

1.0 Water Distribution System

The objective of the Water Distribution System is to provide services that:

- Can be sustained by the water resources upon which services rely
- Is financially viable and complies with all regulatory requirements
- Protects human health and the natural environment
- Promotes water conservation strategies and water efficiency methods

2.0 General

This document will be subject to revisions from time to time. The City of Quinte West reserves the right to make revisions having due regard for applications already in the review process. Individuals or groups affected accordingly will be notified by the City of Quinte West, and revisions will become effective on the date of notification.

(Contents of this document are subject to change without further notice)

3.0 References

In addition to the standards specified in this manual, waterworks designs shall follow current standards and in conformance with the following standards, specifications or publications:

Publications

- Ontario Provincial Standard Specifications
- Municipal Engineers Association Design Manual
- City of Quinte West Official Plan
- Fire Underwriters Survey Water Supply for Public Fire Protection Manual
- American Water Works Association Standards
- Canadian Standards Association
- Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit –
- Ministry of the Environment Safe Drinking Water Branch March 2009
- Practices for the Collection and Handling of Drinking Water Samples April 1, 2009

Standards

City of Quinte West Standard Drawings

- Series 1000 – Water Distribution System

Permits/Approvals

- Ministry of the Environment
- Safe Drinking Water Act, 2002 as amended
- City of Quinte West Fire Services Department
- Hastings and Prince Edward Counties Health Unit

4.0 Table of Contents

<u>SECTION</u>	<u>PAGE</u>
5.0 Formulas _____	4
6.0 Design Criteria _____	4
6.1 Friction Factor Requirements – “C” Value _____	4
6.2 Design Flows _____	4
7.0 Mains _____	5
7.1 Design Specifications _____	5
7.2 Separation Distances from Contamination Sources _____	5
7.3 Materials _____	6
7.4 Eye Bolts and Rods _____	6
8.0 Valves _____	6
8.1 Location _____	6
8.2 Design Specification _____	7
9.0 Service Connections _____	7
9.1 Design Specification _____	8
9.2 Sizing _____	8
9.3 Materials _____	8
10.0 Tracer Wire _____	9
11.0 Cathodic Protection _____	9
12.0 Abandoning Watermains _____	9
13.0 Utility Crossing _____	10
14.0 Sampling Station _____	10
14.1 Location _____	10
14.2 Materials _____	10
15.0 Fire Hydrants _____	10
15.1 Design Specification _____	11
15.1.1 Spacing _____	11
15.1.2 Location _____	11
15.1.3 Flow Rating _____	11
15.1.4 Water Pressure _____	11
15.1.5 Valves _____	11
15.1.6 Flanges _____	12

15.1.7 Colour	12
15.2 Materials	12
16.0 Fire Protection	13
17.0 Temporary Water Service	13
18.0 Testing	13
18.1 Super Chlorination, Pressure Testing and Flushing Procedure	13
18.2 Sampling Procedure	14

5.0 Formulas

Formula	Equation	Criteria
Hazen-Williams Formula	$V = 0.849CR^{0.63}S^{0.54}$	V = Velocity (m/sec) C = Roughness Coefficient (unitless) R = Hydraulic Radius (meters) S = Hydraulic Gradient (m/m)

6.0 Design Criteria

6.1 Friction Factor Requirements – “C” Value

Where data is not available from actual field tests, the following Hazen-Williams “C” value shall be used for design for pipes made of traditional materials:

Diameter (mm)	C-Factor
150mm	100
200mm to 250mm	110
300mm to 600mm	120
Over 600mm	130

Source: *Watermain Design Criteria – MOE March 2009*

6.2 Design Flows

Criteria		Standard	Minimum	Maximum
Average day per capita			450 Liters/ capita/day	2.75 times the average day
Peak Hour Rate Factor		1.5 times average		
Peak Hourly Demand Factor		2.5 times average		
Pressure	Under Normal Operating Conditions		280 kPa	700 kPa
	Under Fire Flow Conditions		140 kPa	
Hydrant Capacity		2273.14 Liters / Minute	1909.44 Litres / Minute	

Design fire flows shall be in accordance with the Underwriters Insurance Bureau of Canada. Where, when using this reference, insufficient fire flow will exist, the Fire Chief shall determine the minimum fire flows which are acceptable to the City.

7.0 Mains

The minimum pipe size for water mains shall be 200mm with exception that dead-end mains on cul-de-sacs of 20 or less dwelling units may be 150mm, subject that adequate fire protection can be met.

Where dead-end watermains cannot be avoided, they shall be designed with a means to provide adequate flushing.

Water mains and water services shall not be used as an electrical ground in new buildings.

7.1 Design Specifications

The minimum depth of cover measured from the top of a main or a service connection gooseneck shall not be less than 1.8m. Pipe bedding and cover shall conform to those set forth in OPSS or as recommended in a soils engineering report.

Water mains shall be evenly graded and hydrants shall be placed at high points.

All bends and plugged ends shall be restrained with mechanical joint restrainers. Location of mechanical joint restrainers must be at any ductile fitting with a minimum of one joint 6 meters from a ductile fitting in accordance with OPSD and AWWA standards.

7.2 Separation Distances from Contamination Sources

Sewers/sewage works and watermains located parallel to each other shall be constructed in separate trenches, maintaining a clear horizontal separation distance of at least 2.5m measured from closest pipe to closest pipe edge.

In the case where a watermain crosses above or below a sewer, a minimum vertical distance of 0.5m between the outside of the watermain and the outside of the sewer shall be provided to allow for proper bedding and structural support of the watermain and sewer pipe.

No watermain shall pass through or come in contact with any part of a sewer access/maintenance hole, septic tank, tile field, subsoil treatment system or other source of contamination. (*Watermain Design Criteria March 2009, MOE*)

7.3 Materials

All materials shall conform to relevant OPSS.

Criteria	Size / Condition	Specification	Required Standard
Pipe	300mm and smaller	PVC DR 18 colored "Blue Brute" or equivalent or DI Pressure Class 350 or CI C/L 52. Rated at 350 psi.	AWWA C-900, CSA B137.3
	Larger than 300mm	DI C/L Class 52 or Pressure Class 350 cement mortar lined with tyton joints Rated at 350 psi.	AWWA C-900, CSA B137.3
Fittings	DI Pipe	Bibby-Ste-Croix, Star Pipe Products, or approved equivalent	D.I. per ASTM A-536 ANSI / AWWA C153/A21.53 and UL requirements
	PVC Pipe	Ipex or approved equivalent	AWWA C-907/C-905, CSA B137.3
Joint Restraints	PVC Pipe	For AWWA C-900/C-905 PVC Pipe Star Pipe Products Pipe Restrainers 1000, 1100, or 1200 series or approved equivalent.	T-Bolts/Rods/Hex Nuts: Low Alloy Steel Per AWWA C-111/A21.11
	DI Pipe	As approved.	

7.4 Eye Bolts and Rods

Eyebolts shall be zinc coated ANSI/ASME B1.1 19mm. Rods shall be ANSI/ASME B1.1 19mm Grade 316 stainless steel. The number of rods required will be set out below:

Number of 19 mm Rods for Eye Bolt Restraint

Pipe Size	Dead End, Tee, & Dead End Valve	Fitting 90° Elbow	Fitting 45° Elbow	Fitting 25° Elbow
150 mm	2	2	2	2
200 mm	2	2	2	2
250 mm	3	3	2	2
300 mm	4	4	2	2
400 mm	Not permitted	Not permitted	3	2

8.0 **Valves**

The operation of all valves, curb stops and hydrants shall be restricted to employees of the Public Works Department.

8.1 Location

Three valves shall be placed on a tee intersection and four valves on a cross intersection. On straight runs isolation valves shall be not less than 150m or such that 40 family dwellings units or equivalent can be isolated.

8.2 Design Specification

Valve boxes shall be adjusted to finish grade. Services within the road surface must be set to grade and raised at time of final lift of asphalt.

Both valve ends shall be mechanical-joint per AWWA Standard C-111.

Criteria	Size / Condition	Specification	Required Standard
Valves	All	Resilient seat counter clockwise opening with 50mm (2") square operating nut Valve body shall be high-strength cast iron Clow Canada Ltd. or approved equivalent	AWWA C-509 & ULC Listed ASTM A126 Class B with 18-8 Type 304 stainless steel body seat.
	400mm or Larger Butterfly Valves for Ductile Iron pipe	Clow Canada Ltd butterfly, 400mm or larger 50mm turning nut opening counter clockwise complete with gear operator as approved	AWWA C-504. AWWA C-504 Class 150B valve shaft diameter, and full C class 150B underground-service-operator torque rating throughout entire travel.
Valve Box	All	5 ¹ / ₄ " – 130mm Slide Valve Box with Guide Plate. Bibby-Ste-Croix or Approved Equivalent	Top - VB625 Bell Bottom - VB530L

9.0 **Service Connections**

Sewer services and water service connections are not permitted in driveways or private sidewalks. Water service connections shall be installed to the mid-point of the frontage of all single-family lots.

Engineering plans should indicate location and standard driveway type. Driveways must not be located above water service valves or utility cleanouts or within a utility easement where a utility is known to exist. If services in a driveway are unavoidable the City requires sewer cleanouts to have a steel cap and water shutoffs set to grade and clean of and asphalt or concrete material.

Water and sewer services shall not be connected at the property line until such time that the "Certificate of Substantial Completion of the Underground Infrastructure" or the required inspections and approvals by the City's Building and Water Departments have been issued.

Service connections shall have a corporation main stop and be "goose-necked" near the water main as per the appropriate OPSD. Main stops may be set at the spring line and the gooseneck may be horizontal.

9.1 Design Specification

Separate services shall be provided to each building and each unit of a semi-detached or row house residential building.

A curb stop with drain and associated valve box to finish grade shall be provided on the service connection to each premises and be located at the property line.

9.2 Sizing

Services shall be sized in accordance with the Ontario Building Code 1992 as amended.

Zoning	Service (minimum)
Single family dwelling units	20mm
Low density lots with an average width greater than 15 meters or where the service line between the main and the dwelling exceeds 25 meters.	25mm

9.3 Materials

All new construction shall use pre-manufactured tees service and fittings. Service pipes shall be constructed of materials acceptable under Part 7 of Division B of the Building Code (O. Reg 350/06) made under the Building Code Act, 1992 and shall conform to the American Water Works Association (AWWA) Standard C800: Underground Service Line Valves and Fittings. (Source: *Watermain Design Criteria March 2008, MOE*)

Criteria	Size / Condition	Specification	Standard
Water Service	Conductive	No-lead Brass "Type K" copper service tube Standard throughout subdivision	ASTM B88 "K" type AWWA C800
	Non-conductive	Ipex Pipe Blue 904 or approved equivalent. #12 Tracer Wire Required	AWWA C904 CSA B137.5
	Connection to PVC mains	Double bolt stainless steel saddle or approved equal, either of which shall be approved by the City. Pre-manufactured tees shall also be considered.	Fully Passivated
Couplings	Copper to copper	No-lead brass couplings. Copper to copper compression, joint couplings Cambridge Brass Series 118-119 or approved equivalent	
	Copper to Steel or Iron Pipe	Joint couplings. Nylon isolation bushing required.	

Saddles	Double Bolt S.S. Saddle	Stainless steel saddle double bolt AWWA outlet	AWWA C-800 Cambridge Brass Series 8403 or approved equivalent. Fully Passivated
Curb Stops	¾" to 2"	Corporation stop ball style with blow out proof stainless steel stem. Compression joint and counter clockwise to open. With drain.	AWWA C-800 No-lead fillings Cambridge Brass or approved equal OPSD 1104.010 OPSD 1104.020
Main Stops	¾" to 2"	Corporation stop ball style with blow out proof stainless steel stem. Compression joint and counter clockwise to open. "goose-necked" as per OPSD	AWWA C-800 No-lead fillings Cambridge Brass or approved equal OPSD 1104.010 OPSD 1104.020
Service Boxes		Supply with stainless steel rods. Slide type No. 8 Bibby Ste Croix or approved equivalent	

10.0 Tracer Wire

All non-metallic mains and services shall be traced with a 12 gauge tracer wire. Non-metallic services shall have the tracer wire extending into the building being serviced and terminated at the water meter remote.

Tracer wire shall be "tack welded" to valve boxes and service boxes or connected in an equal fashion as approved by the City. All non-metallic services shall have the tracer wire thermo welded to the curb box.

Tracer wire splices shall be by means approved by the City.

Tracer wire shall be looped up the outside of all main valve boxes and extended into the valve box by 50mm through a saw cut 50mm below the bottom of the cover bell.

11.0 Cathodic Protection

Tracer wire on mains shall be protected with a 2.3 kg zinc anode, at each end a maximum spacing of which shall be 500 m.

Valves, metallic fittings and hydrants shall be protected with 7.7 kg magnesium anodes.

Metallic services of 25mm or smaller and less than 20m in length shall be protected with a 2.3kg zinc anode.

Other metallic services of 50mm or smaller shall be protected with a 5.5kg zinc anode.

12.0 Abandoning Watermains

Fill watermains larger than 250 mm with sand, plug open ends with bricks and mortar, turn off main stops and crimp the open ends of abandoned water services.

Remove and salvage curb boxes and valve boxes from abandoned water service connections and watermains. Remove all structures to 1 meter below finished grade.

Where a line to be abandoned is connected to a main which will remain, remove the connecting fitting and replace with a straight pipe or revised fitting as appropriate.

13.0 Utility Crossing

Where watermains cross over or under other utilities, 300mm (12") minimum clearance respectively shall be provided. Where watermains cross under sewers, 0.50m (1.6') separation shall be required.

14.0 Sampling Station

The requirement for sampling stations in any development will be determined by the Director of Public Works and Environmental Services or his or her designate.

14.1 Location

Sampling locations should be points significantly beyond the point of entry to the distribution system. They should be evenly distributed as to provide a representation of the water quality in the distribution system. Sampling locations should address elevated storage tanks within the distribution grid, dead ends, ageing watermains, distribution loops, points with the potential for cross connection/back flow and extremities of the distribution system. (*Practices for the Collection and Handling of Drinking Water Samples, April 2009*).

Sampling stations shall be located 0.3m from the property line between two adjacent lots at the furthest point from the water source or as determined by the City. The curb stop shall be located 1.0m from the property line. The location should permit unobstructed operator access and have adequate surface drainage to a legal and adequate outlet.

14.2 Materials

Sampling Station shall be a Test Tap Water Sample Station. All Fittings and materials shall be no-lead. Typical install from watermain to Test Tap Sampling Station: ¾" domestic pipe -> ¾" curb stop -> ¾" domestic pipe -> Test Tap. Sampling station will be equipped with a 1" FIP inlet for the connection to the watermain.

Test Tap shall be 1.2 meters above finished grade with a 1.8 meters bury (standard design).

Test Tap and curb stop to rest on a concrete slab. 30cm x 30cm patio slab is acceptable.

15.0 Fire Hydrants

The access street and fire hydrants for the subdivision are required to be installed, maintained and kept clear (i.e. 3 meter radius) prior to the commencement of combustible construction.

15.1 Design Specification

15.1.1 Spacing

Hydrants shall be located such that the maximum road travel distance from hydrant to the center frontage of a lot shall not exceed 100m. Any deviation beyond the maximum allowable spacing shall require the approval of the City's Fire Chief.

15.1.2 Location

All hydrants shall be placed in an obstruction free zone such that neither their view nor their accessibility is obstructed. The Fire Chief shall have the final authority on the location of structures or other items, which might interfere with the view, or the accessibility of hydrants.

Hydrants should be located at intersections, in the middle of long blocks and at the end of long dead-end streets.

Hydrants set in ditches or swales shall conform to OSPD 217.05.

15.1.3 Flow Rating

Each hydrant shall be flow rated by the owner's engineer in accordance with Installation, Field Testing, and Maintenance of Fire Hydrants AWWA M17. The rating notes shall be passed to the City's Fire Department prior to issue of Certificate or Letter of Substantial Completion of Underground Infrastructure. Further the Fire Chief's concurrence that fire flows meet the development's needs is required prior to issue of the certificate or letter.

15.1.4 Water Pressure

The water requirements for fire fighting purposes must be based on the Fire Underwriters Survey Guide – "Water Supply for Public Fire Protection". For example, the water supply for fire fighting purposes is required to be a minimum of 1,100 IGPM at 20psi based on a residential subdivision with 1 and 2 storey single detached residential dwellings.

15.1.5 Valves

A valve should be provided on lateral connections between hydrants and street mains. Each hydrant shall have an isolation valve with a valve box attached to the main using an anchor tee.

A sufficient number of valves should be installed so that a break or other failure will not affect more than 400 meters of arterial mains, 150 meters of mains in commercial districts, or 250 meters of mains in residential districts.

15.1.6 Flanges

Fire hydrant hose outlets shall not be less than 450mm above final grade (i.e. NFPA standard 24, Chapter 7.3)

The hydrant flanges shall be installed as per O.P.S.D. 1105.010. Flanges shall be placed at a height between 100-150 millimeters from the finished grade such that connecting bolts can be easily removed.

15.1.7 Colour

Fire hydrant tops and caps are required to be color coded to comply with Chapter 5 of NFPA 291.

All fire flow indicator paint shall be Tremclad Rust Paint Semi Gloss and shall correspond with the following Tremclad Colors:

Required Color	Tremclad Color
White	White
Black	Black
Light Blue	Medium Blue
Green	John Deere Green
Orange	Real Orange
Red	Fire Red

15.2 Materials

Hydrants should conform to American Water Works Standard for Dry Barrel Fire Hydrants or Underwriters' Laboratories of Canada listing. Hydrants shall be installed as per OPSD and shall also conform to the following:

Criteria	Specification
Approved Products	Canada Valve Century, McCavity M-67 or Mueller Centurion AWWA Standard C502 and shall be listed with ULC and FM
Barrel	150mm with two 63mm hose connections and one B-33 Pumper (Steamer) Port Connection, counter clockwise opening. 1" Square Operating Nut. Breakaway / Safety Flange
Color	Chrome Yellow Epoxy coating to both interior and exterior of hydrant shoe for corrosion protection
Lateral	Not less than 150mm in diameter

Additional Criteria

- All hydrants shall be self-draining. Washed gravel of suitable size and quantity shall be placed around the drain holes to ensure drainage. Such material shall be topped with suitable geotextile to ensure fines do not migrate into the drainage rock.

- Fire hydrants which are not in service shall have a fiber reinforced yellow bag with "Hydrant Out of Service" in black lettering affixed over it.
- A hydrant shall be provided for flushing purposes on mains larger than 50mm. Such flushing devices shall not be connected to any sewer. Devices other than hydrants shall be approved on a case-by-case basis.

16.0 Fire Protection

To estimate the fire flow requirements for a development or particular structure the owner and/or engineer should refer to the "Fire Protection Water Supply Guideline" by the Office of the Fire Marshal.

17.0 Temporary Water Service

To provide and maintain temporary water services to houses and businesses that are disconnected or isolated from the watermain during the watermain construction for durations greater than 8 hours.

Submit the proposed method of temporary water supply to the Contract Administrator for approval prior to starting the work. All supply piping or hoses shall be CSA approved for potable water use and shall be disinfected, flushed and tested prior to use.

Provide for continuous bleeding of temporary water supplies to maintain water quality.

Connect the temporary water supply to the City system using approved backflow preventers at the source and at the connection to the customer. Obtain certification of backflow prevention device prior to use and provide a copy to the Contract Administrator.

Flush the water service connection prior to returning the service to normal operation.

18.0 Testing

The intent of this policy is to ensure that all new watermains and temporary waterlines whether installed by the City or by independent contractors are sampled and testing in a consistent manner in accordance with current industry standards. No new watermains or temporary watermains will be put into service until satisfactory results are achieved.

Procedures shall follow current AWWA standards and in the event of conflict, the current AWWA standard shall prevail.

- AWWA Standard for Disinfecting Watermains C651-05
- AWWA B300 – Standard for Hypochlorites
- AWWA B301 – Standard for Liquid Chlorine
- Simplified Procedures for Water Examination. AWWA Manual M12. AWWA, Denver (1997)
- Standard Methods for the Examination of Water and Wastewater. APHA, AWWA, and WEF. Washington, D.C. (20th ed., 1998)

18.1 Super Chlorination, Pressure Testing and Flushing Procedure

The City will be given a minimum 48 hours notice prior to any chlorination, pressure testing or flushing.

The new watermain shall be kept isolated from the active distribution system using a physical separation until satisfactory bacteriological testing has been completed and the disinfectant water flushed out.

A professional engineer shall certify that testing and the disinfecting of mains was undertaken as set forth herein.

18.2 Sampling Procedure

This sampling is to be done only after the proper super chlorination, pressure testing and flushing procedures have been completed.

Requirements:

- The City will be given a minimum of 24 hours notice before samples or testing take place.
- The contractor/consultants will supply all the necessary sample bottles and chain of custody forms for the accredited laboratory of their choice.
- Samples will be taken by a Licensed Municipal Operator at locations of his/her choice. The number of samples required will also be at their discretion. **(At the discretion of the City, two samples may be taken at each sample point, one for the contractor/consultant the other for the City to have independently analyzed at a lab of our choice).**
- Free Chlorine residuals will be taken at each sample point and all pertinent information will be documented on the chain of custody forms.
- Upon completion, the samples and chain of custody form will be turned over to the contractor or consultant to be delivered to the lab for analysis. Proper storage and handling is the responsibility of the contractor/consultant.
- Sample results will be sent from the lab directly to the contractor/consultant. Results will then be forwarded to the City of Quinte West.