

SECTION 4: WATER DISTRIBUTION

4.0 INTRODUCTION

This section will cover the design of Water Distribution facilities including, but not limited to, distribution piping, valves, fire fighting facilities, reservoir and pumping facilities.

4.1 GENERAL

The overall design principles described in the Introduction to these standards is the basis on which all construction is undertaken in the City of Prince Albert. These guiding principles are expanded below to provide more specific guidance related to Potable Water Distribution Standards. Often a combination of principles will come into play when designing a component of the system.

The design of water distribution systems must take extreme care with respect to safety. Any threat to the delivery or quality of City of Prince Albert water is unacceptable. The following fundamental factors are to be considered when designing potable water distribution facilities:

- i. Provision of high quality drinking water at all times.
- ii. Minimized interruption in service delivery.
- iii. Provision of adequate fire protection.

Additional safety considerations may be required based on specific conditions.

4.1.1 Level of Service Objectives

Level of service requirements have been defined based on a 2015 Hydraulic Systems Analysis. The City of Prince Albert has adopted this set level of service requirements and as such they will form a basis for these principles of functionality.

The minimum acceptable pressure delivered to each Prince Albert service connection is to be no less than 275 kPa (40 psi) during peak hour demand, and 310 kPa (45 psi) at maximum day demand. The maximum delivered pressure will not exceed 620 kPa (90 psi).

All extensions of the City of Prince Albert water distribution system will be designed and evaluated such that all customers, both existing and new, will not experience any lower level of service.

4.1.2 Applicable Regulations, Guidelines and Resources

The following documentation is the regulations, which have provisions that pertain to water distribution systems:

- *Water Services Bylaw, City of Prince Albert;*
- *Connection Bylaw, City of Prince Albert;*
- *Standard Construction Specifications and Drawings, Roadways, Water, and Sewer, City of Prince Albert;*
- *Water Works Design Standard, Water Security Agency;*

- *National Building Code;*
- *Distribution System Requirements for Fire Protection, (M31), American Water Works Association (AWWA);*
- *Concrete Pressure Pipe, (M9), AWWA;*
- *Steel Water Pipe: A Guide for Design and Installation, (M11), AWWA;*
- *PVC Pipe: Design and Installation, (M23), AWWA; and*
- *PE Pipe: Design and Installation, (M55), AWWA Master Specification.*

Designers are encouraged to contact the Provincial and Federal Governments with regard to regulations which may apply but are not listed here.

4.1.3 Water Distribution Planning Requirements

See Section 2.4.3 for Water Distribution – Development Plan Requirements.

4.1.4 Environmental Considerations

See Section 2.5 for Environmental Considerations.

4.2 DESIGN FLOWS

4.2.1 Hydraulic Network Analysis

In general, a hydraulic network analysis is required for any new development that has not been analyzed previously, or for any development that significantly alters the servicing scheme such as when an existing hydraulic network analysis is no longer applicable.

The developer will submit a report showing that the system will meet level of service requirements at the final development concept and also through interim development stages. A digital plan of the system compatible to the City of Prince Albert Hydraulic Model will be required.

4.2.2 Design Parameters

The following parameters shall be used in the design or evaluation of the water distribution system:

4.2.2.1 Hazen-Williams Coefficient (C)

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| i. Polyvinyl Chloride (PVC) | 140 |
| ii. Asbestos Cement (AC) | 130 |
| iii. Ductile Iron (DI) or Cast Iron (CI) | 80 to 100 |

4.2.2.2 Distribution Main Sizes

The minimum size of Distribution Mains shall be as follows:

- i. Residential = 200 mm diameter
- ii. Industrial = 200 mm diameter

Where two hydrants are to be installed on an unlooped Distribution Main the minimum size of the main shall be 200 mm diameter.

In general, water mains 400 mm and larger will be designated “Trunk Water Mains”.

4.2.2.3 Consumption Rates

Residential per capita consumption rates:

- i. Average Day Demand: 400 litres per capita per day.
- ii. Maximum Day Demand: 715 litres per capita per day.
- iii. Peak Hour Demand: 1070 litres per capita per day.

4.2.2.4 Non-Residential Consumption Rates:

For non-residential developments, the minimum water consumption rate shall be equal to 0.15 litres per second per hectare. The applied peaking factor shall be $PF = 10Q^{-0.45}$ to a maximum of 25 and a minimum of 2.5 where Q is in litres per second. In addition, water demand for large developments should be evaluated based on site specific service requirements as well as fire flow requirements.

4.2.2.5 Design Population

The design population shall be the ultimate population in the area under consideration based on the approved Zoning Bylaw requirements.

4.2.2.6 Fire Flow Requirements

Residential Low Density	60 l/s
Residential Med Density	60 l/s
Residential High Density	120 l/s
Commercial, Local, Highway	120 l/s
Commercial Shopping, Downtown	120 l/s
Industrial Light	180 l/s
Industrial Heavy	180 l/s

The minimum fire flow used for developments larger than a single family (ie: commercial, apartment) should also be in accordance with the fire flow requirements set out by the architect.

4.2.2.7 Pressure

- i. Minimum residual line pressure under maximum day plus fire flow conditions shall be 140 kPa (20 psi) at ground level of any point in the system. Minimum residual line pressure under peak hour flow conditions shall be 275 kPa (40 psi).
- ii. Minor pressure losses through valves and fittings must be accounted for.

4.2.2.8 Velocity

Main line flow velocities should not exceed 1.5 m/s during peak hour flow conditions and 2.5 m/s during maximum day plus fire flow conditions. The design must address low demand conditions which could affect chlorine residuals in the system.

4.3 WATER SYSTEM COMPONENTS

4.3.1 Water Mains

4.3.1.1 Water Main Location

- i. Line assignments for water mains installed in a street or avenue may be found in the City of Prince Albert Construction Specifications.
- ii. A minimum horizontal distance of 1.8 m must be maintained between a water main and any gas main, power cable, telephone cable, duct line or new tree installation.
- iii. Where power cables, telephone cables, television cables, or duct lines cross a water main, they shall be at a minimum distance of 1.0 m from any valve, hydrant or curb stop.
- iv. Where a water main is installed in a utility lot or easement it shall be located on an alignment 1.5 m from a property line.
- v. Where a catch basin is installed at a street intersection, a minimum clearance of 1.5 m shall be maintained from the water main and 3.0 m from water services.
- vi. Water mains must not be designed to be located under significant structures such as retaining walls, planters, etc.

4.3.1.2 Depth

- i. Minimum depth of cover to the top of uninsulated pipe shall be 3.0 m.
- ii. Maximum depth of cover to top of pipe shall be 4.0 m.

4.3.1.3 Sizing

- i. Sizing of water mains will be determined by hydraulic network analysis as set out in Section 4.2 Design Flows.
- ii. The minimum size for water mains will be 200 mm except in cul-de-sacs which do not require hydrants for fire protection. In this case the main will be no smaller than 150 mm and be designed with flushing points to provide adequate flushing velocities.

4.3.1.4 Looping

- i. The number of services allowed at the end of a phase without looping will be 70, provided that they will be looped as per the final build out of the development plan.

- ii. The number of services allowed at the end of a phase without looping on a permanent basis is 35.

4.3.1.5 Dead Ends

Dead ends will be avoided wherever possible. Where looping is not possible, flushing points will be included in the design.

4.3.1.6 Hydrostatic Leakage Testing

All new water mains after backfilling is completed shall be pressure tested before being put into service in accordance with the latest edition of AWWA Standard C651-05 for Test Pressure.

4.3.1.7 Water Main Disinfection

All new water mains shall be disinfected and flushed before being put into service in accordance with the latest edition of AWWA Standard C651 for Disinfecting Water Mains.

4.3.2 Fire Hydrants

Fire Hydrants shall be located:

- i. Minimum of 1.0 m from property line.
- ii. Where structures (i.e. fence, hard landscaping) are erected along property line the offset distance must be a minimum of 1.0 m.
- iii. Where a fire hydrant is installed at a corner of an intersection, it shall be installed at the beginning of the curve of the curb return.
- iv. In cul-de-sacs that are 90 m or less in length, the fire hydrant shall be installed on the intersecting street at or near the intersection of the cul-de-sac. Where the water main in the cul-de-sac is a dead end a flushing point must be included in the design.
- v. Fire hydrant spacing shall be measured along the centerline of the streets.

4.3.3 Residential Hydrant Spacing

- i. The maximum allowable spacing between fire hydrants shall be 180 m.
- ii. The maximum allowable spacing between the back of homes in a cul-de-sac and a hydrant outside of the cul-de-sac shall be 150 m.
- iii. Institutional, Commercial, High Density Residential Hydrant Spacing the maximum spacing between fire hydrants shall be 90 m, or as required by the Public Works Department.

4.3.4 Valves

The location and spacing of valves in the water system should be such that when in operation:

- i. No more than two fire hydrants may be taken out of service by a water main shutdown.
- ii. No more than four valves are required to affect a shutdown.
- iii. No more than 35 single-family lots may be taken out of service by a water main shutdown.

- iv. Valves will be designed at a maximum of 150 m apart on water mains defined as under 400 mm diameter.
- v. Valves will be designed at a maximum of 600 m apart on water transmission mains, defined as 400 mm diameter or larger.
- vi. Mainline valves at intersections of water mains shall be located on the projection of property lines.
- vii. There shall be two valves at each tee and three valves at each cross.
- viii. Hydrant valves shall be installed at a minimum distance of 1.0 m from the water main and 1.0 m from the hydrant.
- ix. There shall be a minimum horizontal separation of 1.5 m between a catch basin lead and a valve. Deflection of a catch basin lead in order to avoid a hydrant lead is acceptable.

4.4 WATER SERVICES

The scope of work as described in this section refers to the portion from the main stop at the distribution main to the curb stop. The curb stop shall be 300 mm from the property line on the City side and greater than 3.0 m from any structure foundation.

New water services will be 25 mm minimum diameter to provide capacity for residential sprinklers.

The Developer must comply with the requirements of the City of Prince Albert Master Specifications, Standard Detail Drawings and the National Plumbing Code.

In general:

- i. Each building shall have separate connection.
- ii. Duplex buildings shall have separate connection to the main.
- iii. Multi-family units shall have shared one service connection connected to the main.

All water services, from property line to main, are to be shown on the service connection note Standard Detail Drawing 00-01-10; 00-01-16 and 00-01-20.

4.4.1 Park Irrigation Services

Connection may be made to the water distribution system for irrigation water as per typical irrigation connection 50 mm Service Standard Detail Drawing 00-01-09.

4.4.2 Private Water Distribution Systems

Water distribution systems must comply with these standards where they service a private development. To protect the quality and safety of water supplied by the City of Prince Albert, these standards apply to any potable water distribution system from the main, in the City right-of-way, to the property line.

4.4.3 Water Main Design Criteria

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| i. | Minimum depth of pipe cover | 3.0 m |
| ii. | Maximum depth of pipe cover | 4.0 m |

- iii. Minimum pipe size of main 200 mm
- iv. Maximum distance between valves 150 m
- v. Maximum distance between hydrants 150 m