provided, chlorine concentrations can be measured using high-range test kits that are easy to use and satisfactory for the precision required. The chlorinated water shall be retained in the main for at least twenty-four (24) hours, during which time all valves and hydrants in the section treated shall be operated to disinfect the appurtenances.

If application of chlorine is carried out from one source, the Contractor must flush hydrants and blow-offs at various locations to the satisfaction of the Engineer to ensure that the chlorine has transferred into all parts of the constructed watermain.

Extreme care is to be exercised by the Contractor to ensure that the section of main being chlorinated is isolated from the existing water system. No valves shall be operated thereby preventing escape of chlorine solution into the distribution system.

5. FINAL FLUSHING

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is not higher than that generally prevailing in the system, and shall be disposed of safely. Acceptable means of disposal are by discharge to storm sewer or a drainage ditch with a

free chlorine residual of 0.0mg/l. A discharge plan for the dechlorination process may be required including monitoring, erosion control measures, and chemicals used to dechlorinate.

Acceptable chemicals may be Hydrogen Peroxide, Sodium Thiosulphate or Sodium Pyrosulphite or approved equal.

6. BACTERIOLOGICAL TESTS

After final flushing and before the watermain or temporary potable water system is placed in service, two consecutive sets of acceptable samples shall be taken at least 24 hours apart. At least one set of samples shall be collected from every 350 m. of the new watermain, plus one set from the end of the line and at least one set from each branch. All samples shall be tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Wastewater*. The Engineer or his representative must be present when the samples are collected.

A City of Sarnia representative shall collect water samples and coordinate with the Contractor to send to an environmental laboratory accredited by the Standards Council of Canada for microbiology testing of water. Samples for bacteriologic analysis shall be collected in sterile bottles provided by the accredited laboratory, and shall follow the sampling procedure directed by the laboratory. The sample bottles may contain sodium thiosulphate or other preservative to neutralize chlorine. This material must not be rinsed out of the bottles.

No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly must be removed and retained for future use.

Water shall be tested for bacteriological contamination. The bacteriological analysis must prove results of zero total coliforms, zero fecal coliforms, and zero background colonies or organisms per 100 ml. The laboratory shall provide a written report confirming the analysis. The new watermain is not to be placed into operation until the results of these tests are known to be satisfactory, and the Contractor has submitted the laboratory results to the Engineer.

7. REPETITION OF PROCEDURE

If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. When the samples are satisfactory, the new main may be connected to the distribution system.

8. DISINFECTION OF TIE-IN SECTIONS

Connections to the distribution shall be disinfected in accordance with AWWA C651-14, or latest revision. For short connections (less than one pipe length $\leq 5.5\text{m}$), this requires spraying or swabbing of 1-5% solution of chlorine just prior to being installed.

9. FIRE HYDRANT FLOW TESTING

Flow testing shall be required on all new fire hydrants installed on private Site Plans and Subdivisions before issuance of occupancy or building permit. Flow tests will be completed by the Developer and results submitted to the Engineering Department. All costs associated with flow test to be borne by the Developer. Colour Code the bonnets of hydrant(s) to designated level of service being provided by that hydrant. The flow test is to be performed by a qualified person who holds a MOE drinking water license and according to NFPA 291 standards. NFPA 291 colour coding is to be based on the theoretical flow at 20psi residual pressure. The City is to be notified 48 hours in advance and to be on site during the flow test. The Developer is responsible to pump out all hydrants that have been flow tested.

Blue	1500 us gpm or greater
Green	1000 to 1499 us gpm
Orange	500 to 999 us gpm
Red	Less than 500 us gpm

E. SERVICING REQUIREMENTS

1. SERVICES FOR NEW DEVELOPMENT

Private

Where development occurs on property that has existing water services, these services must be abandoned and new services installed unless it can be proven that the services are a minimum 20mm (3/4") water service.

Use of these existing water connections shall be at the sole discretion of the City Engineer and wholly the responsibility of the owner/developer.

2. EXISTING SHARED SEWER CONNECTIONS

Capital Projects

There may be some cases where existing water services are shared by adjoining properties. If the City Engineer finds any property owners on the street wanting a new separate connection, the Contractor shall install 20mm (3/4") copper or Pex water service from the main to the property line. All cost associated with this work shall be included in the prices bid for supply and installation of private service. Before commencing any of this work, the City Engineer's approval must be obtained. This work may be deleted from the contract if found unnecessary, without any payment to the contractor.

3. ABANDONING SERVICES

Abandoning services shall be coordinated and witnessed by the Development Engineering Department staff. The work shall be completed before the Engineering Department's signing off on the demolition application form.

Commencement of the demolition project before the services can be disconnected and capped, the owner shall provide a deposit to the City.

i. For Redevelopment

When an existing building is demolished and the services are to be reused for re-development within five years.

The water service shall be disconnected at the curb stop or property line and a 20mm (3/4") poly pipe installed for flushing purposes. The poly is to be brought 300mm (12") above the ground surface and marked with a 2"x4" as per the City of Sarnia Standards Drawing 2064-S. This must be completed before the building demolition permit will be issued.

ii. Permanently

When an existing building is demolished with no intention of re-development within five years.

The water service mainstop shall be shut off, the service cut and both ends crimped within 150mm (6") of the watermain. The curb stop box and rod shall be removed at property line.