

SECTION D WATER DISTRIBUTION SYSTEM

D.1 GENERAL

D.1.1 The Developer and the Developer's Engineer are responsible to ensure that the water system is designed and constructed according to accepted engineering practice. These guidelines are intended as a guide only and shall not be considered as a substitute for a detailed material and construction specification to be prepared by the Developer's Engineer.

D.1.3 Organizations issuing standards:

ASTM – American Society for Testing and Materials

AWWA – American Water Works Association

CSA – Canadian Standards Association

ABC – Alberta Building Code (firewater requirements for new construction)

AFC – Alberta Fire Code (firewater requirements for new construction)

NFPA – National Fire Protection Association

Fire Underwriter's Survey

Alberta Environment Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems

D.2 FLOW REQUIREMENTS

D.2.1 Average Daily Demand	-	320 L/person/day
D.2.2 Population Density (residential)	-	3.5 persons/residence
D.2.3 Maximum Daily Demand	-	2 x Average Demand
D.2.4 Peak Hourly Demand	-	4 x Average Demand
D.2.5 Minimum Residual Water Pressure During Peak Hour Flow	-	280 kPa (40 psi)
D.2.6 Minimum Residual Water Pressure During Maximum Day + Fire Flow	-	140 kPa (20 psi)
D.2.7 Minimum Residual Water Pressure		

During Maximum Day Flow - 350 kPa (50 psi)
(for operation of residential fire sprinklers)

D.2.8 Fire Flow: The County recognizes that due to the nature and limited extent of existing infrastructure and the high cost associated with developing off-site improvements necessary to support required flows of water for fire protection purposes, that the municipality will not provide infrastructure necessary to deliver water flows required for fire protection in non-hamlet areas. Existing residential or industrial developments outside of the hamlet areas that have fire flow rates are to have fire flow rates maintained.

D.2.8.1 Fire flow requirements will be required in the hamlet areas but not areas outside of the hamlets. Fire flow requirements shall be in accordance with the Alberta Building Code, NFPA 1231 Standards and with the Insurer's Advisory Organization Standards, generally these are:

Single Family Residential	3.64 m ³ /min.	(800 igpm)
Town Houses	5.45 m ³ /min.	(1200 igpm)
Walk-up Apartments	9.10 m ³ /min.	(2000 igpm)
Schools	5.45 m ³ /min.	(1200 igpm)
Commercial	11.40 m ³ /min.	(2500 igpm)
Industrial	13.64 m ³ /min.	(3000 igpm)

D.2.8.2 Developers will be required to size any piped water distribution system such that the system can accommodate fire flow volumes if required off-site infrastructure is developed in the future.

D.2.9 If municipal fire protection is required in the development agreement, piped systems shall be designed to meet the fire flow requirements published by the Fire Underwriters Survey for the anticipated type of occupancy. Off-site improvements required by the Developer will be assessed on a case-by-case basis.

D.2.10 Automatic sprinkler protection conforming to NFPA 13 standards is encouraged for all developments if the minimum flow and residual pressure requirements can be met.

D.2.11 Where required by the Alberta Building Code the Developer and the Developer's Engineer will design dedicated self contained fire water storage and delivery systems in accordance with the Code and NFPA 1231 Standards for the building type and occupancy.

D.3 STORAGE REQUIREMENTS

D.3.1 Municipal potable water reservoirs shall be designed and constructed as an underground concrete reservoir and sized to accommodate 2 times maximum day demand when no fire storage is required.

D.3.2 When fire storage is required, potable water reservoirs shall be sized to accommodate the larger of:

D.3.2.1 $S = (A + B + C);$

where S = Total storage requirement (m^3)

A = Fire storage (m^3)

B = Equalization storage = 25% of maximum daily demand (m^3)

C = Emergency storage = min. 15% of average daily demand (m^3)

D.3.2.2 Disinfection contact time storage required to meet Alberta Environment and Water CT requirements; or

D.3.2.3 2 times Maximum Day Demand

D.3.3 All municipal water storage facilities shall be designed with security features acceptable to the County. All fences, doorways and hatches shall be lockable. Access shall be restricted to authorized personnel.

D.4 PIPE SIZING

D.4.1 Sizing of watermains shall be determined by hydraulic network analysis. Results shall be submitted to the Municipal Engineer for approval.

D.4.2 The minimum size for a distribution main shall be 150 mm for residential areas and 200 mm for commercial and industrial areas. Lines must be sized to accommodate the anticipated land use.

D.4.3 Where mains run for 200 m or over without ties to other mains, the minimum pipe size shall be 200 mm.

D.4.4 For lengths of pipe containing two or more hydrant connections without ties to other mains, the minimum pipe size shall be 200 mm.

D.4.5 The maximum velocity under normal operating conditions shall not exceed 3.0 m/s.

- D.4.6** Hazen-Williams “C” value shall be 140 for PVC pipe.
- D.4.7** Analysis shall be made to ensure that there is a minimum residual pressure of 280 kPa (40 psi) under Peak Hour Demand conditions.
- D.4.8** Separate analysis shall be made to ensure that there is a minimum residual pressure of 140 kPa (20 psi) under Maximum Day Demand plus Fire Flow Conditions.

D.5 WATERMAIN ALIGNMENT AND LOCATION

- D.5.1** Watermains shall be located within the road right-of-way and outside the carriageway in accordance with the typical roadway cross section (Section G).
- D.5.2** Watermains shall be located a minimum of 2.5 m o/c from any sewer line, 1.5 m from any catch basin and 1.8 m o/c from any gas line or as required by the utility company. Where power cables, telephone cables, television cables, or duct lines cross a watermain, they shall maintain a minimum distance of 1.0 m from any valve, hydrant or curb stop.
- D.5.3** Public Utility Lot (PUL) widths shall be at least 4.0 m for a single utility and 6.0m for two utilities.
- D.5.4** Water distribution and transmission systems in new subdivisions shall be looped wherever possible. Dead ends will be allowed in residential cul-de-sacs provided that the line is no longer than 120 m. Hydrant or Flush point are to be located near or at dead end.

D.6 REQUIRED DEPTH FOR WATERMAINS

- D.6.1** The watermain shall be installed to provide a minimum cover of 3.0 m from top of curb grade to the top of the pipe, or in lanes, 2.75 m from centerline of the lane to top of pipe.
- D.6.2** The watermain shall have sufficient depth of cover to provide complete frost protection.
- D.6.3** The bottom of hydrant flanges shall be located 50 mm above finished grade. Invert depths at hydrant locations shall be 2.55 m below the top of curb.
- D.6.4** Under normal conditions, watermains shall cross above the sewer with sufficient clearance to allow for proper bedding and structural support of the pipes. Pipe

clearance when passing over any sewer shall be a minimum of 300 mm separation between the top of the sewer pipe and the bottom of the watermain.

D.6.5 Pipe clearance when passing under any sewer shall be a minimum of 500 mm separation between the bottom of the sewer pipe and the top of the watermain. Efforts shall be made to pass over the sewer when possible.

D.7 VALVE LOCATION AND SPACING

D.7.1 The location and spacing of valves should be such that when the system is in operation:

D.7.1.1 No more than two hydrants will be put out of service by a watermain shutdown

D.7.1.2 No more than four valves are required to affect a shutdown

D.7.1.3 No more than 30 lots are out of service due to a watermain shutdown

D.7.2 Valves should be no greater than 800 m apart on lines 450 mm and larger.

D.7.3 Valves shall be located on the projection of the property lines or at the BC of curb returns at intersections.

D.7.4 Valves shall be located at both ends of a main passing through a utility lot or easement and shall be placed 500 mm from the property line.

D.7.5 Flush point valves (min. 50 mm) must be installed at the end of all dead end lines.

D.7.6 Valves shall be the same size as the corresponding main.

D.8 HYDRANT LOCATION AND SPACING

D.8.1 The maximum spacing between hydrants shall be 300 m for residential areas and 150 m for school, industrial or commercial areas.

D.8.2 Hydrants shall be located at the projection of the property lines or at the BC of curb returns at intersections.

D.8.3 For cul-de-sacs less than 75 m in length, the hydrant shall be located at or near the intersection.

- D.8.4** Hydrants shall be located 1.5 m from the curb face when there is no walkway and 2.7 m from the curb face when monolithic curb and gutter sidewalk exists.
- D.8.5** Each hydrant shall be connected to the main with a 150 mm PVC branch controlled by an independent 150 mm gate valve located at least 1.0 m from the hydrant.
- D.8.6** Hydrants within commercial or industrial developments shall be protected by steel bollards. The County may require bollards to protect hydrants within residential subdivisions that may be placed such that they are at particular risk of damage from vehicles.
- D.8.7** Hydrants shall be located at the beginning of the curve of the curb return at the corner of an intersection.
- D.8.8** Hydrants shall be located within all cul-de-sacs which are 90 m or less in length on the intersection street at or near the intersection with the cul-de-sac.
- D.8.9** Hydrants to be shown on site plans, submitted with subdivision application.

D.9 WATER SERVICES

- D.9.1** Separate water service connections shall be provided for each separately titled lot.
- D.9.2** The minimum size of a residential water service shall be 25 mm. Non-residential service connections shall be sized according to anticipated demand.
- D.9.3** Connections for all water services shall be installed at the time of initial subdivision development.
- D.9.4** Curb stops shall be located such that they do not conflict with driveway locations and shall not be placed within concrete sidewalks or driveways.
 - D.9.4.1** A separate service line with metering chamber 1.5 m inside the property line may be required for each lot at the County's discretion. Refer to D.16.2
- D.9.5** The water services shall be installed to the property line. In areas where natural gas distribution facilities require an easement along the front of the property, the service connections shall be extended to the edge of the easement furthest from the roadway.

- D.9.5.1** Residential water services shall be installed in common trench with sanitary sewer and sump pump discharge collection services as depicted on the Detailed Drawings. Class B bedding shall be used. Common trench installation is only permitted for sizes up to 50 mm.
- D.9.6** The minimum allowable distance between main stops shall be 600 mm and the minimum allowable distance between main stops and an adjacent collar or coupling shall be 300 mm. Each residential service connection shall incorporate a horizontal gooseneck and utilize a corporation main stop. Connections shall be staggered radially as required by PVC pipe manufacturers.
- D.9.7** For residential services, the symbol CC shall be stamped in the sidewalk opposite the location of the curb cock.
- D.9.8** Parks may require a water service. The size, type and requirement will be determined by the County Engineer.

D.10 WATER PIPE MATERIALS

D.10.1 General

D.10.1.1 Approved piping material includes:

D.10.1.1.1 AWWA C900 PVC DR 18 or DR 14 (100 mm to 300 mm diameter)

D.10.1.1.2 AWWA C905 PVC DR25 (350 mm to 1200 mm diameter)

D.10.1.1.3 AWWA C906 HDPE DR 11 or DR 17

D.10.1.2 The Developer shall supply and install only new materials. All materials found to be defective or damaged shall be replaced at the cost of the Developer. The pipe shall not be more than two years old at the time of installation.

D.10.1.3 Records of quality control testing performed by the manufacturer shall be made available upon request.

D.10.1.4 Joint lubricants must be certified for potable water use in accordance with National Sanitation Foundation Standards.

D.10.2 PVC

- D.10.2.1** All pipe materials and fabrication shall conform to AWWA C900 or C905, as applicable.
- D.10.2.2** PVC watermain from 100 mm through 300 mm diameter shall be DR18, Class 150 (1035 kPa), cast iron outside diameters with bell and spigot ends. PVC watermain from 450 mm through 900 mm diameter shall be DR25, Class 165 (1138 kPa).
- D.10.2.3** PVC pipe shall be certified under CSA 137.3 and 137.0.
- D.10.2.4** The pipe shall be supplied with integral wall thickened bell ends and jointless elastomeric gaskets conforming to ASTM F477.

D.10.3 Polyethylene

- D.10.3.1** The use of polyethylene pipe requires prior approval by the Municipal Engineer.
- D.10.3.2** All pipe materials and fabrication shall conform to AWWA C901 or C906, as applicable.
- D.10.3.3** Polyethylene pipe shall conform to CSA B137.1 and ASTM F714, D3035, D3350
- D.10.3.4** Watermain shall be HDPE DR17 (Series 100) minimum.
- D.10.3.5** Moulded fittings shall conform to ASTM D2683 or D3261
- D.10.3.6** Fabricated fittings shall be manufactured from pipe of the same series as that used in the piping system.
- D.10.3.7** Pipe shall be joined by thermal butt-fusion, flange assemblies, compression type fittings or electro-fused fittings.
- D.10.3.8** Brass Compression couplings shall be used with stainless steel inserts.
- D.10.3.9** Couplers shall be Victaulic Type 995 for use with HDPE piping or approved equal.
- D.10.3.10** Valves shall be cast iron gates valves with flanged connections.
- D.10.3.11** Each pipe length shall be marked for use with potable water, the manufacturer's name, nominal pipe size, dimension ratio, material grade, manufacturing standard, and a code indicating the date and place of manufacture.

D.10.4 Steel

- D.10.4.1** The use of steel pipe requires prior approval by the Municipal Engineer and shall be used only under special circumstances.
- D.10.4.2** Steel watermain materials and fabrication shall conform to AWWA C200 and ASTM A53. Compliance certificates shall be made available upon request.
- D.10.4.3** The minimum yield strength shall be 207 MPa.
- D.10.4.4** Pipe thickness shall not be less than 6.35 mm.
- D.10.4.5** Pipes shall have bevelled ends for field butt welding.
- D.10.4.6** Fittings shall be standard weight seamless or welded with bevelled ends for butt welding.
- D.10.4.7** Flanges shall be 150 lb. forged ASA type.
- D.10.4.8** Each length of pipe shall be hydrostatically tested by the manufacturer conforming to AWWA C200 and to a test pressure of not less than the determined by the following formula:

$$P = 2 \times S \times t / D$$

- where P = minimum hydrostatic pressure (kPa)
- S = stress in pipe wall during hydrostatic test (kPa), which shall be 0.75 times the specified yield point of the steel used, unless otherwise specified.
- t = wall thickness (mm)
- D = outside diameter (mm)

- D.10.4.9** Each pipe shall be marked with the manufacturer's name and the shipment number.

D.10.5 Concrete, Steel Cylinder Type

- D.10.5.1** The use of concrete pressure pipe requires prior approval by the Municipal Engineer and shall be used only under special circumstances.
- D.10.5.2** Concrete water pipe shall conform to AWWA C301 or C303.
- D.10.5.3** The minimum operating pressure shall be 1035 kPa.
- D.10.5.4** The pipe shall be supplied with bell and spigot ends complete with rubber gaskets.

D.10.5.5 Steel connections shall be lined and coated with cement mortar.

D.10.5.6 Pipe shall be manufactured using sulphate resistant type V cement.

D.11 LININGS AND COATINGS

D.11.1 The application of lining (pipe interior) and coatings (pipe exterior) applies to steel and ductile iron pipe.

D.11.2 Cement mortar lining for use with ductile iron pipe shall conform to AWWA C104.

D.11.3 Epoxy coating and lining for use with steel and ductile iron pipes and fittings shall conform to AWWA C210, C213 or C210 as applicable.

D.11.4 Polyethylene coating for use with steel and ductile iron pipes and fittings shall be Yellow Jacket No.1 extruded polyethylene as supplied by Shaw Pipe Protection Ltd. or approved equal.

D.11.5 Cold applied tape coating for steel and ductile irons specials, joints and repairs shall conform to AWWA C209, C217 or C214 as applicable.

D.11.6 Hyprotec coating for ductile iron pipe shall be as supplied by Canron or approved equivalent and shall be applied by the manufacturer.

D.11.7 Heat shrinkable coatings shall conform to AWWA C216.

D.12 FITTINGS

D.12.1 PVC Fittings

D.12.1.1 Injection moulded fittings shall conform to AWWA C907 and CSA B137.2.

D.12.1.2 Extruded fittings shall conform to AWWA C900 and CSA B137.3

D.12.1.3 Fittings shall be “push-on” type with elastomeric gaskets of pressure actuated seal design and shall be used with PVC or ductile iron pipe.

D.12.2 Steel Fittings

- D.12.2.1** Fittings for PVC, steel and concrete pressure pipe shall conform to AWWA C200 and C208 with a minimum working pressure of 1035 kPa and a yield point strength of 207 MPa.
- D.12.2.2** Slip-on flanges of forged steel shall conform to AWWA C207, Class D and flat faced or weld-neck flanges shall conform to ANSI B16.1, Class 125.
- D.12.2.3** Use stainless steel double threaded studs with two nuts, ASTM A307, Grade B.
- D.12.2.4** Full-faced rubber gaskets shall be used with 1035 kPa working pressure.
- D.12.2.5** Weldolets and threadolets of forged steel shall comply with ASTM A105.
- D.12.2.6** Welding of shop-fabricated fittings shall conform to CSA Z662.
- D.12.2.7** The exterior of all fittings shall be factory coated with an epoxy coating conforming to AWWA C213.
- D.12.2.8** All fittings shall require installation of a zinc sacrificial anode.

D.12.3 Concrete, Steel Cylinder Type Fittings

- D.12.3.1** Fittings shall conform to AWWA C301 or C303 as applicable.
- D.12.3.2** Push-on joints with vulcanized synthetic rubber gasket shall be used.
- D.12.3.3** Cement shall be sulphate-resistant Type V.
- D.12.3.4** Steel connection shall be coated and lined with cement mortar.

D.13 COUPLINGS AND ADAPTORS

- D.13.1** PVC couplings shall conform to AWWA C900, C906, or C907 as applicable.
- D.13.2** Bolted sleeve couplings shall conform to AWWA C219 with ductile iron or carbon steel bodies with epoxy coating conforming to AWWA C213 or AWWA C550 as applicable. Couplings shall have a minimum operating

pressure of 1035 kPa. Linings shall be in accordance with AWWA C210, C213 or C550 and be suitable for use with potable water.

D.13.3 Flange adaptors shall conform to AWWA C219 with ductile iron or carbon steel bodies with epoxy coating conforming to AWWA C210, C213 or C550 as applicable. The minimum operating pressure shall be 1035 kPa. Flanges shall conform to AWWA C207, Class D. Linings shall be in accordance with AWWA C210, C213 or C550 and be suitable for use with potable water.

D.13.4 Couplings for grooved and shouldered joints shall conform to AWWA C606 and shall have operating pressures, coatings and linings as above.

D.14 TAPPING SLEEVES

D.14.1 Tapping sleeves shall conform to AWWA C207, Class D with carbon steel body with fusion bonded epoxy coating or Type 304 stainless steel.

D.14.2 Tapping sleeves for concrete cylinder pipe shall conform to AWWA Manual M-9, body and tapping gland to be fusion epoxy coated to AWWA C213, outlet flange to AWWA C207, Class D.

D.15 PIPE CASING

D.15.1 Steel pipe casings to conform to AWWA C200, minimum tensile strength of 207 MPa.

D.15.2 Inside diameter of casing shall be at least 50 mm larger than the outside diameter of the carrier pipe bell and insulator runners.

D.15.3 Use plastic / polyethylene carrier pipe insulators.

D.16 METERS

D.16.1 The County utilizes sensus meters. All water meters shall conform to AWWA C700, C701 and C710.

D.16.2 Meter chambers may be required at the property line for all properties with a building setback of 150 metres or greater at the county's discretion.

D.16.3 The meter box shall be Mueller/McCullough Thermal-Coil or approved equal.

D.16.4 Chamber shall be 380 mm diameter PVC SDR 35 with a 3 metre bury.

D.16.5 Chamber shall be insulated on the sides with 50 mm polyethylene insulation complete with 1.27 mm thick, high density black polyethylene jacket. The jacket shall be factory installed using the “U.I.P.” system furnished by Urecon Ltd. or approved equal. The top shall be insulated with 100 mm factory supplied insulation.

D.17 VALVES

D.17.1 Valves - General

D.17.1.1 All water valves shall be certified to National Sanitation Foundation (NSF) Standard 61 – Drinking Water System Components: Health Effects and Standard 14 – Plastics and Plumbing System Components.

D.17.1.2 All valves shall be provided with stainless steel bolts.

D.17.1.3 Provide operating nuts located between 2.0 m and 3.0 m below ground surface without rock shields on all valves.

D.17.2 Gate Valves for Buried Service (100 mm – 300 mm)

D.17.2.1 Gate valves shall conform to AWWA C500 for bronze mounted solid wedge valves or C509 for resilient seated valves.

D.17.2.2 Valves shall be an iron body, bronze mounted gate valve with non-rising stem, bell ends, single ring gasket and push-on joints for connecting to pipe with cast iron outside diameter.

D.17.2.3 Provide “O” ring seal for valve stem.

D.17.2.4 Provide 50 mm square operating nut turning clockwise to close.

D.17.2.5 Interior to be factory epoxy coated conforming to AWWA C550. Corrosion protection to be provided by installation of a zinc sacrificial anode.

D.17.2.6 Cast iron valve casing conforming to ASTM A48, Class 25, screw or sliding type with epoxy coating conforming to AWWA C213. Valve casings located within roadways or sidewalks shall be screw type only.

D.17.2.7 For blow offs, valves to be flanged to AWWA C207, Class D.

D.17.3 Gate Valves in Chambers (450 mm – 1500 mm)

D.17.3.1 Must conform to same standards as above, in addition, provide 50 mm square operating nut with hand wheel, horizontal setting, bevel gears, position indicator. Provide by-pass with gate valve to equalize pressure on opening and closing main valve.

D.17.4 Butterfly Valves in Chambers (450 mm and larger)

D.17.4.1 All butterfly valves shall conform to AWWA C504, Class 150B, short body flanged, wafer or fully lugged, cast iron body, rubber seat, bronze disk.

D.17.4.2 Provide removable “O” ring shaft seals.

D.17.4.3 Provide manual geared buried service actuator conforming to AWWA C504.

D.17.4.4 Provide screw type valve casing.

D.17.4.5 Exterior and interior factor applied epoxy coating conforming to AWWA C550. Corrosion protection to be provided by installation of a zinc sacrificial anode.

D.17.5 Check Valves

D.17.5.1 **Swing check valves** shall only be used for sizes 300 mm and smaller conforming to AWWA C508, cast iron body, bronze trimmed cast iron disk, flanged end to ANSI B16.1, bronze seat rings. Minimum 1035 kPa working pressure.

D.17.5.2 **Slanting disc check valves** shall be used for sizes 300 mm and greater, cast iron body ASTM A126, Grade B, flanged ends to ANSI B16.1, ductile iron disk to ASTM A536, bronze seat and disc rings, stainless steel pivot pins and bushing to ASTM T303, valve position indicator. Minimum 1035 kPa working pressure.

D.17.5.3 **Double door check valves** shall have a cast iron body to ASTM A126, aluminium bronze gates to ASTM B148, Grade B, stainless steel spring 316SS, stainless steel stop pin, ANSI 125# flanges, wafer or threaded lug type, Buna N valve seat. Minimum 1035 kPa working pressure.

D.17.5.4 Silent check valves shall be wafer style or globe type, cast iron body to ASTM A126, Grade B, bronze trim, stainless steel spring 316 SS, Buna N valve seat, ANSI 125# flanges. Minimum 1035 kPa working pressure.

D.17.5.5 Rubber flapper check valves shall have a cast iron body, rubber lined Buna N replaceable flapper, “O” ring seating. Minimum 1035 kPa working pressure.

D.17.6 Pressure Reducing Valves

D.17.6.1 Valves 200 mm and smaller shall be of single diaphragm type. Valves 250 mm and larger shall be double diaphragm type.

D.17.6.2 Valves shall be globe style, hydraulically operated, pilot controlled with flanged cast iron body to ANSI B16.1, Class 125. Valves shall have type 304 stainless steel seat and stem.

D.17.7 Flow Control Valves

D.17.7.1 Valves shall be diaphragm type, globe or angle style with cast iron body and bronze trim.

D.17.7.2 Provide an “O” ring seat seal on main valve and strainer and needle valve on pilot inlet lines.

D.17.8 Air Valves

D.17.8.1 All air valves shall conform to AWWA C512 with cast iron body and stainless steel float. Minimum working pressure shall be 1035 kPa.

D.18 HYDRANTS

D.18.1 All hydrants shall be either Canada Valve or Macavity model hydrants unless otherwise approved by the Municipal Engineer.

D.18.2 All hydrants shall be certified to NSF Standard 61 – Drinking Water System Components: Health Effects and Standard 14 – Plastics and Plumbing System Components.

D.18.3 Compression type hydrants shall be supplied conforming to AWWA C502 for dry barrel fire hydrants.

- D.18.4** Hydrant shall be designed for 1035 kPa working pressure.
- D.18.5** Hydrants shall be self-draining and a gravel drainage pit shall be provided on each hydrant lead. Where the hydrant lead is located below the water table, the hydrant drain port shall be plugged. The County shall be notified of any hydrants with plugged drain ports prior to construction. The record drawings shall clearly indicate each plugged hydrant.
- D.18.6** Hydrants shall have one pumper connection, 146 mm outside diameter, and two hose connections (63.5 mm) with Alberta Mutual Aid thread at least 415 mm above the ground flange. Nipples shall be provided with caps without chains or cables. The hose and pumper caps and hydrant valve shall open counter-clockwise.
- D.18.7** Hydrants shall consist of a minimum 2.45 m barrel with 300 mm extension.
- D.18.8** Hydrants shall have a 150 mm cast iron outside diameter inlet elbow with bell end and harnessing lugs. Elbow shall be flanged to the barrel.
- D.18.9** Valve stem in hydrant head to have “O” ring seals.
- D.18.10** Operating nut shall be three sided, each side being a 36.5 mm long arc.
- D.18.11** Hydrants shall have stainless steel bolt assemblies throughout.
- D.18.12** A 150 mm gate valve shall be provided on each hydrant lead.
- D.18.13** External paint shall conform to AWWA C550 – corrosion resistant – lime green/yellow as approved by County of Vermilion River.

D.19 SERVICE CONNECTIONS

- D.19.1** Water service pipe shall be Type K Copper conforming to AWWA C800, Blue Kitec Water Service Tubing (200 psi rating) conforming to CSA B137.1 or Series 160 Polyethylene tubing conforming to AWWA C901 and CSA B137.1
- D.19.2** Minimum service size shall be 25 mm for main stops, piping and curb cocks where the service length is 30 m or less. Where service lengths exceed 30 m, the minimum service size shall be 38 mm.
- D.19.3** For water services 100 mm and larger, match pipe, fittings and valves to main pipe materials.

- D.19.4** Provide corporation main stops, service saddles, curb cocks, service boxes and couplings according to the industry standard. Compression connections with stainless steel inserts are required for all materials.
- D.19.5** All fittings shall be designed for and operating pressure of 1035 kPa.
- D.19.6** Water service saddles shall be stainless steel type 304, bronze or a combination. Bronze components shall conform to ASTM B62. Single or double band design.
- D.19.7** Service saddles for use on polyethylene pipe shall be Romac type 101, 202, 305 or 306 series, Robar 2706 or approved equal for use on polyethylene pipe.
- D.19.8** Operating rods shall be Type 304 stainless steel with brass cotter pins.
- D.19.9** Water service lines may be laid in the same trench as sewer service lines.
- D.19.10** Curb cocks shall be marked with a red 50 mm by 50 mm by 1.50 m marker projecting 0.60 m above finished ground elevation. Curb cock boxes shall be installed in collapsed position unless directed otherwise by the Town Engineer. Curb stops shall be placed 0.3 m (1 foot) from the property line within the public right of way.

D.20 CATHODIC PROTECTION

- D.20.1** Cathodic protection shall be provided for all steel and ductile iron pipe, cast iron fittings, valves and hydrants.
- D.20.2** Magnesium and zinc anodes shall conform to the industry standard.

D.21 TRENCHING, BEDDING AND BACKFILLING

- D.21.1** All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.
- D.21.2** If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the design drawings or as a brief report to the Municipal Engineer prior to construction.
- D.21.3** Class “B” pipe bedding shall be utilized in suitable soil conditions. Washed rock shall be used if water table is above the pipe zone. Bedding sand shall have minimum depth of 100 mm below the pipe, shall extend up both sides to

the trench wall and provide a minimum cover of 300 mm above the pipe. The Developer's Engineer shall identify special pipe foundation measures for areas where unsuitable pipe foundation conditions exist.

- D.21.4** The minimum trench width measured at the pipe springline shall be the pipe outside diameter plus 450 mm. The maximum trench measured at the pipe springline shall be the pipe outside diameter plus 600 mm. The Municipal Engineer must be notified if the trench must be excavated deeper or wider than specified.
- D.21.5** Excavated material shall be stockpiled at a safe distance from the edge of the trench.
- D.21.6** The Developer's Engineer shall identify areas where the trench excavation requires sheathing, shoring or bracing in order to protect workers, property or adjacent structures.
- D.21.7** Trench excavations shall be kept free of water.
- D.21.8** It shall be the Developer's responsibility to ensure that the utility trenches are adequately compacted.
 - D.21.8.1** Native backfill under existing or proposed roads or laneways shall be compacted throughout the entire right-of-way width to:
 - D.21.8.1.1** 98% standard proctor density from subgrade to 1.5 m below subgrade or original ground, whichever is lower;
 - D.21.8.1.2** 95% standard proctor density greater than 1.5 m from the subgrade or original ground, whichever is lower;
 - D.21.8.2** Granular backfill under existing or proposed roads or laneways shall be compacted to 95% of standard proctor density throughout the entire trench depth below subgrade and the entire right-of-way width.
 - D.21.8.3** Backfill in all other areas shall be compacted to 95% standard proctor density.
 - D.21.8.4** Subgrade and base course compaction for roadway construction shall be as specified in Section G.
 - D.21.8.5** If the above standards cannot be achieved due to a large variation in soil types throughout the development, the Municipal Engineer may at

his sole discretion, establish a more appropriate standard on an individual case basis. One-mould proctor density testing may be permitted if the Developer submits an acceptable proposal prepared by the Developer's Engineer, justifying the required changes to the compaction standards.

- D.21.9** If the minimum compaction standards cannot be met due to abnormal weather or wet ground conditions, the Municipal Engineer may establish a more suitable standard on a site-specific basis provided adequate justification is presented by the Developer. One-mould proctor density testing will not be permitted as an alternate testing procedure due to wet soil conditions. The Developer's engineer will be required to suggest appropriate measures such as drying in-situ material or importing suitable material in order to meet the required Standard Proctor Densities.
- D.21.10** All landscaping, pavement structures, sidewalks, curb and gutter damaged or removed during trenching shall be restored or replaced unless otherwise directed by the Municipal Engineer.
- D.21.11** All debris, surplus fill and unused materials must be removed from the site.

D.22 WATERMAIN INSTALLATION

- D.22.1** The pipe and gasket installation shall be conducted in compliance with the pipe manufacturer's specifications.
- D.22.2** Installation of PVC pipe and fittings shall conform to AWWA M23.
- D.22.3** Installation of cast iron fittings shall conform to AWWA C600.
- D.22.4** Field welding procedures shall be in accordance with CSA Z662. Welders shall be qualified as B pressure welders.
- D.22.5** Align pipes carefully when jointing. Keep joints free of mud, gravel and foreign material and ensure that the joint is complete as outlined in the manufacturer's specifications. Complete each joint before laying the next length of pipe. Deflections shall not exceed those permitted by the manufacturer.
- D.22.6** The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete.

- D.22.7** The alignment of pipes less than 900 mm in diameter shall not be more than 150 mm off the designated alignment. The alignment for pipes larger than 900 mm shall not deviate by more than 50 mm per 300 mm of diameter.
- D.22.8** The invert of the pipe shall not deviate from the design grade by more than 40 mm.

D.23 OPERATION OF BOUNDARY VALVES & EXISTING HYDRANTS

- D.23.1** County representatives shall be notified at least 48 hours (two full business days) in advance of valve operation requirements. County personnel shall operate the boundary valves.
- D.23.2** The Developer shall obtain permission for using a hydrant as a water source for construction. Arrangements for payment for water used may be required. County representatives may outline conditions of use depending on the circumstances.

D.24 VALVE INSTALLATION

- D.24.1** Valves, valve casings and fittings shall be installed in accordance with the manufacturer's specifications.
- D.24.2** All valves shall be installed with a concrete thrust block.
- D.24.3** Valve casings shall be between 5 – 15 mm below grade for unpaved areas and at grade for paved surfaces and sidewalks.
- D.24.4** Upon completion, all valve casings must be checked to ensure that they are plumb and that the operating nut can be turned properly.

D.25 HYDRANT INSTALLATION

- D.25.1** Hydrants shall be installed in accordance with the manufacturer's specifications and AWWA M17.
- D.25.2** All hydrants shall be installed with a concrete thrust block.
- D.25.3** A gravel drain shall be provided at the base of the hydrant barrel consisting of a minimum of 1.0 m³ of washed rock.

- D.25.4** Hydrant drain ports shall be left open except where the water table is above the hydrant drain. The County shall be notified of hydrants with plugged drain ports.
- D.25.5** Upon completion, all hydrants must be checked to ensure that they are plumb and that the operating nut is functioning properly.

D.26 SERVICE INSTALLATION

- D.26.1** Residential water services shall be installed in common trench with the sanitary and storm sewer services. Double services may be in a common trench to the property line.
- D.26.2** Tapping for residential service connections shall be done with full operating pressure in the main. The tap shall be made within 30° of the pipe crown and goose-necked to service trench level. The service line shall be supported by sand bags until it reaches trench level.
- D.26.3** A tapping valve and sleeve must be used for services 100 mm and larger.
- D.26.4** Curb stops shall be installed 300 mm from the property line.
- D.26.5** Services crossing existing roadways and/or sidewalks shall be augered, bored or tunnelled unless otherwise approved by the Municipal Engineer.
- D.26.6** When placing the hot water service, it will always be on the right of the sanitary service.

D.27 INSPECTION AND TESTING

D.27.1 Inspections

All water installations shall be subject to inspections by the Municipal Engineer prior to issuance of the Construction Completion Certificate (C.C.C.) and Final Acceptance Certificate (F.A.C.).

D.27.2 Compaction Testing

The developer's Engineer is required to submit all compaction test results to the County for review prior to the issuance of the Construction Completion Certificate (C.C.C.).

D.27.3 Pressure Testing

- D.27.3.1** The entire system shall be subjected to a hydrostatic pressure test in the presence of the Municipal Engineer. The Developer is responsible for the supply of all necessary labour, materials and equipment to complete the testing. The Developer shall notify the County at least 48 hours (two full business days) in advance of the testing.
- D.27.3.2** Select acceptable test sections in consultation with the Municipal Engineer. The maximum length of distribution main test sections shall be 450 m. The maximum length of transmission main sections shall be 800 m.
- D.27.3.3** The test section shall be filled with water 24 hours prior to the test. All thrust blocks must be cured and backfill partially or completely done.
- D.27.3.4** Ensure that all main valves and hydrant isolation valves in the test section are open and that the hydrants are closed.
- D.27.3.5** Ensure that all air is expelled from the section using hydrants and service taps and high points and dead-ends and raise the watermain pressure to the test pressure. The test pressure shall be 150% of the working pressure measured at the lowest elevation or 1035 kPa whichever is greater.
- D.27.3.6** Note the pressure and water level at the beginning of the test. The test duration shall be 2 hours. The pressure shall be maintained within 20 kPa of the specified test pressure throughout the test.
- D.27.3.7** Measure the water level at the end of the test and calculate the observed leakage. Compare against the allowable leakage calculated as follows:

$$L = \frac{NDP^{1/2}}{128,225} \quad \text{for PVC pipe}$$

$$L = \frac{NDP^{1/2}}{32,046} \quad \text{for Ductile Iron Pipe}$$

where L = allowable leakage, L/hr
N = total number of joints
D = nominal pipe diameter, mm

P = test pressure, kPa

D.27.4 HDPE Pressure Testing

- D.27.4.1 Before acceptance of any high density polyethylene pipe water system, the entire system shall be subjected to hydrostatic pressure test in the presence of the County Engineer. The Developer shall provide all the necessary labour, materials and equipment for the test including a suitable pump, measuring tank, pressure hoses, connection, plugs, caps, gauges and all other apparatus necessary for filling the main, pumping to the required test pressure and recording the pressure and expansion-leakage loss.
- D.27.4.2 Expel air from collection system by slowly filling the main with water. High points must have automatic air/vacuum relief valves to vent air when filling and be closed when pressure is applied.
- D.27.4.3 A hydrostatic test pressure of 1.5 times the rated pressure of the pipe at the lowest point in the system main shall be applied.
- D.27.4.4 Pressurized pipe to require test pressure over a 3 hour period and hold required test pressure for an additional hour to allow for pipe expansion and stretching prior to the leakage test.
- D.27.4.5 Test period shall be for a 2 hour duration. Amount of make up water (leakage) required to return the pipe to required test pressure shall not exceed the allowance given in the following table.

Field Testing of HDPE Water line Systems

Nominal Pipe Size	Allowance for Expansion
mm	(liters/100m of pipe)
	2-Hour Test
50	1.6
75	1.9
100	3.1
150	7.5
200	12.5
250	16.2
300	28.7
350	33.7

400	41.1
450	53.6

D.27.4.6 Total time under test pressure must not exceed 8 hours. If test is not accepted due to leakage or equipment failure, test selection must be permitted to “relax” for 8 hour period prior to the next testing sequence.

D.27.4.7 Prior to the start pressure and leakage, chlorination and bacteria testing, the Developer’s Engineer will be required to provide a plan outlining how the testing is to be accomplished. The plan must include the sequence of valve turning, sections of water main to undergo pressure and leakage testing, how chlorination is to be accomplished, and location when chlorine residual and bacteria tests are to be taken. Testing will not be allowed to proceed until the above is approved by the Municipal Engineer.

D.27.5 Disinfection

D.27.4.1 Water mains are to be flushed and disinfected in accordance with AWWA C651 continuous feed method.

D.27.4.2 Chlorine residual tests shall be performed at the beginning and end of the disinfection and again after flushing the lines.

D.27.4.3 Approximately 16 hours after flushing the chlorine, one bacteriological sample for each 90 metres of main shall be taken and submitted for analysis unless otherwise approved by the Municipal Engineer. Where dead ends exist, samples shall be taken at the end of the line. Approved bacteriological sample bottles from the Provincial Laboratory of Public Health or the local Health Unit must be used.

D.27.4.4 The mains shall not be commissioned and put into use until the bacteriological sample results are approved by the Municipal Engineer.

D.27.4.5 Under Alberta Environment Protection Standards and Regulations, super chlorinated water used for disinfection of the system cannot be directed into a ditch drainage system or open water body. De-chlorination will be required before being discharged into the environment.

D.28 Hydrants

- D.28.1** At least one hydrant flow test shall be conducted by the Developer in order to ensure that the flows and pressures identified in the design calculations are being provided in the field. If discrepancies are found, all hydrants in the development shall be tested and the Developer's Engineer shall indicate the corrective action that the Developer must undertake to remedy the deficiency.

D.29 SUMMARY OF WATER DISTRIBUTION SYSTEM STANDARDS

The following is a list of standards applicable to water distribution system materials and construction. In all cases, it is intended that the latest version apply.

Standard	Title
CSA B137.1	Polyethylene Pipe, Tubing, and Fittings for Cold Water Pressure Services
CSA B137.2	PVC Injection-Moulded Gasketed Fittings for Pressure Applications
CSA B137.3	Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications
CSA A23.1 and A23.2	Concrete Specifications
AWWA C104	Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C111	Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C150	Standard for Thickness Design of Ductile-Iron Pipe
AWWA C151	Standard for Ductile-Iron Pipe, Centrifugally Cast for Water
AWWA C200	Steel Water Pipe – 6 In. (150 mm) and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 In. (100 mm) and Larger – Shop Applied
AWWA 213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

AWWA C500	Metal-Seated Gate Valves for Water Supply Services
AWWA C502	Dry-Barrel Fire Hydrants
AWWA C504	Rubber-Seated Butterfly Valves
AWWA C509	Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
AWWA C651	Disinfecting Water Mains
AWWA C800	Underground Service Line Valves and Fitting
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. for Water Distribution
AWWA C905	Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
AWWA C907	Polyvinyl Chloride (PVC) Pressure Fittings for Water – 4 In. Through 8 In. (100 mm through 200 mm)
ASTM A48	Gray Iron Castings
ASTM D698	Moisture-Density Relation of Soils and Soil-Aggregate Mixtures
	Standard Proctor Maximum Density

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