THE REGIONAL MUNICIPALITY OF DURHAM

DESIGN SPECIFICATION FOR WATERMAINS

WORKS DEPARTMENT

April 2023

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1. Water Supply System By-Law 89-2003

The Region of Durham's Water Supply System By-Law 89-2003 shall comply in-conjunction with the Region of Durham's Design Standards or most recent amendment.

2. Design Flows

2.1 Watermain Capacities

Watermains shall be sized to carry the greater of maximum day plus fire flow or maximum hour demand. Fire flow shall be calculated as outlined in the current edition of "Water Supply for Fire Protection, A Guide to Recommended Practice" issued by the Fire Underwriters Survey of the Insurance Bureau of Canada, unless otherwise approved by the Region of Durham.

The minimum required fire flow for single family, detached dwellings is 4,500 L/min.

2.2 Commercial and Institutional Water Demands

A population equivalent of 86 persons per hectare shall be used to estimate the water consumption for large commercial areas unless more specific data is available.

The following average daily consumption rates for individual commercial and institutional use:

1. Shopping Centers: 2500 - 5000 L/ day/ 1000 m^3
2. Hospitals: 900 - 1800 L/ bed/ day
3. Schools: 70 - 140 L/ student/ day
4. Campgrounds: 225 - 570 L/ campsite/ day

The water usage will drop to residential usage rates during the remainder of the day. Schools generally do not exhibit large maximum day to average day ratios and a factor of 1.5 will generally cover this variation. For estimation of peak demand rates, a fixture-unit approach shall be used.

The peak water usage rates in campgrounds varies with the type of facilities provided (showers, flush toilets, clothes washers, etc.) and the ratio of these facilities to the number of campsites. A peak rate factor of four shall be used.

This factor shall be applied to the average expected water usage at full occupancy of the campsite.

2.3 Industrial Water Demands

The industrial water demand shall be estimated in terms of water requirements per hectare of industrial development if more specific data are not available.

An average day value of 45 m^3 per hectare per day shall be used with a maximum day figure of 90 m^3 per hectare per day.

3. Water Supply System Pressures

3.1 Water Distribution Systems/ Private Lawn Sprinkler Systems

The distribution system shall be sized to meet normal demands. The maximum sustained operating pressures shall not exceed 700 kilopascals (kPa). Under conditions of simultaneous maximum day and fire flow demands, the pressure shall not drop below 140 kPa in the regional portion of the Water Distribution System. Under normal operating conditions, the pressure shall not drop below 275 kPa in the regional portion of the Water Distribution System.

The Ontario Building Code requires, “where the static pressure exceeds 550 kPa, a pressure reducing valve shall be installed to limit the maximum static pressure to not more than 550 kPa in areas that may be occupied”.

As indicated in the Water Supply System By-Law 89-2003 Part II Section 7.3 indicates “The Region of Durham does not guarantee to any Consumer an uninterrupted supply of Regional Water or that any standard of water pressure, water quantity or water quality will be met or maintained and any failure to provide an uninterrupted supply of Regional water or to provide an uninterrupted supply of Regional Water or to meet any such standard shall not be construed as neglect on part of the Region of Durham.”

4. Friction Factors

The following “C” values shall be used in the Hazen Williams equation for the design of water distribution systems unless actual pipe materials and “C” factors are known:

Pipe Diameter (mm)	**“C” Factor**
150	100
200 to 300	110
350 to 600	120
Over 600	130

The Hazen Williams Equation is:

$$Q = 0.84918\ CAR^{0.63}S^{0.54}$$

C = Coefficient of Roughness

R = Hydraulic Radius (m)

S = Slope of the Energy Grade Line (m/m)

A = Cross-Sectional Flow Area (m^2)

The above “C” factors represent long-term values. A “C” factor of 140 shall be used to calculate maximum velocities for transient pressure estimations, or for checking pump motor sizes for run out conditions.

In evaluating existing systems for expansion, the “C” factors shall be determined by actual field tests, wherever possible.

5. Watermains

5.1 Minimum Sizes of Pipe

Sizes and looping of watermains shall be determined at the preliminary stage of the development. The following are the minimum size requirements:

1. Residential areas shall be a minimum of 150 millimetre diameter.
2. Industrial, commercial, and institutional areas shall be a minimum of 300 millimetre diameter.
3. Pipes of 250 millimetre, 350 millimetre, 450 millimetre, and 500 millimetre diameter are no longer considered standard production sizes and shall not be used for the design of new distribution systems.

5.2 Minimum Depth of Pipe

Roads with curb and gutter shall have a minimum cover of 1.80 metres, the watermain measured from the top of pipe to the finished centre line road grade.

Roads with open ditches, the watermain shall have a minimum cover of 1.80 metres.

5.3 Dead Ends

Wherever possible, the distribution system shall be designed to be looped to eliminate dead end sections. Where dead ends cannot be avoided, they shall be provided with a fire hydrant for flushing purposes, and a maximum of 20 houses shall be permitted. The Region of Durham must be provided with a Watermain Analysis Report to ensure that the watermain is adequately sized to meet the water flow and pressure requirements for the area. A secondary watermain loop is required for any dead ends that will have more than 20 houses. All fittings and joints encountered within the restraining length shall be restrained.

6. Valves

6.1 Mainline Valves

Resilient seat gate valves shall be used on all watermains 400 millimetres in diameter and less in size.

Butterfly valves are not permitted on all watermains 400 millimetres and smaller in size unless otherwise specified.

All valves shall be of the approved type with non-rising stem and a 50 millimetres square operating nut opening counter clockwise.

All in-line valves shall be restrained.

6.2 Sizes

The size of the valve shall be the same size as the watermain up to and including 600 millimetres diameter. Valves on 750 millimetres diameter and larger watermains may be one size smaller than the water main size.

6.3 Number, Location and Spacing

Three valves are required at a tee intersection and four valves are required at a cross intersection. Wherever practical, the valves shall be located at the point where the projection of the street line intersects the watermain. Valve boxes and chambers shall be located in boulevards whenever possible.

Mainline valves shall be located such that approximately 20 houses can be shut-off from another block and isolated from the system. In no case shall the spacing exceed 300 metres. Valves on feedermains shall be spaced from approximately 700 metres to 900 metres.

6.4 Air Valves

Air valves shall be placed at all significant high points on feedermains.

6.5 Drain Valves

Drain valves shall be located at the low points of all watermains 600 millimetres diameter and greater and shall be constructed in a chamber.

6.6 Valve Boxes

All valves 400 millimetres diameter and smaller shall have valve boxes and specified direct bury operators shall be used.

All valves larger than 400 millimetres diameter can be installed in valve chambers. All valves in chambers shall be installed with extension stems. Handwheels shall not be installed.

The tops of valve boxes and valve chamber maintenance hole covers shall be set flush with finished grade. The top of the roof slab of valve chambers shall be at least 0.60 metres below the profile of the finished pavement.

A one metre minimum 50 millimetre circular asphalt collar shall be installed around a valve box located in a gravel shoulder according to Region of Durham Standard Drawing S-101.030.

6.7 Chambers

The use of chambers shall be minimized or eliminated whenever possible.

All drain valve and air valve chambers shall be provided with a drainpipe connection to the storm sewer if feasible. No connections are permitted to the sanitary sewer. Storm sewer connections shall include a backflow preventer in an accessible location. The location of the storm sewer connection shall be shown on the contract drawings.

7. Hydrants

7.1 Numbers, Spacing and Type

For hydrant specifications refer to Region of Durham Approved Manufacturers' Product List.

Hydrants shall be installed on all watermains 150 millimetres diameter and larger with the following maximum allowable spacing:

1. 150 metres in residential areas, or to provide for a maximum hose length of 75 metres measured along the length of the watermain.
2. 75 metres in industrial, commercial, and institutional areas to provide for a maximum hose length of 37.5 metres measured along the length of the watermain.
3. The Region of Durham can request that the hydrant spacing of 150 metres for residential areas and 75 metres for non-residential areas be reduced based on a site-specific bases.

7.2 Branch Valves and Boxes

All hydrants installed on watermains shall be installed with 150 millimetres diameter branch valve and box, attached to the watermain with an anchor tee.

7.3 Anti-tampering Devices

Anti-tampering devices shall be installed on hydrants designated by the Region of Durham. The device shall be installed by the Region of Durham and shall remain in place until the final acceptance certificate is issued or until building construction is complete.

A fee shall be charged to the developer to cover the cost of supply, installation, and removal of the device.

8. Sampling Stations

Sampling stations shall be installed at locations as directed by the Region of Durham.

For sampling station specifications and installation requirements refer to the Region of Durham Watermain Standard Drawings.

9. Water System Testing

All new watermains shall be cleaned by foam swabbing (up to and including 300 mm) to remove all debris in the pipeline, hydrostatically tested, disinfected and flushed. Refer to Section 01450 Quality Control.

Tracer wire shall be installed on all feedermains according to Region of Durham Standard Drawing S-220.010. Tracer wire shall be brought to the surface using 50 millimetres diameter valve boxes spaced 300 metre intervals along the feedermain for locating purposes.

Watermain shall be constructed according to Region of Durham Construction Specifications Section 02511, and referring to AWWA 651, so as to include sample points at 366 metre intervals.

10. Connections

All water connections to service private property shall comply with the Design Specifications for Service Connections.

11. Materials

For acceptable watermain products, refer to the Region of Durham Approved Manufacturers' Products List.

For the purpose of this clause, the following definitions shall apply:

1. A "Distribution Main" is a watermain carrying potable water supplied by a feedermain. The primary function of the distribution main is:
    1. To distribute water to customers through service connections, and
    2. To provide fire protection through hydrants.

Distribution mains are normally size 150 millimetres to 300 millimetres in diameter.

2. A “Feedermain” is any watermain where the primary function of such main is for the transmission of potable water from a Water Supply Plant to a Reservoir for supply of water to distribution mains. Feedermains are normally sized 400 millimetres in diameter and larger. Feedermains shall not be tapped for individual service connections. Service connections will require a local distribution main from the feedermain across the frontage of the property and looped back to the feedermain unless prior written approval is received from the Region of Durham. The local watermain shall be sized to meet the requirements of the these Watermain Design Standards and the Water Supply System By-Law 89-2003.

Distribution mains shall be constructed of Polyvinyl Chloride (PVC) to AWWA C900.

Feedermains shall be constructed of Concrete Pressure Pipe (CPP). CPP pipe type shall be as specified on the Approved Manufacturers’ Products List for the pipe size required.

11.2 Alternative Watermain Materials

For watermains which are 400 millimetres in diameter and larger, alternative watermain materials as specified on the approved manufacturer’s product list will be considered during detailed design stage only where the consequence of failure scoring is less than the average consequence of failure score as calculated by the Region of Durham. The Region of Durham considers many factors in calculating consequence of failure including, but not limited to, critical customers, traffic, accessibility, environment, public safety, redundancy, etc.

Ductile Iron (DI) pipe may be permitted to replace existing DI pipes for short sections (approximately 2 to 3 pipe lengths) only. DI pipe must have a polyethylene encasement according to AWWA C105/A21.50.

11.3 High Density Polyethylene (HDPE) Pressure Pipe in Horizontal Directional Drilling (HDD) Applications

HDPE pipe will only be considered in HDD applications providing a geotechnical survey indicates favourable conditions.

Mechanical restraints shall be required for two pipe lengths at each end of the installation to provide a safety factor.

Following installation, HDPE shall not be connected for a minimum of two days to allow the pipe to contract. Further delays in connecting may be required as recommended by the manufacturer.

Pipe material conversions are to be made only at fittings.

Double reinforced tracer wire shall be installed at the same time as the HDPE installation.

All HDPE pipe shall be joined using the butt fusion process according to ASTM F2620.

A minimum rating of DR11 shall be used in lieu of a liner. HDPE pipe sizes shall range from 100 millimetres to 305 millimetres diameter (inside diameter). Site specific approval shall be required for use of 400 millimetres diameter (inside diameter) as indicated in the Approved Manufacturers' Product Section.

Designs specifications must note that HDPE pipe is sized based on outside diameter (OD) and therefore one size larger than the required size must be specified.

All HDD pipe shall be constructed according to OPSS 450 "Construction Specification for Pipeline and Utility Installation in Soil by Horizontal Directional Drilling" and Region of Durham Construction Specifications.

12. Cathodic Protection

12.1 Tracer Wire

Cathodic protection shall be provided for all tracer wires on PVC and CPP watermains. One 5.4-kilogram (kg) zinc anode shall be installed for every 1000 metre of tracer wire. The location of the anodes shall be shown on the construction drawings.

12.2 Copper Service Connections

One 5.4 kg zinc anode shall be installed on all new copper service connections and all existing copper service connections that are exposed during any type of road reconstruction work.

12.3 Valves, Hydrants and Fittings on Non-Ferrous Watermains

One 5.4 kg zinc anode shall be installed on every valve, hydrant and fitting connected to a non-ferrous watermain.

Fittings include bends, tees, crosses, sleeves, reducers, plugs, caps, joint restrainers, and couplings.

12.4 Valves, Hydrants and Fittings on Existing Ferrous Watermains

All valves and fittings installed on existing ferrous watermains shall be cathodically protected by a 14.5 kg magnesium anode. Bonding cables shall be provided on each side of the fitting to the existing watermain. Bonding cables shall be Number 6, seven strand coated copper wire connected to the fittings and watermain by a thermite weld (Cadweld).

12.5 Connecting Non-Ferrous Watermains to Ferrous Watermains

When connecting a non-ferrous watermain to a ferrous watermain, the ferrous watermain shall be cathodically protected by a 14.5 kg magnesium anode.

12.6 Exposed Ferrous Watermain

When a ferrous watermain is exposed during construction of underground utilities, a 14.5 kg magnesium anode shall be installed at each location.

12.7 Thermite Weld Coating

All thermite weld connections shall be coated with an approved coating material.

13. Easement Requirements

For minimum widths of permanent easements refer to Section 6 of the Design Specifications for Engineering Submissions.

The locations of sanitary sewers within easements or where deemed necessary by the Region of Durham, shall be indicated with marker sign and post. Contractor shall supply and install marker post, the location and spacing will be determined by the Region of Durham and shown on the contract drawings. Marker signs shall be made available from the Region of Durham at no cost. All costs associated with the installation of marker signs and posts shall be borne by the contractor.

14. Restrained Joints

Joint restrainers and granular thrust blocks shall be used on all fittings as indicated on the appropriate Region of Durham Standard Drawing. Joints shall be restrained in the opposing direction to thrust forces. All joints encountered within the specified restraining length as indicated on the appropriate Standard Drawings, shall be restrained. Watermains in poor soil conditions shall be restrained as directed by the Region of Durham. Any fittings, which are to be cut into an existing PVC watermain pipe, shall be specifically designed by the Engineer to ensure that all existing and proposed pipe joints are adequately restrained.

15. Concrete Encasement

Concrete encasement of PVC pipe is not permitted.

16. Water Meters/ Backflow Prevention

Commercial, industrial, institutional and multi residential water meters shall be installed in a meter utility room or in a location within the building. Where it is not feasible to locate the water meter in a utility room or building, other means of housing the water meter will be considered on a site-specific basis. The location, size, and type of water meter to be installed shall be determined by the Region of Durham and in accordance with the Water Supply System By-Law 89-2003. A backflow preventer may also be required. Please refer to The Region of Durham Backflow Prevention By-law 24-2018 for additional information.

All proposed commercial, industrial, institutional and multi residential developments shall provide water flow demand rates.