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**6.01 Community Water Supply**

Capacity of the City of Parksville waterworks system will be assessed with respect to the domestic and fire flow demands of the proposed land development proposal. The City’s most current Water Master Plan shall be used as a reference in the design of individual water networks. The City will conduct a modelling analysis using the City’s network model at the expense of the developer.

Water main design shall conform to the requirements of the Provincial Ministry of Health and to the specifications of this manual. The system shall provide adequate flow and pressure for fire protection and for domestic demand. The flow that will govern the water main design will be calculated as the sum of the maximum day domestic flow and the required fire flow.

**6.02 Per Capita Demand**

|                             |                        |
|-----------------------------|------------------------|
| Average daily domestic flow | 518 litres/capita/day  |
| Maximum daily domestic flow | 1319 litres/capita/day |
| Peak hour domestic flow     | 1910 litres/capita/day |

In the absence of detailed design population information, the following minimum design population densities shall be used.

| Areas                            | Population Density                            |
|----------------------------------|---|
| Single Family Dwelling           | 2.2 ppu* or 28 ppha**                         |
| Multiple Family Dwellings        | 1.3 ppu or 37 ppha                            |
| Industrial (or equivalent of)    | 36 ppha                                       |
| Commercial (or equivalent of)    | 90 ppha (including parking)                   |
| Institutional (or equivalent of) | 50 ppha (including park, but not green space) |

\* ppu = person per unit

\*\* ppha = person per hectare

Design computations shall be based on the Hazen-Williams formula.

$$Q = \frac{C D^{2.63} S^{0.54}}{278,780}$$

- where Q = rate of flow in litres per second
- D = internal pipe diameter in millimetres
- S = slope of hydraulic grade line in m/m
- C = roughness coefficient (125 for all mains)

**6.03 Fire Flow**

Fire flow shall be in accordance with the criteria outlined in the most recent edition of "Water Supply for Public Fire Protection", published by the Fire Underwriters Survey.

However, the following minimum fire flows shall be met for the noted zones.

| <u>Zone</u>               | <u>Required Fire Flow</u> |
|---------------------------|---------------------------|
| Single Family Residential | 75 litres/second          |
| Multi Family Residential  | 150 litres/second         |
| Commercial                | 250 litres/second         |
| Resort / Recreational     | 250 litres/second         |
| Institutional             | 250 litres/second         |
| Industrial                | 200 litres/second         |

or as specified by the Fire Underwriters Survey calculations.

**6.04 Water Pressure/Velocity**

|  |                       |
|--|-----------------------|
| Minimum pressure at peak hour demand       | 275 kilopascals       |
| Maximum allowable pressure                 | 1030 kilopascals      |
| Minimum fire hydrant pressure (residual)   | 140 kilopascals       |
| Maximum velocity (max. day plus fire flow) | 3.0 metres per second |

**6.05 Hydraulic Network Considerations**

- a) Where development will be serviced by the existing water system, the City will conduct a hydraulic analysis using the City's network model, at the expense of the Applicant. The analysis will review system flows, pressures and velocities for conformance to City specifications and guidelines.
- b) The maximum length of any permanent non-interconnected water main shall be 150 metres. All mains exceeding 150 metres shall be looped, except with the approval of the City Engineer.
- c) In residential areas, water mains servicing fire hydrants shall be 150 millimetres diameter or larger.

In commercial, industrial and institutional areas, the minimum water main diameter shall be 200 millimetres.

**6.06 Minimum Depth of Cover**

The minimum cover over any water main shall be 1.2 metres.

**6.07 Minimum/Maximum Grade**

The minimum grade for a main shall be 0.1 percent. The maximum grade shall be 8.0 percent unless provisions are made to anchor the pipe to the bottom of the trench with concrete anchor blocks.

**6.08 Minimum Clearance**

If a minimum clear vertical separation of 0.5 metre can't be established at a storm/sanitary sewer crossing, then the water main is to be fully concrete encased or wrapped with petrolatum tape at all joints within three metres of either side of the crossover point.

All water mains shall be installed at a minimum clear horizontal distance of 3.0 metres from any adjacent storm drain or sanitary sewer. If the minimum horizontal clearance cannot be maintained then the water main shall be protected to the satisfaction of the Regional Public Health Engineer.

There shall be a minimum vertical clearance of 75 millimetres if the water main crosses underground conduit other than storm drain, sanitary sewer or conductors.

**6.09 Valving**

Specifications for valves are as follows.

- a) In general, valves shall be located in road intersections, in a cluster at the intersection of pipes, or at the projected property lines to avoid conflicts with curbs and sidewalks.
- b) So that specific sections of mains may be isolated, install
  - i) three valves at 'X' intersections
  - ii) two valves at 'T' intersections.
- c) Not more than one hydrant shall be isolated.
- d) Spacing shall be not more than 150 metres.
- e) Valves shall, in all instances, be the same diameter as the water main.

Bypasses at least 50 millimetres in diameter shall be provided on all gate valves 350 millimetres and larger. Bypass valves shall be gate valve style with a standard size square operating nut.

### 6.10 Hydrants

Fire hydrants shall be located, in general, at street intersections. Hydrant spacing shall be a maximum 150 metres in low/medium density residential areas.

In high density residential, commercial and industrial areas, hydrants shall be spaced at a maximum of 75 metres in order that each lot can be serviced by a minimum of two hydrants.

In mid-block locations, fire hydrants shall be located at the property lines. It shall be the Consultant's responsibility to ensure the design and proposed locations of the fire hydrants will not conflict with existing or proposed street lights, power poles, fences, etc. A three (3) metre minimum distance free of obstructions shall be maintained around the fire hydrant.

The centre of any hose outlet shall not be less than 575 millimetres above final grade.

Pumper ports (100 millimetres) are required on all hydrants complete with a quick connect Storz connection.

### 6.11 Air Valves

Air release valves shall be installed at the summit of all mains 200 millimetres in diameter and larger, except where the difference in grade between the summit and valley is less than 600 millimetres.

Designs shall minimize high points where air release is required.

### 6.12 Flushouts

Flushouts are required at the ends of all water mains. A hydrant can be a substitute for a flushout.

### 6.13 Joint Restraints and Thrust Blocks

Mechanical joint restraints shall be provided for all fittings requiring thrust restraint. The Consultant shall show calculations and the number of joint restraints required to resist the thrust at the fittings. Where approved by the Engineer, the Consultant's design may utilize concrete thrust blocks. Thrust block design calculations and soil bearing pressures must be shown on the design drawings.

Concrete used for thrust blocks shall have a minimum 20 MPa compressive strength.

**6.14 Chamber Drainage**

Chambers or manholes containing valves, meters or backflow prevention devices (see Drawing W14) shall be provided with a 100 millimetre gravity drain service to the nearest storm sewer, complete with a P-trap to restrict gas entry. If it is determined that a gravity service cannot be installed, then an alternative shallow chamber design will be required. This design shall be provided by the Consultant for consideration by the City Engineer.

**6.15 Service Connections**

Minimum 25 millimetre diameter Type K annealed copper service connections to ASTM B88M are required for all lots, except in corrosive soils in which case the connections shall be 38 millimetre polyethylene pipe to AWWA C901-08 complete with tracer wire. For single family residential lots, these connections shall typically be located in accordance with the standard drawings.

Traffic islands with planting areas shall be provided with a service connection, complete with a double check valve assembly approved by the City Engineer.

A corporation stop shall be installed for each connection 50 millimetre diameter in size or smaller.

Fire line services shall be constructed in accordance with the standard drawings.

**6.16 Water Location/Corridors**

Where a right-of-way over a waterline is required, the minimum acceptable width is four metres.

Water Construction

Section 6

**6.17 Scope**

- 6.17.1 This specification governs the installation of water pipe and waterworks appurtenances within the City.
- 6.17.2 Water services shall include that portion of the installation from, and including, the corporation stop, up to the property line, and including the water meter.

**6.18 General**

- 6.18.1 Newly constructed mains will not be connected to existing mains until such time as the new main has been fully tested, chlorinated and flushed, and test results submitted to and approved by the City Engineer.
- 6.18.2 The installation, including excavation, jointing and backfill of all water pipes shall be in accordance with the current AWWA Standards.
- 6.18.3 Testing of the soil adjacent to the proposed water main alignment shall be conducted for all new or replacement mains during design stage by a geotechnical engineer. Soil analysis shall be conducted in accordance with a standardized evaluation procedure. A copy of the corrosion analysis report and recommendations shall be provided to the City. The main and appurtenances shall be of a suitable material and thickness, or supplemented by a corrosion mitigation technique to ensure at least 50 years of service prior to a leak or failure. If ductile iron pipe is installed then an approved means of conductance for each joint is required.
- 6.18.4 Water services shall be installed in accordance with the standard drawings and shall conform to these specifications.
- 6.18.5 Every reasonable precaution must be taken during construction of the works to prevent contamination of pipe and fittings.
- 6.18.6 When the water main is under construction in a trench, water and debris shall be prevented from entering openings in the pipe by keeping the excavation dewatered and by capping or plugging openings with water-tight fittings.
- 6.18.7 The water service shall be one continuous piece between the corporation stop and curb stop.
- 6.18.8 Control of all existing valves shall rest with the City. Existing hydrants shall be opened or closed only under the authority of a Hydrant Use Permit.



- 6.18.9 For 100 millimetre diameter pipe, 25 millimetre services shall be tapped a minimum 600 millimetres apart (and 600 millimetres from a collar), and rotated a minimum 100 millimetres on the circumference of the pipe. Taps into pipes greater than 100 millimetres in diameter shall be 1.25 metres apart. The minimum distance of tapping from a pipe end or joint shall be 1.0 metre, or 2.0 metres from a pipe end equipped with a flushout.
- 6.18.10 Where new mains pass under existing asbestos cement (AC) mains, the existing piping must be removed 600 millimetres past the trench wall on both sides and replaced with PVC piping complete with approved couplers.
- 6.18.11 Where tee and cross connections are to be made in asbestos cement (AC) mains, the AC mains shall be replaced with PVC pipe one metre either side of the tee or cross and repaired with approved couplings.

**6.19 Alignment and Grade**

- 6.19.1 The main and appurtenances shall be installed within the tolerance described in Section 6.19.3 of the location specified on the plan approved by the City Engineer.
- 6.19.2 Water services shall be installed perpendicular to the water main. If this can't be achieved, the last metre of service line shall run parallel to the side lot line to allow for proper alignment of the meter box in relation to the property.
- 6.19.3 All pipe shall be laid to designed alignment and grade, with the following tolerances:
  - a) Horizontal tolerances shall be less than 60 millimetres from the designed location. The rate of deviation from the required alignment shall be less than 30 millimetres in 7.5 metres.
  - b) Vertical tolerances shall be less than 50 millimetres from designed grades on 200 millimetre and larger water mains.

**6.20 Excavation**

- 6.20.1 Blasting can proceed only with the permission of the City Engineer.
- 6.20.2 If the pipe is not located under pavement, sidewalk, driveway or gravel shoulder, all topsoil to a maximum depth of 300 millimetres shall be removed and stockpiled for replacement.
- 6.20.3 The trench shall be excavated to the required alignment, width, depth and grade as shown on the standard drawing. When trenching along or across a paved surface, pavement shall first be saw cut in straight lines parallel to the trench centerline. The total width of cut pavement shall not be greater than the specified maximum trench width at the ground surface shown on the drawings. Where, in the opinion of the City

Engineer, existing pavement is in such poor condition that a saw cut is not warranted, pavement may be cut with trenching equipment.

- 6.20.4 Where trenches are excavated on the traveled portion of a road, all excavated matter shall be removed from the site, except in cases where approval is recommended by the geotechnical engineer and given by the Works Inspector for the use of this material as backfill. The Contractor shall ensure that existing asphalt surfaces are not scarred by track equipment. Should damage to the pavement occur the Contractor will take full responsibility for the cost of providing a pavement overlay to the satisfaction of the City Engineer.
- 6.20.5 The clear width of trench at the top of the pipe shall be no greater than that specified on the standard drawing. Where this is exceeded, the Consultant shall obtain approval of the City Engineer before further construction continues.
- 6.20.6 If, in the opinion of the City Engineer, trench width exceeds the maximum allowable for pipe support, the Contractor shall provide a higher class of bedding, a pipe with a higher strength class or concrete encasement.
- 6.20.7 If the bottom of the trench is organic or other unsuitable material, the trench shall be excavated to firm ground, or other remedial measures shall be taken as required by the Consultant, subject to the approval of the City Engineer.
- 6.20.8 Any excavation carried out below the pipe invert shall be backfilled with pit-run gravel or crushed rock and granular pipe bedding per these Standards and Specifications. These materials shall be compacted with approved mechanical compactors in a maximum of 150 millimetre lifts. The trench bottom shall be firm and capable of supporting the pipe to be installed.
- 6.20.9 All water, soft silt or disturbed material shall be removed from the bottom of the trench prior to placement of bedding.
- 6.20.10 All solid rock boulders and large stones shall be removed to provide a minimum clearance of 150 millimetres around the pipe. When the end of the service connection is in solid rock, the rock must be blasted 3.0 metres past the end of the connection.
- 6.20.11 Where an existing structure or underground installation may be affected by the works, it is the responsibility of the Consultant to inform the owner of the potential impact of the works in advance of construction so that the owner can specify protective measures for the structure or installation.
- 6.20.12 Where an unforeseen obstruction is encountered that interferes with the designed alignment, the Consultant shall stop construction and not proceed until such time as revised design is approved by the City Engineer.

**6.21 Bedding**

6.21.1 Bedding shall be well graded. Bedding material shall be granular in nature, free of organics, silt and clay, and shall conform to the following gradation limits when tested in accordance with ASTM C136.

| Sieve Designation | Gradation Limits<br>(Percent by Weight Passing) |          |
|-------------------|---|----------|
|                   | Type 1*   | Type 2** |
| 19.0 millimetres  | 100   | 90 – 100 |
| 12.5 millimetres  |   | 65 – 85  |
| 9.5 millimetres   | 85 – 100  | 50 – 75  |
| 4.75 millimetres  | 70 – 100  | 25 – 50  |
| 2.36 millimetres  |   | 10 – 35  |
| 1.18 millimetres  | 20 – 65   |          |
| 0.850 millimetres |   | 5 - 20   |
| 0.600 millimetres | 0 – 45  |          |
| 0.425 millimetres |   | 0 - 15   |
|                   |   | 0 – 8    |
| 0.150 millimetres | 0 – 10  |          |
| 0.075 millimetres | 0 – 5   | 0 - 5    |

6.21.2 Type 1 is the standard bedding type and shall be used for dry trench conditions. Type 2 shall be used for wet trench conditions as determined by the City Engineer or Consultant prior to use. If there is a potential for migration of soils from trench walls, filter fabric may be required.

6.21.3 Bedding installation shall be in accordance with the standard drawing. Bedding material shall be compacted to a minimum 95 percent Modified Proctor Density in compliance with ASTM D1557.

6.21.4 Bedding shall be compacted in equal lifts not exceeding 150 millimetres and under the pipe by means of a hand tamping bar.

6.21.5 Field compaction tests of pipe bedding will be conducted a minimum of once per day. All compaction tests are to be submitted to the Consultant and to the City Engineer for review.

6.21.6 Alternate bedding materials may be proposed for use only where approved by a geotechnical engineer. Alternate material will require approval by the City Engineer (subject to sieve analysis at the cost of the proponent).

## 6.22 Materials

### 6.22.1 Ductile Iron Pipe

All ductile iron pipe shall conform to AWWA C150 and AWWA C151 complete with a standard cement mortar lining to AWWA C104. A cathodic protection system shall be provided where warranted by soil conditions.

Unless otherwise specified, the pipe shall have a minimum pressure class as follows.

75 millimetres through 300 millimetres diameter - Pressure Class 350  
350 millimetres through 450 millimetres diameter - Pressure Class 250

Note: All pipe shall bear the underwriter's label.

Joints shall be single rubber gasket for push-on bell and spigot, Tyton type joint and/or mechanical pipe joints to AWWA C111.

### 6.22.2 Polyvinyl Chloride (PVC) Pressure Pipe

Pipe shall be manufactured to specifications for pipe size ranges as follows.

- Pipes 100 to 300 millimetre diameter. - AWWA C900, and CSA B137.3
- Pipes 350 to 900 millimetre diameter - AWWA C905, and CSA B137.3

Note: All pipe shall be blue in colour and bear the underwriter's label.

PVC pipes 300 millimetres and smaller shall be Class 235 DR 18 maximum with ductile iron fittings, unless approved otherwise. PVC pipes 350 millimetres and greater require special design by the Consultant. The pipe shall be supplied in 6.0 metre nominal lengths.

Joints shall be push-on integrally thickened bell and spigot type to ASTM D313.9 with single elastomeric gasket to ASTM F477.

PVC pipe shall be marked with tracer wire.

### 6.22.3 Fittings, Joints, and Couplings

Ductile iron fittings shall conform to AWWA C153, have a minimum pressure rating of 2415 kilopascals and be cement mortar lined in accordance with AWWA C104.

Ductile iron compact fittings shall be treated with an anti-corrosive coating: asphalt, thermal plastic or epoxy coating in accordance with AWWA C104.

All other fittings shall conform to the current CSA, AWWA, or ASTM specifications for a working pressure of 1030 kilopascals. Where working pressure exceeds 1030 kilopascals, materials must be approved by the City Engineer. All bends, tees, crosses, reducers and caps shall have Tyton type ends except for 350 millimetre pipe or larger which shall have mechanical joint ends.

All flanged joints shall conform to AWWA C110 and shall be flat faced conforming in dimension and drilling to ANSI B16.1, Class 125. Full face flange gaskets shall be manufactured from black natural rubber 3.175 millimetres thick with a layer of cotton on both sides.

Couplings and flanged coupling adapters shall conform to AWWA Specification C219 and shall bear an epoxy coating on the interior and exterior centre sleeve and end rings.

**6.22.4 Service Pipe**

Service pipe 25 millimetres shall be Type K annealed copper to ASTM B88M. Polyethylene pipe or PVC series pipe conforming to ASTM D2241, certified to CSA B137.3 may be used for service pipe 38 and 50 millimetres, and shall be used in corrosive soils or other specific applications as approved by the City Engineer.

All services 100 millimetres and greater will be made of the same material as that specified for the mainline pipe.

When polyethylene or PVC is used the service shall be accompanied by a tracer wire to be pulled out of the meter box.

**6.22.5 Service Saddles**

Saddles on ductile iron pipe for 25 to 50 millimetre services shall have a ductile iron body to ASTM A536 with an anti-corrosive coating to AWWA C219 and shall bear two high strength low alloy steel straps to AWWA C111. All saddles for ductile iron pipe shall be as listed in the Approved Products List.

Saddles for PVC pipe shall conform to AWWA specification C900/905. To provide full support around the circumference of the pipe, saddles with lugs or U-bolt straps that may gouge or deform the pipe are not allowed. Saddles on PVC pipe for 25 millimetre to 50 millimetre services shall have a bronze body to ASTM B62 and two stainless steel straps to ANSI T304, with a minimum width per strap of 50 millimetres. All saddles for PVC pipe shall be per the Approved Products List.

**6.22.6 Corporation Stops**

Corporation stops for services 25 to 50 millimetres shall be bronze to ASTM B62 complete with an AWWA threaded inlet and compression type outlet.

Underground service line valves and fittings 25 millimetres to 50 millimetres shall conform to AWWA C800, and be suitable for a working pressure of 1035 kilopascals.

### 6.23 Resilient Wedge Gate Valves

- 6.23.1 Gate valves shall be adequately blocked or tied to prevent movement under normal working pressure. Valves shall be non-rising stem. They shall open by turning the stem counter-clockwise, with a 50 millimetre square operating nut or hand wheel, and with the word 'open' and an arrow cast in the metal to indicate the direction to open. All valves shall be manufactured and tested to AWWA Standard C-509 (75 millimetres to 400 millimetres) and have the following minimum construction features.
- a) The wedge shall be ductile iron fully encapsulated with urethane rubber. The rubber shall be permanently bonded to the wedge and meet ASTM D429 for testing rubber metal bond.
  - b) Stems for the NRS assemblies shall be cast bronze with integral collars or stainless steel in full compliance with AWWA. The non-rising stem stuffing box shall be the O ring seal type, with two rings located above the thrust collar. The two rings shall be replaceable with the valve fully open and subjected to full rated working pressure.
  - c) There shall be two low torque thrust washers located above and below the stem collar. The stem nut shall be made of cast iron to ASTM A126 Class B. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area.
  - d) The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior for corrosion resistance. Each valve shall have the manufacturer's name, pressure rating and year of manufacture cast on the body. Prior to shipment, each valve shall be tested by hydrostatic pressure equal to or twice the specified working pressure.
  - e) Every valve shall have a positive stop to prevent distortion of the wedge. Valve operating nuts greater than 1.2 metres below finished grade require an extension rod complete with a rock guard.

### 6.24 Check Valves

All double check valve assemblies used for fire line services shall be UL listed and FM approved, and shall meet the requirements of NFPA.

Double check valve assemblies shall conform to CSA B.64.

### 6.25 Valve Boxes/Markers

All valves shall be set plumb directly on the centreline of the pipe and installed in accordance with the standard drawing.

Valve boxes in unpaved areas shall have a 1.0 metre wide, 50 millimetres thick asphalt apron around the valve box.

Valve boxes on abandoned water mains shall be removed and the riser pipe filled with controlled density fill to within 450 millimetres of the surface. The top 450 millimetres of the riser shall be filled with 19 millimetres minus gravel.

### 6.26 Air Valves

All air valves shall be combination air release valves. Bushings, reducers and unions to be used in the valve connection shall be brass manufactured to ASA specification A40.2 using ASTM B62 bronze. Nipples shall be standard brass and threaded at both ends.

Service valves for use in air valve assemblies shall have screw ends and shall be brass or bronze. Packing shall have each ring cut to fit, with staggered joints. Continuous (spiraled) packing shall not be used. Gate valves 100 millimetres or less in diameter shall be wedge disk type with non-rising stem, hand wheel and stuffing box glands, as specified for 1375 kilopascals (200 pounds per square inch) water service.

Air valves shall be installed in accordance with the standard drawing and shall meet the specifications of AWWA C512.

All air valves shall have a 12 millimetre ball-type drain valve. An alternate location for the drain valve is on the brass nipple immediately below the valve body.

Air valves for water mains greater than 300 millimetres in diameter shall be as approved by the City Engineer.

### 6.27 Flushouts

All flushouts shall be below grade flushouts in accordance with the standard drawing. Above ground flushouts may be constructed only with approval of the City Engineer.

All piping and fittings shall be 65 millimetre diameter iron pipe thread, galvanized steel pipe. The shut-off valve shall be a 65 millimetre cast iron gate valve meeting all specifications for main line valves.

The valve box shall be a cast iron Nelson box and shall be raised so that surface loads are not transmitted to the valve body or piping. A minimum of 300 millimetres of adjustment shall be

available. The 65 millimetre diameter fire hose connection and cap shall meet standard British Columbia fire hose thread requirements.

## **6.28 Hydrants**

- 6.28.1 All hydrants are to meet or exceed the testing and performance requirements of AWWA C502, latest revision, and UL and FM listings. Hydrants are to be UL and FM listed for 1380 kilopascals (200 pounds per square inch) rating. (see standard drawing).
- 6.28.2 The nozzle section (upper barrel), barrel section and base section are to be ductile iron.
- 6.28.3 The hydrant base (shoe) is to be a 150 millimetre Tyton joint with closed tie-rod lugs. The ductile iron shoe is to be fusion bonded epoxy coated, inside and out.
- 6.28.4 The nozzle section (upper barrel) is to be fusion bonded, polyester coated, inside and out, with a UV (ultra-violet) resistant coating outside.
- 6.28.5 The operating nut is to have a travel stop nut for safety when the hydrant is in operation. Hose nozzles are to be bayonet style for outside mounting, with 64 millimetre British Columbia standard Higby style thread.
- 6.28.6 The pumper nozzle is to be a 100 millimetre outside diameter Storz connection with cap. Every hydrant shall have two hose nozzles and one pumper port, complete with caps and gaskets.
- 6.28.7 Bury length shall be 1.2 metres minimum.
- 6.28.8 To open the hydrant, the wrench nut shall turn left (counter clockwise).
- 6.28.9 All hydrants shall be red with white caps and ultraviolet coating. Any newly installed hydrants with chips or scratches on the epoxy coating will not be accepted until a replacement barrel has been installed.
- 6.28.10 The operating nuts and caps are to be pentagon style with 25 millimetre sides, conforming to AWWA C502.
- 6.28.11 Unless specified, all drains in the valve are to be provided open.
- 6.28.12 The valve disc is to be manufactured from carboxylated nitrile high tensile and low compression rubber for long term maintenance protection against rocks and swelling.



**6.29 Backfill**

- 6.29.1 Where a pipe is installed beneath an existing or future pavement, sidewalk, driveway or gravel shoulder, the backfill shall be imported granular fill or equal and compacted to a minimum 95 percent Modified Proctor Density. The sub-base shall extend at least 0.3 metres beyond the future back of curb/sidewalk.

Backfill used in untraveled areas such as boulevards and easements should be compacted to a minimum 90 percent Modified Proctor. Compaction shall be in layers of 150 millimetres using a plate compactor or in 300 millimetre layers using a hydraulic compactor.

- 6.29.2 If required to meet optimum moisture content, a controlled amount of water shall be added to the gravel for compaction.

- 6.29.3 Imported granular fill used for backfill shall consist of well graded granular material, with not more than 8 percent passing the 0.075 millimetre sieve. It shall not contain stones larger than 150 millimetres in diameter, stumps, roots, organic matter or other deleterious material.

- 6.29.4 Suitable native materials may be used as backfill in road areas, provided it has been tested and approved by a geotechnical engineer. Backfill in these cases shall be free of stones over 150 millimetres in diameter, frozen material, and organic or other perishable or objectionable material that would prevent proper consolidation or cause subsequent settlement.

Approved native backfill material shall under no circumstance have a silt and clay content exceeding 30 percent by volume.

- 6.29.5 Where it is required to replace topsoil it shall occupy the upper 300 millimetres of the trench and shall be heaped and compacted on top to allow for settlement. If the installation is under a lawn, the soil shall be fine raked during the appropriate season, sown with a top quality grass seed at the rate of 50 grams of seed per square metre, and rolled. In certain conditions, the City Engineer may request the placement of sod over the trench.

- 6.29.6 Pavement that has been removed to permit trenching shall be disposed of as waste material and shall not be placed in the trench under any circumstances.

- 6.29.7 Field compaction tests of trench backfill shall be conducted a minimum of once per day and shall act as a method of quality control for the Contractor. All compaction tests are to be submitted to the Municipal Works Inspector for review.

**6.30 Water Meters**

- 6.30.1 Meters shall be compatible with the Sensus Touch Read automated meter reading and billing system and shall be equipped with a touch read pit lid register mounted at ground level. RadioRead technology may be required at the discretion of the City Engineer.
- 6.30.2 For all new single family and duplex services, the Contractor shall pre-install the meter setter and water meter box in accordance with the standard drawings. All 25 millimetre meters will be supplied and installed by City forces upon request of the homeowner for service activation.
- 6.30.3 All meters 38 millimetres through 50 millimetres shall be per the Approved Products List unless otherwise approved by the City Engineer. For service installations, the Contractor shall pre-install the meter setter and appurtenances, pit lid register and water meter box in accordance with the standard drawings. City crews shall, upon proper notice, install the meter and activate the service.
- 6.30.4 All meters used for fire line services shall be UL listed and FM approved, and shall meet the requirements of NFPA. All meters shall be Sensus meters and shall be sized by the Consultant. If there are hydrants or other items between the property line and the building that require isolation from City water, a Double Check Valve Assembly (DCVA) must be placed on private property in a separate vault from the meter, immediately upstream of the meter, complying with the City's Cross Connection Control Program. The meter shall be supplied and installed by the Contractor and shall be activated only by City forces.

**6.31 Water Meter Chambers**

- 6.31.1 All water meter chambers shall be constructed in accordance with Standard Drawing W14, and must be in conformance with WorkSafe BC regulations. Chambers shall be precast or cast in place reinforced concrete. Chambers shall be sized such that clearances between the internal water works (e.g. pipes, fittings, devices, etc.) and walls and ladders shall be a minimum of 300 millimetres and 450 millimetres respectively, and clearances can accommodate the required access opening and cover. Exterior surfaces of all chambers shall be treated with tar to ensure water tightness. Inside walls shall be painted with a white, water soluble cement paint.
- 6.31.3 All meter chambers shall be fitted with a 100 millimetre gravity connection to the nearest storm sewer, complete with a P-trap to restrict gas entry. If a gravity connection cannot be made, then an alternate shallow chamber design will be required.
- 6.31.4 All chamber floors shall be graded at 2 percent to a 300 x 300 x 150 millimetre deep sump located on one side.

- 6.31.5 A 50 millimetre PVC duct for the touch read wiring shall be installed into the wall of the chamber and extended with a minimum of 150 millimetres of cover to the touch read pit-lid register mounted at grade. Under no circumstances shall the Contractor splice the touch read wiring.
- 6.31.6 Chambers must be complete with ladders or wall rungs selected and installed in conformance with WorkSafe BC regulations. Rungs inserted into chamber walls may be used, provided they meet the specified requirements, e.g., located vertically in line with the edge of the access opening and cover. Ladders and wall rungs must be located on the side of the chamber most suitable for required maintenance, testing and inspection of the internal devices. Ladder rungs and wall rungs must be spaced 300 millimetres apart, and include a safety post. The first rung must be a maximum of 500 millimetres from the top of the chamber access cover.
- 6.31.7 Access openings must be fitted with square, lockable, galvanized, and double-hinged lift assist covers constructed to support H-20 loading. The access openings and covers must be sized so that the largest assembly can be removed with no horizontal movement required, and so that maintenance workers have sufficient head room to stand on both sides of the assembly. The hinges must not be on the same side as the ladder or wall rungs.

## **6.32 Cleaning and Flushing**

- 6.32.1 Before flushing and testing, the waterworks system shall be completely finished except for tie-ins to existing water mains. The Consultant shall schedule testing and disinfection of mains. Notice shall be provided to the Works Inspector to witness testing and disinfection.
- 6.32.2 Water may be supplied from City fire hydrants upon application to the Operations Department depending on whether or not water restrictions are in place at the time. In order to use any City hydrant, the Contractor must utilize a reduced pressure principal backflow prevention device conforming to AWWA C511, complete with certification that confirms positive testing within the last year.
- 6.32.3 All foreign material is to be removed from the pipe and related appurtenances by flushing with water. The main is to be flushed at water velocities as high as can be obtained from available water sources. Minimum velocity shall be 0.91 metre per second and/or in accordance with AWWA C651. Flushing water is to be discharged into storm sewers, water courses or ditches that have sufficient capacity to carry the flow, provided no measurable chlorine residual is present. If chlorine residual is present, the water shall be discharged to the nearest sanitary sewer or dechlorinated per Appendix B of AWWA C651. Flushing shall continue at least until flow from the most distant point has reached the discharge point and until the discharged water is clean and clear.

### 6.33 Testing Procedure

#### 6.33.1 General

All testing shall be done in the presence of the Consultant and the City Works Inspector. Notification of testing shall be provided to the City Works Inspector a minimum of 48 hours in advance of the test.

Pressure and leakage testing of ductile iron pipe shall be carried out in accordance with AWWA Specification C600. Pressure and leakage testing of polyvinyl chloride (PVC) piping shall be carried out in accordance with AWWA Specification M23.

Where any section of pipe is provided with concrete thrust blocks, no tests shall be conducted until at least five days after the placement of concrete, or two days if high early strength concrete is used. Joint restraints are required in lieu of or in combination with concrete thrust blocks. Calculations for joint restraints by the Consultant are required.

New sections of water main that are installed when expanding a distribution system must be separated from the existing system until they are approved for operation. Until satisfactory flushing, disinfection, and bacteriological sampling have been completed, the new water main is considered contaminated. In addition, the chlorine concentration used for disinfection (minimum 25 milligrams per litre) renders the water non-potable.

The minimum required protection when filling the new water main during disinfection and flushing is the installation of a double check valve assembly on the supplying water line (typically from a fire hydrant, if a Hydrant Use Permit has been issued). This prevents contaminated water in the new mains from entering the existing system. The new mains must be disconnected from the backflow prevention assembly and supply piping during hydrostatic pressure testing of the new water main.

After satisfactory bacteriological sample results are obtained from the new water mains, a section of connecting pipe must be installed between the new mains and the existing system. Before installation, the interiors of all pipe and fittings used to make the connection must be appropriately swabbed or sprayed with a one percent available chlorine solution.

#### 6.33.2 Testing Procedure

Upon construction completion of any section, defined as the pipe and appurtenances between any two adjacent valves, the Contractor shall make the section ready for hydrostatic testing.

Before the pipe is filled with water, pipe bedding, concreting of all valves and fittings, and backfilling shall be completed, per this specification. Each section of pipe shall be slowly filled with water to expel all air from the test section. If permanent air release valves are not located at all high points, the Contractor shall install main stops at points that allow air to expel as the line is filled.

Once completed, the pipeline shall be submitted to pressure and leakage tests.

6.33.3 Pressure and Leakage Tests

- a) Pressure and leakage tests shall be conducted after the water main has been filled with water and all air has been expelled from the system. Preliminary tests shall be done by the Contractor at his own expense. After a satisfactory test has been achieved, the Consultant shall notify the Works Inspector of a final test. The Contractor shall furnish the pump, pipe, connections, and all other necessary apparatus, and shall conduct the test.

During the test, water will be pumped into each test section until the static pressure reaches 1035 kilopascals (150 pounds per square inch) or 1.5 times the average operating pressure at the low end of the test section, but not less than 1.25 times the normal working pressure at the highest elevation, whichever is greater. The pressure of the system shall be maintained within 70 kilopascals throughout the test by adding a measured quantity of water to the system. The duration of the test shall be a minimum of two hours. The quantity of water required to maintain the test pressure is the leakage.

All caps, hydrants, valves and services will be subjected to leakage tests in accordance with this section.

- b) No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$\text{For PVC Pipe} \quad L = \frac{H \times N \times D \times \text{square root of } P}{130,000}$$

- Where L = the allowable leakage in litres
- H = the test duration in hours
- N = the number of joints in the test section
- D = the nominal pipe diameter in millimetres
- P = average test pressure in kilopascals

- c) If any test produces leakage greater than that specified, the Contractor shall, at his own expense, locate and repair the defects until the leakage is within the specified allowance.

- d) A copy of the leakage and test pressure report shall be forwarded to the City Works Inspector to confirm that the test has passed.

**6.34 Disinfection and Flushing Procedures**

- 6.34.1 Granular hypochlorite shall not be used for disinfection of PVC pipe with solvent welded joints as there is the potential for an explosive reaction.
- 6.34.2 The disinfection procedure shall include retaining water containing not less than 25 milligrams per litre of free chlorine in the water system for a period of at least 24 hours, in accordance with AWWA C651, Continuous Feed Method.
- 6.34.3 Water from the existing distribution system, isolated by a reduced pressure principal backflow prevention device, or other approved source shall be controlled to flow at a constant, measured rate into the new water main. In the absence of a meter, the rate may be approximated by methods such as a Pitot gauge in the discharge, by measuring the time to fill a container of known volume, or measuring the trajectory of the discharge using the formula presented in AWWA C651.
- 6.34.4 At a point no more than three metres downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L of free chlorine. To ensure that this concentration is provided, the chlorine concentration shall be measured at regular intervals, as specified in AWWA C651.
- 6.34.5 The amount of chlorine required to produce 25 milligrams per litre concentration in 30 metres of pipe of various sizes is provided in the following table:

| <u>Pipe Size</u><br><u>(millimetre)</u> | <u>100 Percent Chlorine</u><br><u>(kilogram)</u> | <u>One Percent Chlorine Solution</u><br><u>(Litre)</u> |
|---|--|--|
| 100                                     | 0.006  | 0.61   |
| 150                                     | 0.014  | 1.36   |
| 200                                     | 0.024  | 2.46   |
| 250                                     | 0.039  | 3.86   |
| 300                                     | 0.054  | 5.45   |
| 400                                     | 0.098  | 9.85   |

- 6.34.6 The flow of water containing chlorine shall not cease until the entire main, all service connections, extremities and hydrants are filled with 25 milligrams per litre of chlorine solution. The chlorinated water is to be retained in the main for at least 24 hours, during which time all valves, curb stops and hydrants in the section are to be operated in order to disinfect them thoroughly. At the end of the 24 hour period, the water contained within the main shall have no less than 10 milligrams per litre of

free chlorine. If the chlorine content falls below this value, the procedure shall be repeated.

- 6.34.7 After the completion of chlorination, the chlorinated water shall be flushed from the system, hydrants and services until the chlorine concentration remaining in the line is less than 1.0 milligram per litre. Chlorinated water flushed from mains shall not be discharged into any storm sewer, water course or natural water body. All chlorinated water shall be discharged to the nearest sanitary sewer or as otherwise approved by the City Engineer.
- 6.34.8 Once the main has been flushed of all chlorine and fresh water introduced, that water must remain in the main for a further 24 hours before bacteriological testing takes place. A set of two samples shall be taken by the Consultant not less than 24 hours apart. One set of samples shall be taken every 370 metres of new water main, plus one set from the end of the line and at least one set from each branch greater than one pipe length. The installation will not be accepted until the bacteriological tests are satisfactory to the City Engineer.
- 6.34.9 Once all the bacteriological tests and an engineer certified letter have been received by the City, the Consultant shall schedule a tie-in through the Municipal Works Inspector. A minimum of 48 hours' notice (two working days) shall be given to ensure that all residents affected by any required shut-off will be given proper written notice. Unless otherwise noted, all tie-ins 100 millimetres or greater shall be performed by the Contractor under the supervision of City forces. The cost of City staff time will be borne by the developer for the duration of the time of the tie-in.
- 6.34.10 All fittings and appurtenances shall be disinfected at the point of tie-in in accordance with ASTM Specification C651.
- 6.34.11 During the course of testing, all valves and hydrants shall be operated by City forces.

### **6.35 Clean Up**

- 6.35.1 Upon completion of the water main installation, the Contractor shall remove excess material and clean up the area of construction.
- 6.35.2 All test and chlorination lines are to be removed by the Contractor after use and before paving is started.