



**Watermain Design Criteria for
Future Alterations Authorized
Under a Drinking Water Works Permit**

Ministry of the Environment
Safe Drinking Water Branch
March 2009

PIBS 7064e

Preface

These Watermain Design Criteria specify minimum design requirements for a municipal residential drinking water system that satisfy one of the conditions imposed by the Director in a drinking water works permit authorizing the future alteration (which includes additions, modifications, replacements or extensions) of watermains within the drinking water system. Compliance with these Watermain Design Criteria and other conditions of the permit negates the need for the owner of the drinking water system to apply for an amendment to the drinking water works permit for the alteration of watermains within the drinking water system.

The authorization for future alterations and the associated requirement meet the Watermain Design Criteria would not be relevant for watermain alterations which:

- (a) are exempt from section 31(1) of the SDWA by 9(2) of O. Reg. 170/03, or
- (b) constitute maintenance or repair of the watermains,

as these undertakings would not require an amendment to the DWWP before proceeding.

The existence of these Watermain Design Criteria does not preclude alteration of a watermain that is not designed in accordance with these Watermain Design Criteria. However, any watermain alteration that is either not designed in accordance with these Watermain Design Criteria or does not satisfy the conditions of the drinking water works permit is subject to the requirement to obtain an amendment to the drinking water works permit for the drinking water system prior to proceeding with the undertaking.

Other approving authorities, such as municipalities in which the works are constructed or regional governments, may have servicing standards or criteria that are more stringent than the requirements outlined in these Watermain Design Criteria and they shall be considered acceptable for the purposes of complying with the requirements of these Watermain Design Criteria.

Definitions

From the *Safe Drinking Water Act, S.O. 2002*:

“alteration” includes the following, in respect of a drinking water system, but excludes repairs to the system:

- (a) an extension of the system;
- (b) a replacement of part of the system;
- (c) a fragmentation of the system; and
- (d) taking all or part of the system permanently out of service.

“distribution system” means the part of a drinking water system that is used in the distribution, storage or supply of water and that is not part of a treatment system.

“plumbing” means a system of works:

- (a) that comprise a “water system” for the purposes of the definition of “plumbing” in subsection 1(1) of the *Building Code Act, 1992*, other than equipment installed in plumbing to treat water; and
- (b) that are connected to a drinking water system.

“treatment system” means any part of a drinking water system that is used in relation to the treatment of water and includes:

- (a) any thing that conveys or stores water and is part of a treatment process, including any treatment equipment installed in plumbing;
- (b) any thing related to the management of residue from the treatment process or the management of the discharge of a substance into the natural environment from the system; and
- (c) a well or intake that serves as the source or entry point of raw water supply for the system.

From the ‘Definitions’ section of a drinking water works permit:

“alteration” may include the following in respect of the drinking water system:

- (a) An addition to the system
- (b) A modification of the system
- (c) A replacement of part of the system, and
- (d) An extension of the system

From Ontario Regulation 170/03:

“secondary disinfection” means a process or series of processes intended to provide and maintain a disinfectant residual in a drinking water system’s distribution system, and in plumbing connected to the distribution system, for the purposes of:

- (a) protecting water from microbiological re-contamination;
- (b) reducing bacterial regrowth;
- (c) controlling biofilm formation; and
- (d) serving as an indicator of distribution system integrity;

and includes the use of disinfectant residuals from primary disinfection to provide and maintain a disinfectant residual in a drinking water system’s distribution system for the purposes described in clauses (a) to (d).

“service connection” means:

- (a) a point where a drinking water system connects to plumbing, other than plumbing in a trailer park or campground; or
- (b) in a trailer park or campground, a fixture that allows a trailer or other vehicle to connect to the trailer park’s or campground’s drinking water system.

“service pipe” means the pipe portion of a drinking water system that extends from a watermain to the property line of a property serviced by the watermain.

“watermain” means any system of pipes and appurtenances used for the distribution of drinking water, but does not include plumbing or a pumping facility.

From the Ontario Water Resources Act:

“**sewage**” includes drainage, storm water, commercial wastes and industrial wastes and such other matter or substance as is specified by the regulations.

“**sewage works**” means any works for the collection, transmission, treatment and disposal of sewage or any part of such works, but does not include plumbing to which the *Building Code Act*, 1992 applies.

Note:

In the context of these Watermain Design Criteria, a reference to ‘the watermain’ shall mean reference to all watermains associated with alteration of the watermain authorized through the drinking water works permit.

1.0 System Pressures

- 1.1 The watermain shall be designed on the basis of providing a minimum pressure of 140 kPa at ground level under maximum day demand plus fire flow conditions.

2.0 Transient Pressures

- 2.1 The watermain shall be designed to withstand the maximum operating pressure plus the transient pressure to which it may be subjected.
- 2.2 The watermain shall be designed so that pipes and joints are able to withstand the maximum operating pressure plus the surge pressure that would be created by stopping a water column moving at 0.6 m/s.

3.0 Friction Factors

- 3.1 Where data are not available from actual field tests, the watermain shall be designed using the Hazen-Williams C-factors listed in Table 1 for pipes made of traditional materials.

Table 1: Hazen-Williams C-Factors	
Diameter – Nominal	C-Factor
150 mm	100
200 mm to 250 mm	110
300 mm to 600 mm	120
Over 600 mm	130

4.0 Pipe Diameters

- 4.1 For distribution systems designed to provide fire protection, the minimum diameter of watermains shall be 150 mm except beyond the last hydrant on cul-de-sacs where the minimum diameter of watermains may be 25 mm.
- 4.2 For distribution systems that are not designed to provide fire protection, the minimum diameter of watermains shall be 75 mm.
- 4.3 In all cases, watermain diameters shall be such that a flushing velocity of 0.8 m/s can be achieved for cleaning and flushing procedures.

5.0 Pipe System Design

- 5.1 Where dead-end watermains cannot be avoided, they shall be designed with a means to provide adequate flushing.
- 5.2 With the exception of watermains which will be taken out of service and drained in winter, the minimum depth of cover over watermains and service connections shall be greater than the depth of frost penetration.
- 5.3 Watermains with a diameter greater than 300 mm, that do not have service connections and that are not dead ends, may be installed so that the frost-free depth corresponds with the springline of the pipe rather than the crown.

6.0 Service Pipes

- 6.1 The minimum diameter of service pipes shall be 19 mm.
- 6.2 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.

7.0 Materials

- 7.1 All watermain materials used in the addition, modification, replacement, extension, or operation of the drinking water system including pipes, fittings, valves, fire hydrants and materials used for the rehabilitation of watermains shall meet all applicable quality standards set by the American Water Works Association (AWWA) and, in addition, the consumer safety standards NSF/ANSI Standard 60: Drinking Water Treatment Chemicals – Health Effects and NSF/ANSI Standard 61: Drinking Water System Components – Health Effects.
- 7.2 Notwithstanding subsection 7.1 the following are acceptable materials for the purposes of this Watermain Design Criteria:
 - 7.2.1 Water pipe and pipe fittings meeting AWWA specifications made from ductile iron, cast iron, PVC, fibre and/or steel wire reinforced cement pipe or high density polyethylene (HDPE);
 - 7.2.2 Articles made of stainless steel, glass, HDPE or Teflon®;
 - 7.2.3 Cement mortar for watermain lining and for water contacting surfaces of concrete structures made from washed aggregates and Portland cement;
 - 7.2.4 Food grade oils and lubricants; and
 - 7.2.5 Any other material or chemical where the owner has written documentation signed by the Director that indicates that the Ministry is satisfied that the chemical or material is acceptable for use within the drinking water system and the chemical or material is only used as permitted by the documentation.

8.0 Permeation by Organic Compounds

- 8.1 Where watermains are installed in areas of groundwater contaminated by organic compounds, materials which do not allow the permeation of the organic compounds shall be used for all portions of the system, including pipes, joint materials, O-rings, gaskets, hydrant leads and service connections.

9.0 Pipe Strength

- 9.1 The watermain material selected for a particular application shall be able to withstand, with a margin of safety, all the combinations of loading conditions to which it is likely to be exposed.

10.0 Flushing

- 10.1 Flushing hydrants or devices shall be provided on watermains which are not capable of providing fire flow and for dead-end watermains.
- 10.2 Flushing devices shall be sized to provide flows which give a velocity of at least 0.8 m/s in the watermain being flushed.
- 10.3 No flushing device shall be directly connected to any sewer.

11.0 Fire Hydrants

- 11.1 Fire hydrants shall only be installed on watermains capable of supplying fire flow.
- 11.2 Fire hydrants shall be dry-barrel type and shall conform to the latest edition of AWWA Standard C502: Dry-Barrel Fire Hydrants.
- 11.3 Fire hydrants shall be provided with adequate thrust blocking to prevent movement caused by thrust forces.
- 11.4 Fire hydrant leads shall be a minimum diameter of 150 mm.
- 11.5 In areas where the water table will rise above the hydrant drain ports, the drain ports shall be plugged.

12.0 Valves

- 12.1 Intersecting watermains shall be equipped with the number of shut-off valves indicated in Table 2.

Table 2: Shut-Off Valves	
Type of Intersection	Number of Valves
"T" Intersection	At least 2
Cross Intersection	At least 3

- 12.2 Valves shall conform to relevant AWWA standards.

13.0 Air Release and Vacuum Relief Valves

- 13.1 Air release and vacuum relief valves shall conform to AWWA Standard C512: Air Release, Air/Vacuum and Combination Air Valves for Waterworks Service.
- 13.2 Automatic air release or vacuum relief valves shall not be used in situations where flooding of the access hole or chamber may occur.

14.0 Valve, Meter and Blow-off Chambers

- 14.1 Chambers, pits or access holes containing valves, blow-offs, meters or other such appurtenances to the distribution system, shall not be located in areas subject to flooding or in areas of high groundwater.

- 14.2 Chambers, pits and access holes shall not connect directly to any sanitary sewer, but may be connected to storm sewers provided backflow prevention is included.
- 14.3 Blow-offs and air release valves shall not be connected directly to any sewer.

15.0 Separation Distances from Contamination Sources

- 15.1 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 2.5 m measured from closest pipe edge to closest pipe edge.
- 15.2 In the case where a watermain crosses above or below a sewer, a minimum vertical distance of 0.5 m 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.
- 15.3 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.

16.0 Restraints

- 16.1 In the case of non-restraining mechanical and/or slip-on joints, restraint shall be provided by adequately sized thrust blocks positioned at all plugs, caps, tees, line valves, reducers, wyes, hydrants and bends deflecting 22 ½ degrees or more.
- 16.2 In designing thrust blocks and other restraint systems, transient pressures shall be added to the normal operating pressures when calculating the thrust forces.