



MUNICIPAL DEVELOPMENT STANDARDS

SECTION 6 – WATER DISTRIBUTION SYSTEMS

October 2020
Planning & Engineering

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6 WATER DISTRIBUTION SYSTEMS

6.1 General

These standards cover the design requirements for water distribution systems. The designs are to be in accordance with the City of Lloydminster Water Distribution Study.

This section also covers the design and construction of water mains and accessories to be built in the City. Drawings relating to the construction of water distribution systems are provided in Section 6 (Water Distribution) of the Standard Drawings.

This section provides the minimum acceptable standard for general construction requirements, construction materials, and construction procedures. These minimum standards may be exceeded wherever appropriate. Good engineering practices and designs must prevail on all projects.

6.2 Design Flow

The waterworks system must be designed in accordance with the Water Security Agency of Saskatchewan Waterworks Design Standard EPB 501 as part of the overall municipal distribution system. The system must be capable of delivering the peak day demand plus fire flow, or the peak hour flow - whichever is greater. Velocities at maximum flows must not exceed 3.0 metres per second.

The rate of water demand must be determined by the land use density basis of either the ultimate subdivision design population in the Outline Plan or if population is unknown, 45 persons per hectare or 3.5 persons per residential unit, whichever is greater. The minimum per capita water demands for the city are as follows:

- Average Daily Demand = 250 litres/capita/day (L/c/d)
- Peak Daily Demand = 2.0 times average daily demand
- Peak Hour Demand = 3.0 times average daily demand

Commercial and industrial areas must be designed subject to the peak daily demand and peak hourly demand multipliers.

Design rates of consumption are as follows:

- Commercial (local) = 15,000 L/ha/d
- Commercial (highway) = 26,000 L/ha/d
- Industrial (light) = 10,000 L/ha/d
- Industrial (heavy) = 20,000 L/ha/d
- Institutional (schools) = 10,000 L/ha/d
- Institutional (hospitals) = 20,000 L/ha/d

Fire flows must be in accordance with the recommended Standards of the Insurance Bureau of Canada. Typical requirements are:

Land Use	Flow Rate (L/s)	Duration (Hours)
Residential – Single Family	100	2.0
Residential – Multi-Family – Townhouses	150	2.0
Residential – Multi-Family – Medium Density	185	2.5
Residential – Multi-Family – High Density	225	3.0
Commercial – Local	185	2.5
Commercial – Highway	225	3.0
Industrial	225	3.0
Institutional	225	3.0

Confirm the required flows for these and other types of construction with the latest edition of the Fire Underwriters Survey “Water Supply for Public Fire Protection.” It is the responsibility of the Developer to conduct fire flow tests in the area being developed, and to coordinate with the City to do so. The fire flow results from this testing are to be used in the design of the water network in the area.

6.3 Design Computations

Calculation of design flows must utilize the Hazen-Williams formula:

$$Q = CD^{2.63}S^{0.54} \times 278.5$$

Where: Q = Rate of flow in L/s
 D = Internal pipe diameter in m
 S = Slope of hydraulic grade line in m/m
 C = Roughness coefficient 125 for all mains

Minimum pressure at peak demand: = 273 kPa
 Minimum pressure with automatic sprinklers: = 350 kPa
 Maximum allowable pressure: = 700 kPa
 Minimum fire pressure at main: = 150 kPa

Network analysis must be by the Hardy-Cross method or a suitable computer program.

6.4 Minimum Main Pipe Diameter

Sizing of pipes will adhere to the recommendations within the Water Master Plan; otherwise the following minimum sizes will be used:

- Single Family Residential = 200 mm
- Single Family Residential without hydrants = 150 mm
- Multi-Family Development = 250 mm
- Industrial/Commercial = 250 mm

6.5 Dead Ends

All dead end watermains must be provided with a blow off valve or a hydrant located at the end of line. Temporary blow off valves are required at the dead ends of construction staging, to facilitate flushing and disinfection. This temporary valve must be removed when the next stage of construction connects to the main.

Except in cul-de-sacs of less than 150 m length, all watermains must be looped. Blow off valves or hydrants must be provided at the end of all cul-de-sacs and dead end watermains, as illustrated in Standard Drawing 6-200.

After the last hydrant tee on a residential dead end, the water main diameter may be reduced to 150 mm.

6.6 Pipe Location

Where at all possible, water mains should cross above sewer mains. The minimum separation of the water main from sanitary sewer mains, storm sewer mains, and power/telephone/cable is as follows:

- Minimum 3.0 m horizontally unless watermain depth requires increased spacing;
- Minimum 0.6 m vertical clearance between the bottom of a sewer pipe and the top of the watermain, if the watermain is passing under; and
- Minimum 0.3 m vertical separation between the top of a sewer pipe and the bottom of the watermain, if the watermain is passing over.

Pipes being crossed must be supported as shown in Standard Drawing 4-300.

All watermains are to be installed 3.0 m from the centerline of the roadway.

6.7 Minimum Depth of Cover

Minimum cover to be 3.0 m below finished grade to obviate and must be of sufficient depth to:

- Prevent freezing; and
- Clear other underground utilities.

If it is not possible to achieve the minimum depth to prevent freezing, insulation must be installed as per Standard Drawing 4-101.

6.8 Valves

In general, valves must be located to conform to the following:

- One (1) valve at the boundary of any phase or stage of a subdivision;
- Closing a valve will cause not more than one (1) hydrant to be isolated;
- A maximum of four (4) valves will be closed to isolate any one section; and
- A maximum of 30 lots cut off from the water supply in all areas.

These valves must be located adjacent to hydrants where possible, a minimum of 2 m from the hydrant tee, with no services located between the valve and the tee. These valves should be downstream of the hydrant tee, in the context of flushing direction. Valves must be the same size as the main they are installed on.

6.9 Hydrant Location

Fire hydrants will be located, in general, at street intersections and spaced as follows:

- In accordance with "Water Supply for Public Fire Protection" published by Fire Underwriters Survey;
- Location to be 2.0 m back from curb, 0.5 m from property line, no closer than 1.0 m to back of walk, and 3.0 m from franchise utilities (pedestals, transformers, street lights, etc.) and catch basins;
- No more than 180 m apart in residential areas;
- No more than 100m from a dwelling; and
- No more than 90 m apart in a commercial/industrial area.

6.10 Service Connections

Water service installations must conform to the following:

- Water service connection pipes must have minimum 2.85 m cover at the property line. Services must extend 4.0 m past property line, or 2.0 m past the shallow utility easement, whichever is further;
- Where the service is rigid pipe, water service must be designed as a single connection from the main to the property line, straight in to the building at a right angle to the main; and
- The Consulting Engineer must provide detailed record drawings for all installed service connections with such drawings providing pipe diameter, elevation, and location relative to property line(s) and lot number on a lateral service card.

6.11 Thrust Blocking

Concrete thrust blocking (Type HS Cement) must be provided at bends, tees, reducers, plugs, caps, hydrants and valves as per Standard Drawings 6-300, 6-301, 6-302 and 6-303.

6.12 Chamber Drainage

Chambers or manholes containing valves, blow-offs, meters or other appurtenances must not be connected directly to a storm drain or sanitary sewer, and blow-offs or air release valves must not be connected to any sewer. Such chambers or manholes must be drained to the surface by gravity where they are not subjected to flooding by surface water or to absorption pits underground where it is above the groundwater table or pumped to a sanitary sewer. They must be insulated to prevent freezing where necessary and must also be sealed to prevent groundwater infiltration.

6.13 Disinfection and Flushing

All disinfection and flushing of new water mains will be done by the Developer, at their cost. All water used during flushing and disinfection must be potable and supplied by the Developer. Any sampling as required by the Water Security Agency of Saskatchewan, and submission for testing, will be the responsibility of Water Services. The costs associated with sampling and testing will be borne by the Developer.

6.14 Materials

Pipes, fittings, valves, fire hydrants and other appurtenances must conform to the latest standards issued by AWWA and/or CSA. Material used for any newly constructed water distribution works or alteration or extension to existing water system works must comply with the latest versions of “NSF/ANSI Standard 61: Drinking Water System Components – Health Effects” and “NSF/ANSI Standard 372: Drinking Water System Components – Lead Content”. Anticipated water quality and bedding soil characteristics must be considered in selecting pipe materials, which will protect against both internal and external pipe corrosion.

6.14.1 Pipe

Table 6.1 lists specifications for acceptable pipe materials and approved PVC materials are listed in Section 6.15.

Table 6.1 – Acceptable Water Pipe Materials

Material	General Size Range (mm)	Specification
Polyvinyl Chloride (PVC)	150 to 300	AWWA C900, DR18
	400 to 900	AWWA C900, DR25

6.14.2 Fittings and Hardware

Acceptable fittings and hardware to be used are listed in Table 6.2.

Table 6.2 – Acceptable Water Fittings and Hardware

Material	Specification
Cast iron fittings	AWWA C110 1.03 MPa (Class 150) working pressure
PVC fittings	150 to 300 mm: CSA B137.2 (Class 150), AWWA C907
	350 to 900 mm: CSA 137.3 (Class 150), AWWA C905
Flanged joints	Class 125, ANSI B16.6, B16.5 flat-faced
Bolts and nuts	Stainless steel, Type 304, wrapped with Denso or Petroguard Petrolatum paste and tape

6.14.3 Cathodic Protection

Cathodic protection must be provided for all buried metallic fittings, valves and hydrants:

- All buried metallic fittings and valves must be cathodically protected with 2.3 kg zinc anodes. See Standard Drawing 6-401;
- All hydrants must be cathodically protected with 5.5 kg zinc anodes. See Standard Drawing 6-400; and
- Zinc anodes must conform to the latest version of ASTM B418.

6.14.4 Bedding

Bedding material for pipes must be Class B sand, conforming to Standard Drawing 4-200 and the gradation specified under Section 4.14.4.

6.14.5 Trench Section

Refer to Section 4 (Trench and Backfill) of the Standard Drawings for trenching specifications.

6.14.6 Fire Hydrants

Hydrants must conform to the following requirements:

- Approved materials are listed in Section 6.15;
- The minimum hydrant connection size is a 150 mm hub end;
- The minimum cover over hydrant leads is 3.0 m;
- Hydrants must have two (2) 65 mm hose connections and one (1) 100 mm pumper connection as presently used in the community;
- Hydrant connections must have threads conforming to the Saskatchewan specifications:
 - Hose Connection:
 - 6 threads/inch
 - Outside diameter = 82.55 mm
 - Pumper Connection:
 - 6 threads/inch
 - Major diameter = 123.11 mm
 - Pitch diameter = 119.76 mm
 - Minor diameter = 116.41 mm
- Hydrant main spindles must turn to the left (counter clockwise) to open;
- A gate valve must be provided on each connection between a hydrant and main;
- Hydrants must be cathodically protected. See Standard Drawing 6-400.

6.14.7 Gate Valves

Gate valves must be in accordance with AWWA C509 and conform to the following requirements:

- Gate valves must have an iron body, bronze mounted, and are to be cathodically protected;
- Valves must be resilient seat gates with non-rising stem, to open by turning in a counter-clockwise direction;
- Valve boxes with operating stem and nut are required on all valves. All valve boxes must be sliding Type A; and
- Dresser style 450 mm diameter butterfly valves suitable for buried installation may be considered as an approved alternative, subject to written approval of the City on main sizes >400 mm.

6.14.8 Service Connections

Water service connections must conform to the following:

- Water Service Pipe:
 - Approved Materials are listed in Section 6.15;
 - Flexible pipe service connections must be Q-line. For service connections 37 mm to 50 mm, high density polyethylene (HDPE) is permitted;
 - Service connections larger than 50 mm must be PVC;
 - Couplings must be Standard Brass, compression type;
 - Meet the following minimum sizes:

Unsprinklered dwelling:	19 mm for services less than 30 m in length
Sprinklered dwelling:	38 mm
Multi-family/commercial:	sized accordingly, minimum 150 mm stub
- Water Service Fittings:
 - Approved materials are listed in Section 6.15; and
 - Curb stop will be stop and drain type.

6.15 Approved Materials

Polyvinyl Chloride (PVC) Water Pipe

Manufacturer	Model/Type	Size (mm)	Remarks
Ipex Royal	Blue Brute C900 Pressure	100 to 300	AWWA C900, DR18 C.I.O.D.
Ipex Royal	Centurion C900 Pressure	350 to 900	AWWA C900, DR25 C.I.O.D.

Fire Hydrants

Manufacturer	Model/Type	Lead Size (mm)	Remarks
Canada Valve Darling	Century	150	AWWA C502 Saskatchewan threads

Service Saddles

Manufacturer	Model/Type	Size (mm)	Remarks
Robar	2616, 2626, 2706	100 to 600	AWWA C800

Main Stops

Manufacturer	Model/Type	Size (mm)	Remarks
Cambridge Brass	301 Series	20 to 50	AWWA C800
Mueller	B2500 Series	20 to 50	AWWA C800

Water Service Unions

Manufacturer	Model/Type	Size (mm)	Remarks
Cambridge Brass	118 Series	20 to 50	AWWA C800 Compression Ends
Mueller	300 Series	20 to 50	AWWA C800 Compression Ends

Curb Stops – Select Connections to Suit Service Tubing Material

Manufacturer	Model/Type	Size (mm)	Remarks
Cambridge Brass	202 Series	20 to 50	AWWA C800 Compression Ends
Mueller	B-25209 Series	20 to 50	AWWA C800 Compression Ends

Service Pipe

Manufacturer	Model/Type	Size (mm)	Remarks
Ipex	Q-Line	20 to 25	Requires its own brass.
Ipex	Gold Stripe	25 to 50	Third party certified to NSF 61

Service Boxes Including Chairs and Rods

Manufacturer	Model/Type	Size (mm)	Remarks
Norwood Foundry Trojan Industries	Complete Service Box	20, 25	See Standard Drawings 7-401, 7-402
Norwood Foundry Trojan Industries	Complete Service Box	40, 50	See Standard Drawings 7-401, 7-402

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Appendix 6A - WATER MAIN SPECIFICATIONS

6A.1 Pipe Installation

Installation of pipes and fittings must conform to the following subsections.

6A.1.1 Bedding

For Class B bedding, the sewer pipe will be bedded in compacted granular material, which will have a thickness as shown on Standard Drawing 4-200. The granular material will be compacted to 95% Standard Proctor Density for the full width of the trench up to 300 mm above the crown of the pipe.

6A.1.2 Pipe

The pipe must be protected against impact shocks and free fall during handling and must be kept clean at all times. All pipe to be used for water main distribution must be sealed before leaving the production plant and must remain sealed throughout transportation and storage on site until installed.

Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water by reaming or swabbing with water to the full pipe diameter before installation. Carefully inspect materials for defects. Remove defective materials.

Lay and join pipes to AWWA manual of Practice M-23 and manufacturer's standard instructions. Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

Lubricants are to be potable conforming to NSF 61. Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

Install gaskets to manufacturer's recommendations. Avoid displacing the gasket or contaminating it with dirt or other foreign material. Gaskets so disturbed or contaminated must be removed, cleaned, lubricated and replaced before jointing is attempted again.

Pipes being crossed must be supported as shown in Standard Drawing 4-300. Where a water main must cross below a sewer main, the water main pipe is to be centred on the sewer main, so that the joints are equidistant from the sewer pipe.

6A.1.3 Valves

Valve ends must be provided to fit the pipe. Where flanged valves are used, they must be accompanied by flexible couplings. Stem seals must be o-ring. All bolts and nuts will be stainless steel, type 304, and wrapped in Denso tape or an approved alternate.

Support valves located in valve boxes or valve chambers by means of either concrete or wood blocks, located between the valve and solid ground, with bedding the same as the adjacent pipe. Valves must not be supported by the pipe.

The valve box must be sliding Type A, and must be plumb and centred over the wrench nut of the valve, must be set evenly on the valve bonnet, must be supported so that it does not transmit shock or stress to the valve, and must be braced against lateral movement to the sides of the trench. PVC lower section of valve boxes are acceptable.

The casing will consist of a hood, one or more intermediate sections and a top section with a lid and a suitable stone disc. The top section must be flanged at its lower end and provided with a socket at the ground surface to receive a suitable cast iron lid. An extension stem of sufficient length to reach within 150-300 mm of the top of the casing when casing and extension stem are assembled in place must be provided with each valve.

All valve boxes are to be adjusted such that the top of the valve box is 10-15 mm below the finished design grade at the proposed roadway or flush with any concrete work.

6A.1.4 Hydrants

Set hydrants plumb, with hose outlets parallel with the edge of the roadway or curb line, with pumper connection facing the roadway and with the body flange set at an elevation of 50 mm above final grade or as shown on the Drawings. The hydrant breakaway flange must be installed immediately below the body flange of the hydrant. The inside rod coupling (traffic type) must be located within 50 mm of the breakaway flange. All flanges below ground must be wrapped in Denso or Petroguard Petrolatum tape or an approved alternate, ensuring that drain holes are unobstructed. All bolts and nuts must be stainless steel, type 304, and wrapped in Denso or Petroguard Petrolatum tape, or an approved alternate. See Standard Drawing 6-102.

Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed. To provide proper drainage for each hydrant, excavate a sump pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to a level of 150 mm above the drain holes. Hydrant drain ports must be left open to drain into sumps. Where the water table is above the hydrant drain, the hydrant drain port may require plugging. In these instances, the City must be consulted to determine drain plugging requirements. When the drain port is plugged, the letters "ND" must be painted on the hydrant barrel above the body flange in white letters 50 mm high.

Hydrants must be enamel painted to CAN/CGSB-1.59. City of Lloydminster hydrants are to be all yellow in colour.

6A.1.5 Cathodic Protection

All buried couplings, fittings and valves must be cathodically protected with 2.3 kg zinc anodes and all hydrants must be cathodically protected with a 5.5 kg zinc anode.

Zinc anodes must conform to ASTM B418 Type II and must have the following composition:

- Aluminium 0.005% maximum
- Cadmium 0.003%
- Iron 0.0014%
- Zinc remainder

A certificate of compliance is required from manufacturer stating that the specifications as noted above have been met.

Anodes must be packaged in a permeable cloth bag or cardboard chip type tube containing a backfill mixture. Lead wires must be 2 metres long, connected with cadwelds in accordance with the manufacturer's recommendations. All welds must be covered with Denso or tape or an approved alternate.

A minimum of 2 litres of water is to be poured on each 2.3 kg anode and 3 litres on 5.5 kg anode to initiate the anode operation. An alternative is to soak the anode in water for a minimum of 10 minutes.

6A.1.6 Thrust Blocking

Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated in Standard Drawings 6-300, 6-301, 6-302, and 6-303. Keep joints and couplings free of concrete. Do not backfill over concrete within 24 hours after placing.

6A.1.7 Service Connections

See Section 7 (Service Connections) of the Standard Drawings for service connection installation details. Water service installations must conform to the following:

- Water and sanitary services in a common service trench must have the following minimum horizontal separation, based on the water service diameter:
 - 0.3 m for 50 mm diameter or less;
 - 2.0m for greater than 50 mm to less than 100 mm diameter; and
 - Separate trenches required for services 100 mm diameter or larger.
- Locate water service curb stops as per Standard Drawings 7-101, 7-102 and 7-103.

6A.1.8 Disinfection

The method of disinfection must conform to the latest version of AWWA Standard C651 – Disinfecting Water Mains. The forms of chlorine that are acceptable for use by the City are liquid chlorine, sodium hypochlorite solution and calcium hypochlorite granules or tablets that are NSF/ANSI 60 certified products compliant with AWWA B300, and AWWA B301 for potable water use.

A Disinfection Application, found on the City’s website (www.lloydminster.ca), must be submitted to, and the Developer’s disinfection plan must be approved by, Water Services before disinfection may proceed.

6A.1.9 Hydrostatic Pressure Testing

Hydrostatic pressure testing will follow the procedure outlined in Section 9.7.

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